PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 2019
(Third Semester)

Branch – **MATHEMATICS**

MECHANICS-I (STATICS)

Time : Three Hours Maximum : 75 Marks

SECTION-A (20 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 x 2 = 20)

1 Define Thrust.
2 State parallelogram law of forces.
3 Define moment of a force about a point.
4 What is the magnitude of the resultant of two like parallel forces and its direction?
5 When a couple is positive or negative?
6 Define axis of a couple.
7 State the necessary and sufficient conditions that a system of coplanar forces acting on a rigid body may be in equilibrium.
8 State the second form of the conditions of equilibrium.
9 Define centre of gravity of a body.
10 Where is the centre of gravity of a uniform parallelogram and uniform solid hemisphere?

SECTION - B (25 Marks)
Answer **ALL** Questions
ALL Questions Carry **EQUAL** Marks (5 x 5 = 25)

11 a The resultant of two forces P and Q acting at an angle α is equal to $(2m+1)\sqrt{P^2+Q^2}$. When they act on angle $90^\circ - \theta$, the resultant is $(2m-1)\sqrt{P^2+Q^2}$. Prove that $\tan\theta = \frac{m-1}{m+1}$.

OR

b State and prove the theory on resultant of any number of coplanar forces acting at a point.

12 a Obtain the resultant of two like parallel forces acting on a rigid body.

OR

b State and prove Varigon's theory on moments.

13 a Prove that two couples in the same plane and whose moments are equal and of same sign are equivalent to one another.

OR

b Prove that a force acting at any point A of a body is equivalent to an equal and parallel force acting at any other arbitrary point B of the body, together with a couple.

14 a Obtain the equation to the line of action of the resultant.

OR

b Forces $F_1, F_2, F_3, F_4, F_5, F_6$ act along the sides of a regular hexagon taken in order. Show that they will be in equilibrium if (i) $F_1+F_2+F_3+F_4+F_5+F_6=0$ and (ii) $F_1-F_4=F_3-F_6=F_5-F_2$.

15 a Determine the centre of gravity uniqueness.

OR

b Obtain the centre of gravity of a thin plate in the form of a parallelogram.

Cont...

SECTION - C (30 Marks)

Answer any **THREE** Questions
ALL Questions Carry **EQUAL** Marks (3 x 10 = 30)

16 State and prove Lami's theorem. Prove that if A, B are fixed points on horizontal line at a distance C apart to a fine tight strings AC and BC of length b and a respectively. Show that the tensions of the strings are in the ratio $b(a^2 + c^2 - b^2) : a(b^2 + c^2 - a^2)$.

17 a Find the condition of equilibrium of three coplanar parallel forces.

b Two like parallel forces P and Q act on a rigid body at A and B respectively. (i) If Q be changed to P^2/Q, show that the line of action of the resultant is the same as it would be if the forces are simply interchanged (ii) If P and Q be interchanged in position, show that the point of application of the resultant will be displayed along AB through a distance d where $d = \frac{P-Q}{P+Q}AB$.

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

19 A uniform beam of length ℓ and weight w hangs from a fixed point of two strings of length a and b. Prove that the inclination of the rod to the horizon is $\sin^{-1}\left[\frac{a^2 - b^2}{\ell\sqrt{2(a^2 + b^2) - \ell^2}}\right]$

20 Obtain the centre of gravity of a hollow hemisphere.

Z-Z-Z END