TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR THE BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING/BUILDING & CIVIL ENGINEERING/CIVIL ENGINEERING
(BSME 13/BSCE 13/BSCE 13)

SMA 2177: APPLIED GEOMETRY

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: OCTOBER 2013
TIME: 2 HOURS

<u>**Instructions to Candidates:**</u>
You should have the following for this examination
- *Answer Booklet*

This paper consist of **FIVE** questions in **TWO** sections **A** & **B**
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **TWO** printed pages

SECTION A (COMPULSORY)

Question One

$$-360^{o} \le x^{o} \le 360^{o} \quad 4\cos^{2} x + 9\sin x - 6 = 0$$

a) Solve in the domain   **(5 marks)**

$$x^{2} + 4y^{2} - 6x - 16y - 11 = 0$$

b) Sketch the curve   and determine its foci and eccentricity. **(7 marks)**

$$\frac{\sin 2A + \cos 2A + 1}{\sin 2A + \cos 2A - 1} = \frac{\tan(45^\circ + A)}{\tan A}$$

c) Show that **(5 marks)**

$$r = a(1 + 2\cos\theta)$$

d) Find the Cartesian equation of the polar equation **(2 marks)**

$$3x + 2y = 4$$

e) Find the equation of the circle which passes through the point (1, 0) and touches the line at the pint (2, -1) **(5 marks)**

f) Find the acute angle between the two lines L_1 and L_2 with respective slopes m1 = 3 and m2 = 7. If the lines intersect at (1, 2) calculate the distance of the point (5, 4) from L_1 **(6 marks)**

SECTION B (Answer any TWO questions from this section)

Question Two

a) Solve within the domain indicated:

$$\sin 5x + \sin 3x = \cos x, \; -90^\circ \le x^\circ \le 90^\circ$$

(i) **(7 marks)**

$$4\sin x - 3\cos x = 2, \; -200^\circ \le x^\circ \le 200^\circ$$

(ii) **(6 marks)**

b) Show that with the usual notation of a triangle ABC:

$$\sin\frac{1}{2}A = \pm\sqrt{\frac{(s-b)(s-c)}{bc}}$$

where s is half of the perimeter of the triangle **(7 marks)**

Question Three

a) Derive the sine rule in terms of the circumradius, R **(4 marks)**

b) Solve triangle RST if r = 3.5, S = 4.7 and t = 2.8 **(6 marks)**

c) An ellipse has its foci at the points (-1, 0) and (7, 0). If its eccentricity is ½ find its equation in rectangular and parametric forms. **(10 marks)**

Question Four

$$x^2 = 9y^2 = 9$$

a) The hyperbola is given:
   (i) Sketch the hyperbola
   (ii) Find the equation of the tangents to the hyperbola that are drawn from the points (3 , 2) and find the points of contact **(11 marks)**

$$y^2 = 49x$$

b) Find the point of intersection of tangents drawn to the parabola at the point t_1, and t_2 where t_1, S, t_2 are collinear where s is the focus of the parabola **(9 marks)**

Question Five

a) Sketch the curve represented by the polar equation $r = 1 + 2\cos\theta$ **(6 marks)**

b) Given the circle $x^2 + y^2 - 8x + 2y + 7 = 0$,
   (i) Verify that the point (3, 2) lies on the circle **(1 mark)**
   (ii) Determine the centre of the circle and hence find the equation of the tangent to the circle through the point (3, 2) **(5 marks)**

c) Verify the identity:
$$\tan 3\theta = \frac{3\tan\theta - \tan^3\theta}{1 - 3\tan^2\theta}$$

(8 marks)