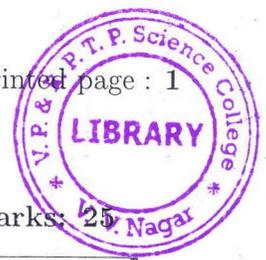


V.P.& R.P.T.P. Science College, Vidyanagar.  
B.Sc. ( SEMESTER - V ) Internal Test  
MATHEMATICS : US05CMTH06 ( Mechanics - 1 )

Date. 6/10/2016 ; Thursday

11.00 a.m. to 12.30 p.m.

Maximum Marks: 25



Que.1 Fill in the blanks.

- (1) If  $V = x^2 + y^2$  then component of grad V at point (0,1) in the direction making angle  $45^\circ$  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)  $1 kg cm^2 sec^{-2}$

3

Que.2 Answer the following ( Any Two )

- (1) If resultant  $\vec{R}$  of two forces  $\vec{P}$  and  $\vec{Q}$  make an angle  $\alpha$  with first force  $\vec{P}$  and  $\beta$  with the other force  $\vec{Q}$  then prove that  $Q = \frac{R \sin \alpha}{\sin(\alpha + \beta)}$ .
- (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  $120^\circ$ , angle between  $\vec{Q}$  and  $\vec{R}$  is  $90^\circ$ . Find out the forces .
- (3) Find mass center of the area in the first quadrant bounded by ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ .

4

Que.3 If the fundamental law of mechanics of a particle moving on a straight line is

$$m \frac{d}{dt} \left( \frac{\dot{x}}{\sqrt{1 - \frac{\dot{x}^2}{c^2}}} \right) = F . \text{ Find the distance traveled from the rest in time 't' under the action of a force F .}$$

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  $ks = \frac{1}{m-1} \left[ \frac{1}{v^{m-1}} - \frac{1}{u^{m-1}} \right]$ . 3
- (b) Two forces  $\vec{P} + \vec{Q}$ ,  $\vec{P} - \vec{Q}$  make an angle  $2\alpha$  with one another .Their resultant force make an angle  $\theta$  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  $\vec{P}$ ,  $\vec{Q}$  and  $\vec{R}$  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  $\frac{\sin \theta}{\sin \theta'} = \frac{w'}{w}$ . 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  $\frac{w \cos \alpha \cos \beta}{2 \sin(\alpha + \beta)}$ , where  $w$  is weight of the rod,  $\alpha$  and  $\beta$  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  $\frac{8\sqrt{2}}{15} \pi a^3$ . 2