EASTERN UNIVERSITY, SRI LANKA

DEPARTMENT OF MATHEMATICS

SECOND EXAMINATION IN SCIENCE - 2010/2011

FIRST SEMESTER (April, 2013)

AM 215 - CLASSICAL MECHANICS II

(Proper)

Answer all questions **Time : One hour**

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1. With the usual notations derive the following equations for a common catenary:

$$\text{(a) } S = c\tan\psi, \quad \text{(b) } x = c\ln[\sec\psi + \tan\psi], \quad \text{(c) } S = c\sinh(x/c).$$

A weight W is suspended from a fixed point by a uniform heavy string of length l and weight w per unit length. It is drawn aside by horizontal force P. Show that in equilibrium, the distance of W from the vertical through the fixed point is

$$\frac{P}{w}\left[\sinh^{-1}\left(\frac{W+lw}{P}\right) - \sinh^{-1}\left(\frac{W}{P}\right)\right].$$

2. With usual notations, prove the Claypeyron's equation

$$M_1a + 2M_2(a+b) + M_3b = -\frac{w}{4}(a^3+b^3) + 6EI\left(\frac{y_a}{a} + \frac{y_b}{b}\right)$$

for the bending moment of a slightly elastic beam.

A uniform rod ABC of weight w per unit length is supported at its ends A, C and at the point B on its length. The three points A, B and C being at the same horizontal level of $AB = a$ and $BC = b$. Show that the reaction of the support at A is $\frac{w}{8a}(3a^2+ab-b^2)$. Hence, show that the rod can remain in contact with all the supports if

$$\frac{(\sqrt{13}-1)}{6} < \frac{a}{b} < \frac{(\sqrt{13}+11)}{2}.$$