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 2011
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 Lami's theorem.
   (b) *ABCDEF* is the regular hexagon of sides l, and at *A*, forces act in magnitude and direction by *AB, 2AC, 3AD, 4AE, 5AF*. Show that the magnitude of resultant is $\sqrt{351}l$.

2. (a) State and prove Varignon's theorem on moments.
   (b) Three like parallel forces *P,Q,R* act at the corners of the ΔABC and if their resultant passes through the circumcentre of the ΔABC if
   $$\frac{P}{Sin2A} = \frac{Q}{Sin2B} = \frac{R}{Sin2C}.$$

3. (a) The moments of a given coplanar force about the three points (-2,0);(0,3);(2,4) are +6,+3,-2 units respectively. Find the magnitude of the resultant force of the system and the equation of its line of action.
   (b) Prove that a system of coplanar forces reduces to either a force or a single Couple.

4. (a) A uniform rod rests on a fixed smooth sphere with its lower end pressing against a smooth vertical wall which touches the sphere. If θ is the angle which the rod makes with the vertical, when in equilibrium. Prove that $a = 2l\sin\frac{\theta}{2}\cos^3\frac{\theta}{2}$ where *l* is the length of the rod and *a'* radius of the sphere.
   (b) A solid cone of height *'h'* and semi vertical angle α is placed with its base against vertical wall and is supported by a string attached to its vertex and to a point in the wall. Show that the greatest possible length of the string is $h\sqrt{1+\frac{16}{9}\tan^2\alpha}$.

5. (a) State the laws of statistical friction and define the angle of friction.
   (b) A solid hemisphere of weight *W* rests in limiting equilibrium with its curved surface on rough inclined plane. Its plane face being kept horizontal by a weight *'P'* attached to a point in its rim. Prove that the coefficient of friction is
   $$\mu = \frac{P}{\sqrt{W(2P+W)}}.$$

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6. (a) A cone of radius *r* and height h is placed on a inclined plane, whose inclination is gradually increased. Find whether the cone tilts before it slides or vice-versa.

(b) A hemispherical shell rests on a rough plane, the angle of friction being λ. Show that the inclination of the plane base of the rim to the horizontal cannot be greater than $\sin^{-1}(2\sin\lambda)$.

7. (a) Find the Centre of gravity of a Solid hemisphere of radius '*a*'.

(b) Find the Centre of gravity of an arc of a circle of radius '*a*' subtending an angle 2α at the centre.

8. (a) A uniform Chain of length '2*l*' is to be suspended from two points A and B in the same horizontal line, so that either terminal tension is n times that at the lowest point. Show that the span AB must be $\frac{2l}{\sqrt{n^2-1}}\log_e(n+\sqrt{n^2-1})$

(b) Derive the equation of catenary in the form $y = c\cosh\left(\frac{x}{c}\right)$.

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