



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – MATHEMATICS

FIFTH SEMESTER – NOVEMBER 2011

MT 5506/MT 4501 - MECHANICS - I

Date : 02-11-2011
Time : 9:00 - 12:00

Dept. No.

Max. : 100 Marks

PART – A

Answer ALL questions

(10 x 2 = 20 marks)

1. State triangle of forces.
2. State the converse of Lami's Theorem.
3. Define a couple.
4. Define Statical friction and dynamical friction.
5. Define angular velocity and angular acceleration.
6. State Newton's first law of motion.
7. Derive Newton's first law from second law.
8. Find the time of flight of a projectile.
9. Find the magnitude of velocity of a projectile at the end of time t.
10. Define oblique impact of two bodies.

PART – B

Answer any FIVE questions

(5 x 8 = 40 marks)

11. State and prove Lami's Theorem.
12. Two like parallel forces P and Q ($P > Q$) act at A and B respectively. If the magnitude of the forces are interchanged, show that the point of application of the resultant of AB will be displaced through the distance $\frac{P-Q}{P+Q} \cdot AB$.
13. A particle is placed on a rough inclined plane, inclined at an angle greater than the angle of friction to the horizontal. If the least force sufficient to move the body up the plane is P, show that the least force acting parallel to the plane which will move the body up the plane is $P\sqrt{1+\mu^2}$, where μ is the co-efficient of friction.
14. A train moves in a straight line with uniform acceleration and describes distances a and b in successive intervals of time t_1 and t_2 . Prove that the acceleration is $\frac{2(bt_1 - at_2)}{t_1t_2(t_1 + t_2)}$.
15. Discuss the motion of a particle moving along a straight line with uniform acceleration f.
16. A particle of mass m slides down a rough inclined plane of inclination α . Discuss the motion.
17. Find the range of a particle projected up an inclined plane.
18. If a particle falls from a height h, show that the whole distance described by the particle before it has finished rebounding is $\frac{1+e^2}{1-e^2}h$ and the time taken is $\frac{1+e}{1-e} \cdot \sqrt{\frac{2h}{g}}$.

PART – C

Answer any TWO questions

(2 x 20 = 40 marks)

19. a) Prove that the resultant of two forces, acting along \vec{OA} and \vec{OB} and equal in magnitude respectively to λ OA and μ OB, acts along \vec{OC} where C is the point on AB such that λ AC = μ CB and is of magnitude $(\lambda+\mu)$ OC. (8)
- b) A weight is supported on a smooth plane inclined at the angle α to the horizon, by a string inclined to the vertical at an angle β . If the inclination of the plane is increased to γ and the inclination of the string with the vertical is unaltered, tension in the string is doubled in supporting the weight. Prove that $\text{Cot } \alpha = \text{Cot } \beta + 2 \cot \gamma$. (12)
20. a) Find the resultant of two like parallel forces.
b) State and prove Varignon's theorem on moments.
21. a) A particle is projected vertically upwards with a velocity of u ft/sec 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 $\frac{4u^2 - g^2 t^2}{8g}$ after a time $\left(\frac{t}{2} + \frac{u}{g}\right)$ seconds from start.
b) Discuss the direct impact of two smooth spheres.
22. a) 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 $\frac{\ell^2 - h^2}{\ell} \sqrt{\frac{g}{2h}}$.
- b) A particle moving in a straight line is subjected to a resistance kv^3 producing retardation where v is the velocity. Show that if v is the velocity at any time t .
When the distance is s , $v = \frac{u}{1 + kus}$ and $t = \frac{s}{u} + \frac{1}{2} ks^2$, where u is the initial velocity.

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