LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION –**MATHEMATICS**

FOURTH& FIFTH SEMESTER – **APRIL 2018**

MT 4501 / MT 5506– MECHANICS - I

Date: 03-05-2018 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART – A

Answer ALL the questions **(10 x 2 = 20 marks)**

1. Find the magnitude and direction of the resultant of two perpendicular forces P and Q.
2. State the triangle law of forces.
3. Three like parallel forces P, Q, R acting at three non-callinear points has its centre at the centroid of ΔABC. Show that P = Q = R.
4. Define a couple.
5. Write down the components of the acceleration of a particle in the tangential and normal directions.
6. A vessel which can steam in still water with a velocity of 48 k.m. ph. Is steaming with its low pointed due east and it is carried by a current which falls northward with speed of 14 k.m.p.h. Find the speed of the vessel.
7. State the principle of conversation of momentum.
8. Define coefficient of restitution.
9. Define (i) trajectory (ii) horizontal range.
10. Define limiting velocity.

PART – B

Answer any FIVE questions **(5 x 8 = 40 marks)**

11. State and prove Varignon's theorem on moments.
12. A uniform plane lamina in the form of a rhombus one of whose angles is 120^o is supported by two forces of magnitudes P and Q applied at the centre in the direction of the diagonals so that one side is horizontal. Show that if $P > Q, P^2 = 3Q^2$.
13. If three co-planar forces are in equilibrium, prove that the forces are either parallel or concurrent.
14. Show that when masses P and Q are connected by a string over the edge of the table, then tension is the same whether P hangs and Qis on the table or Qhangs and P is on the table.

15. A heavy rod ACDB where AC = a and DB = b rests horizontally upon two smooth pegs C and D. If a load P is applied at A, it will first disturb the equilibrium. If CD = c, Prove that the weight of the rod is $\frac{pa+qb}{c}$.

16. A particle is dropped from the top of a tower and describes during the last second of its fall (9/25) of the height. Find the height of the tower.

17. A particle projected from the top of a wall 50 m high, at an angle of 30° above the horizon, strikes the level ground through the foot of the wall at an angle of 45°. Show that the angle of depression of the point of striking the ground from the point of projection is $tan^{-1}\left(\frac{\sqrt{3}-12}{2\sqrt{3}}\right)$.

18. Discuss the motion of two particles connected by a string.

PART – C

Answer any TWO questions. **(2 x 20 = 40 marks)**

19. a) State and prove Lami's theorem.

b) O is the centre of the ΔABC. Forces of magnitudes P, Q and R acting respectively along $\overrightarrow{OA}, \overrightarrow{OB}$, *and* $\overrightarrow{OC}$ are in equilibrium. Prove that

$$\frac{P}{a^2\left(b^2+c^2-g^2\right)}=\frac{Q}{b^2\left(c^2+a^2-b^2\right)}=\frac{R}{c^2\left(a^2+b^2-c^2\right)}.$$ (12+8)

20. a) Find the resultant of two like parallel forces P and Q and determine the position of the point of application.

b) A solid cone, of height h and semi vertical angle α, and is supported by a string attached to its vertex and to a point in the wall. Show that the greatest possible length of this string is

$h\sqrt{1+\frac{16}{9}tan^2\alpha}$. **(12+8)**

21. Derive the equation of the path of a projectile is Cartesian form. Also determine the time of flight, greatest height and horizontal range. **(20)**

22. Two smooth spheres of masses m_1 and m_2 moving with velocities μ_1 and μ_2 impinge directly. Obtain

(i) The motion after impact.

(ii) The impulse imparted each sphere due to impact.

(iii) The change is K. E. due to impact. **(20)**

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