LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **NOVEMBER 2017**

MT 5506– MECHANICS - I

Date: 02-11-2017 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART – A

ANSWER **ALL** THE QUESTIONS: **(10 × 2 = 20 marks)**

1. Define (a) Composition of forces and (b) Equilibrium of forces.
2. State triangle of forces.
3. Define like parallel forces and unlike parallel forces.
4. Define (a) Limiting friction and (b) Dynamical friction.
5. Define relative angular velocity.
6. A particle moving with uniform acceleration in a straight line has velocity u at A and v at B. Find the velocity at the mid of AB.
7. State Newton's laws of motion.
8. State the principle of conservation of linear momentum.
9. What is the time of flight of a projectile?
10. State Newton's experimental laws.

PART - B

ANSWER ANY **FIVE** QUESTIONS**:** **(5 × 8 = 40 marks)**

11. State and prove Lami's theorem.
12. Two forces of magnitudes P and $Q(P > Q)$ act on a particle and the angle between the forces is α. If the magnitudes of forces are interchanged, show that the resultant turns through the angle $2\tan^{-1}\left(\frac{P-Q}{P+Q}\tan\frac{\alpha}{2}\right)$.
13. Two like parallel forces P and $Q(P > 0)$ act at A and B respectively. If the magnitudes of the forces are interchanged, show that the point of application of the resultant on AB will be displaced through the distance $\frac{P-Q}{P+Q}AB$.
14. The line joining 2 points A and B is of a constant length a and the velocities of A, B are in directions which make angles α and β respectively with AB. Prove that the angular velocity of $AB = \frac{u\sin(\alpha-\beta)}{a\cos\beta}$ where u is the velocity of A.
15. Discuss the motion of a particle moving along a straight line with uniform acceleration f.
16. Show that the velocity with which a particle must be projected down a smooth inclined plane of length l and height h so that the time of descent shall be the same as taken by another particle in falling freely through a distance equal to the height of the plane is $\frac{l^2-h^2}{l}\sqrt{\frac{g}{2h}}$
17. If v_1 and v_2 be the velocities at the ends of a focal chord of a projectile path and u, the horizontal component of the velocity, then show that $\frac{1}{{v_1}^2}+\frac{1}{{v_2}^2}=\frac{1}{u^2}$.
18. If A, B and C are 3 small smooth spheres of masses m, $2m$ and m respectively, lying in a straight line on a smooth horizontal table. $A$is projected along the line ABC with velocity u. If the coefficient of restitution be 0.5 in each case, show that after Bstrikes C, the velocities of A, B, C are in the ratio 0: 1: 2 and that there are no further impacts.

PART - C

ANSWER ANY **TWO** QUESTIONS: **($2 \times 20 = 40$ marks)**

19. (a) Two weights P and Q are suspended from a fixed point O by the strings OA and OB and are kept apart by a light rod AB. If the strings OA and OB make angles α and β with the rod, show that the angle θ which the rod makes with the vertical is given by $\tan\theta = \frac{P+Q}{Q\cot\beta - P\cot\alpha}$.

(10)

(b) A weight is supported on a smooth plane inclined at the angle α with the horizon, by a string inclined to the vertical at the angle β. If the inclination of the plane is increased to γ and the inclination of the string with the vertical is unaltered, the tension in the string is doubled in supporting the weight. Prove that $\cot\alpha - 2\cot\gamma = \cot\beta$.

(10)

20. (a) A uniform rod of length AB of length $2a$ and weight W is resting on two pegs C and D in the same level at a distance d are apart. The greatest weights that can be placed at A and B without tilting the rod are W_1 and W_2 respectively. Show that $\frac{W_1}{W+W_1} + \frac{W_2}{W+W_2} = \frac{d}{a}$

(08)

(b) State and prove Varignon's theorem on moments. **(12)**

21. (a) A particle is projected vertically upwards with a velocity of u feet per second and after t seconds; another particle is projected upwards from the same point with the same velocity. Prove that the particles will meet at a height $\frac{4u^2 - g^2t^2}{8g}$ after a time $\left(\frac{t}{2} + \frac{u}{g}\right)$ seconds from start.

(10)

(b) A string passes over a fixed smooth pulley and to one end, there is attached a mass m_1 and to the other a smooth light pulley over which passes another string with masses m_2 and m_3 at the ends. If the system is released from rest, Show that m_1 will not move if $\frac{4}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$.

(10)

22. Show that the path of projectile is a parabola**.** **(20)**

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