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(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2021 ONLY)

21UMS407

REG.NO. :

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI

END-OF-SEMESTER EXAMINATIONS :MAY-2023

COURSE NAME: B.Sc.-MATHEMATICS **MAXIMUM MARKS: 70**

SEMESTER: IV **TIME : 3 HOURS**

PART – III
STATICS

SECTION - A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS.
MULTIPLE CHOICE QUESTIONS. (K1)

1. The resultant of two equal forces p, p at an angle α is_____ in a direction bisecting the angle between them.
   a) $p\cos\alpha/2$ b) $p\cos\alpha$ c)$2p\cos\alpha$ d) $2p\cos\alpha/2$
2. The magnitude of the resultant of two unlike parallel forces is their_____.
   a) sum b) difference c) product d) square of difference
3. The effect of a couple upon a rigid body is not altered if it is transferred to a _____ provided its moment remains unchanged in magnitude and direction.
   a) parallel plane b) perpendicular plane c) perpendicular line d) couple
4. If three forces acting on a rigid body are in equilibrium, they must be _____.
   a) perpendicular b) parallel c) coplanar d) normal
5. The ratio of the limiting friction to the normal reaction is called the _____.
   a) angle of friction b) coefficient of friction c) cone of friction d) centre of gravity

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES. (K2)

6. State parallelogram law of forces.
7. State principle of moments.
8. Define couple.
9. Write the equation to the line of action of the resultant.
10. Define centre of gravity.

SECTION – B (5 X 4 = 20 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)

11. a) A and B are two fixed points on a horizontal line at a distance c apart. Two fine light strings AC and BC of lengths b and a respectively support a mass at C. Show that the tensions of the strings are in the ratio $b(a^2+c^2-b^2):a(b^2+c^2-a^2)$

(OR)

b) Prove that the algebraic sum of the resolved parts of two forces in any direction is equal to the resolved part of the resultant in the same direction.

12.a) Three like parallel forces, acting at the vertices of a triangle, have magnitudes proportional to the opposite sides. Show that their resultant passes through the incentre of the triangle.

(OR)

b) Forces P, Q, R act along the sides BC, AC, BA respectively of an equilateral triangle. If their resultant is a force parallel to BC through the centroid of the triangle, prove that $Q = R = \frac{1}{2}P$.

13.a) ABC is an equilateral triangle of side a: $D.E.F$ divide the sides BC, CA, AB respectively in the ratio $2:1$. Three forces each equal to P act at D, E, F perpendicularly to the sides and outward from the triangle. Prove that they are equivalent to a couple of moment $\frac{1}{2}Pa$.

(OR)

b) If there forces acting on a rigid body be represented in magnitude, direction and line of action by the sides of a triangle taken in order, they are equivalent to a couple whose moment is twice the area of the triangle.

14.a) Forces $P, 4P, 2P, 6P$ act along the sides AB, BC, CD, DA of a square of sides a,

(i) Reduce the system to a force at A and a couple

(ii) Show that the equation to the line of action of the resultant is $2x - y + 6a = 0$ with AB and AD as axes of coordinates

(iii) Find the points where the resultant meets AB and AD.

(OR)

b) The algebraic sum of the moments of a system of coplanar forces about points whose coordinates are (1,0) (0,2) and (2,3) referred to rectangular axes are G_1, G_2 and G_3 respectively. Find the tangent of the angle which the direction of the resultant force makes with the axis of x.

15.a) State the law of friction.

(OR)

b) A particle of weight 30 kgs. resting on a rough horizontal plane is just on the point of motion when acted on by horizontal forces of 6 kg wt. and 8 kg. wt. at right angles to each other. Find the coefficient of friction between the particle and the plane and the direction in which the friction acts.

SECTION - C (4X10= 40 MARKS)

ANSWER ANY FOUR OUT OF SIX QUESTIONS
(16thQUESTION IS COMPULSORY AND ANSWER ANY THREE QUESTIONS.
(FROM Qn. No : 17 to 21) (K4 (Or) K5)

16. State and prove Lami's Theorem.

17. ABC is a triangle, with a right angle at A: AD is the perpendicular on BC. Prove that the resultant of the forces $\frac{1}{AB}$ acting along AB and $\frac{1}{AC}$ acting along AD.

18. State and prove Varigon's Theorem of Moments

19. Prove that if two couples, whose moments are equal and opposite, act in the same plane upon a rigid body, they balance one another.

20. A uniform rod, of length a, hangs against a smooth vertical wall being supported by means of a string, of length l, tied to one end of the rod, the other end of the string being attached to a point in the wall: show that the rod can rest inclined to the wall at an angle θ given by $cos^2\theta = \frac{l^2 - a^2}{3a^2}$ What are the limits of the ratio of a: l in order that equilibrium may be possible?

21. A thin wire is bent into the form of a triangle ABC and heavy particles of weights P, Q, R are placed at the angular points. Prove that, if the centre of mass of the particles concides with that of the wire, then $\frac{P}{b+c} = \frac{Q}{c+a} = \frac{R}{a+b}$

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