STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted during the academic year 2008 – 09 & thereafter)

SUBJECT CODE : MT/MC/SS54

B. Sc. DEGREE EXAMINATION, NOVEMBER 2012
BRANCH I - MATHEMATICS
FIFTH SEMESTER

COURSE : MAJOR – CORE
PAPER : STATICS
TIME : 3 HOURS **MAX. MARKS : 100**

ANSWER ANY SIX QUESTIONS: **(6 * 17)**

1. a) State and prove triangle law of forces.
   b) The angle between two forces of equal magnitude is θ and the resultant is R. If the angle is decreased by $\pi/3$, then the resultant is $\sqrt{3}\,R$. Find θ.

2. a) State and prove Varignon's theorem.
   b) A string ABCD hangs from fixed points A,D carrying a weight of 12 kgm at B and a weight of W kgm at C. AB is inclined at an angle 60° to the horizontal; BC is horizontal and CD is inclined at 30° to horizontal. Find W.

3. a) Show that any system of coplanar forces is equivalent to a single force acting at a choosen point and a couple.
   b) Two unlike parallel forces P and Q $(P > Q)$ act at A and B, P and Q are each increased by R show that the resultant will move through a distance $\frac{R}{P-Q}\ AB$.

4. a) Prove that if three forces acting on a rigid body are represented in magnitude and direction by the sides of a triangle taken in order, then they are equivalent to a couple of moment equal to twice the area of the triangle.
   b) If six forces of relative magnitude 1, 2, 3, 4, 5 and 6 act along the sides of a regular hexagon, taken in order show that the single equivalent force is of relative magnitude 6 and it acts along a line parallel to the direction of force 5 at a distance from the centre of the hexagon 3½ the distance of the centre from a side.

5. a) A uniform ladder of length l metres rests on a rough horizontal ground with its upper end projecting very slightly over a smooth horizontal rod at a height a metres above the ground. If the ladder is about to slip down, show that the coefficient of friction is equal to $\frac{a\sqrt{l^2-a^2}}{l^2+a^2}$.
   b) Two rough particles connected by a light spring rest on an inclined plane. If their weights are W and W' and their coefficients of friction are μ and μ', show that the greatest inclination of the plane for equilibrium is $tan^{-1}\left[\frac{\mu W+\mu' W'}{W+W'}\right]$.

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6. a) A body of weight W is in equilibrium on a rough inclined plane of angle $\alpha(\neq \lambda)$ under the action of a force P upwards at an angle θ to the line of the greatest slope, in a vertical plane through the line of the greatest slope. Find P if equilibrium is limiting, where λ is the angle of friction.
   b) A solid hemisphere of weight W rests in limiting equilibrium with its curved surface on rough inclined plane, its place face being kept horizontal by a weight P attached to a point in its line. Prove that the coefficient of friction is $\mu = \frac{P}{W(2P+W)}$.

7. a) Find the center of gravity of a solid hemisphere.
   b) A piece of wire of given length l is bent into the form of a circular quadrant and its bounding radii. Show that the distance of C.G. of the whole from the centre of the circle is $\frac{6\sqrt{2}\, l}{(\pi+4)^2}$.

8. a) Derive the equation of Catenary in the form $s = c\tan\psi$.
   b) A telegraph were stretched between two poles distant a feet apart, sags n feet in the middle. Prove that the terminal tension is approximately $W\left[\frac{a^2}{8n} + \frac{7n}{6}\right]$, where W is the weight per unit length of the wire.

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