

School of Advanced Sciences

Department of Mathematics

Subject: MAT 1011 – Calculus for Engineers

Continuous Assessment Test (CAT) – I, August 2016

Slot: D<sub>2</sub>

Date: 24/8/2016

Duration: 90 Mins.

Max. Marks: 50

Answer ALL questions (5 x 10 = 50 Marks)

1. (A) During the first 40 s of a rocket flight, the rocket is propelled straight up so that in  $t$  seconds it reaches a height of  $s = 5t^3$  ft. (6M)

- (i) How high does the rocket travel in 40 seconds?
- (ii) What is the average velocity of the rocket during the first 40 seconds?
- (iii) What is the instantaneous velocity of the rocket at the end of 40 seconds?

(B) The voltage  $V$  volts, current  $I$  amperes and resistance  $R$  ohms of an electric circuit are related by the equation  $V = IR$ . Suppose that  $V$  is increasing at the rate of 1 ohm/sec, while  $I$  is decreasing at the rate of  $\frac{1}{3}$  amp/sec. Find the rate at which  $R$  is changing when  $V=12$  volts and  $I=2$  amp. Is  $R$  increasing or decreasing? (4M)

2. (A) The arithmetic mean of two numbers  $a$  and  $b$  is the number  $\frac{a+b}{2}$ . Show that the value of  $c$  in the conclusion of the Mean value theorem for  $f(x) = x^2$  on the interval  $[a, b]$  is  $c = \frac{a+b}{2}$ . (3M)

(B) Suppose that a point moves along some unknown curve  $y = f(x)$  in the  $xy$ -plane in such a way that at each point  $(x, y)$  on the curve, the tangent line has slope  $x^2$ . Find an equation for the curve given that it passes through the point  $(2, 1)$ . (3M)

(C) Consider the function  $f(x) = \frac{e^x + e^{-x}}{2}$  for  $-\infty < x < \infty$  (4M)

- (i) Find the interval(s) on which  $f(x)$  is increasing
- (ii) Show that  $f(x)$  is always concave up.