V.P.& R.P.T.P. Science College ,Vidyanagar.
B.Sc.(SEMESTER - V) Internal Test
MATHEMATICS : US05CMTH06 (Mechanics - 1)
Date. 6/10/2016 ; Thursday 11.00 a.m. to 12.30 p.m. Maximum Marks: 25

Que.1 Fill in the blanks. 3

(1) If $V = x^2 + y^2$ then component of grad V at point (0,1) in the direction making angle $45^0$with X axis is .....
(a) $\sqrt{2}\,\bar{i}$ (b) $-\sqrt{2}\,\bar{i}$ (c) $\sqrt{2}\,\bar{j}$ (d) $-\sqrt{2}\,\bar{j}$

(2) Moment of vector (X , Y , Z) about the perpendicular to the plane O_{xy} at the point (a , b) is M = ...
(a) $(x-a)Y + (y-b)X$ (b) $(x+a)Y + (y+b)X$
(c) $(x-a)Y - (y-b)X$ (d) $(x+a)Y - (y+b)X$

(3) In dynamics , the cgs unit of work is .....
(a) $1\ g\ cm^2\ sec^{-2}$ (b) $1\ g\ cm^2\ sec^{-1}$ (c) $1\ g\ cm\ sec^{-2}$ (d) $1\ kg\ cm^2\ sec^{-2}$

Que.2 Answer the following (Any Two) 4

(1) If resultant $\bar{R}$ of two forces $\bar{P}$ and $\bar{Q}$ make an angle α with first force $\bar{P}$ and β with the other force $\bar{Q}$ then prove that $Q = \dfrac{R\sin\alpha}{\sin(\alpha+\beta)}$.

(2) The forces $\vec{P}, \vec{Q}$ and $\vec{R}$ acting on a particle are in equilibrium angle between $\vec{P}$ and $\vec{Q}$ is 120^o, angle between $\vec{Q}$ and $\vec{R}$ is 90^o . Find out the forces .

(3) Find mass center of the area in the first quadrant bounded by ellipse $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$.

Que.3 If the fundamental law of mechanics of a particle moving on a straight line is $m\dfrac{d}{dt}\left(\dfrac{\dot{x}}{\sqrt{1-\dfrac{\dot{x}^2}{c^2}}}\right) = F$. Find the distance traveled from the rest in time 't' under the action of a force F . 6

OR

Que.3 (a) A particle moves on a straight line under a retardation kv^{m+1}, where v is the velocity at time t and k is constant . Show that $ks = \frac{1}{m-1}[\frac{1}{v^{m-1}} - \frac{1}{u^{m-1}}]$. 3

(b) Two forces $\bar{P} + \bar{Q}$, $\bar{P} - \bar{Q}$ make an angle 2α with one another .Their resultant force make an angle θ with bisectors of the angle between them.Then prove that $P\tan\theta = Q\tan\alpha$. 3

Que.4 (a) State and prove theorem of Varignon . 3

(b) If O is the orthocenter of $\triangle ABC$, forces $\bar{P}, \bar{Q}$ and $\bar{R}$ are acting along $\overline{OA}, \overline{OB}$ and $\overline{OC}$ are in equilibrium , if $BC = a$, $CA = b$, $AB = c$, then show that $P : Q : R = a : b : c$. 3

OR

Que.4 (a) A door of weight w , height $2a$, width $2b$ is hanged at top and bottom . If the reaction at upper hinge has no vertical component , find the components of reaction at both hinge, assume that the weight of the door acts at it's center . Determine this reaction for a door of weight 34.5 lb wt and measuring $6ft\ 10in$ by $3ft\ 2in$. 4

(b) State and prove the polygon law of forces . 2

Que.5 (a) Find the potential of thin spherical shell at any point inside the spherical shell . 3

(b) If two heavy particles of weight w , w' are connected by a light inextensible string and hang over a fixed smooth circular cylinder of radius a , the axis of which is horizontal . If system is in equilibrium then prove that $\dfrac{\sin\theta}{\sin\theta'} = \dfrac{w'}{w}$. 3

OR

Que.5 (a) A rod AB is movable about point A , and at B attached a string whose other end is tied to a ring. The ring slides on a smooth horizontal wire passing through A . By using principle of virtual work prove that horizontal force necessary to keep the ring at rest is $\dfrac{w\ \cos\alpha\ \cos\beta}{2\ \sin(\alpha+\beta)}$, where w is weight of the rod , α and β are the inclination of the rod and the string to the horizontal. 4

(b) Using Pappu's theorem prove that volume of the solid generated by the revolution of the loop of curve $2ay^2 = x(x-a)^2$ about the line $y = a$ is $\dfrac{8\sqrt{2}}{15}\pi a^3$. 2