Department of Mathematics Welcome you all !

1 Introduction

We offer the following 3 credit course in semester 1
MA1013: Mathematics(Logic and Set Theory, Real Analysis, Vectors and Matrices).
There will be 3 hours of lectures and 1 hour of tutorial classes.

There are 3 major areas in Pure Mathematics: Analysis, Algebra and Topology.
Examples for Applied Mathematics topics are Differential Equations and Numerical Analysis. Statistics is regarded as a separate area.
Logic and Set Theory provides the foundations of Pure Mathematics.

This course is intended to provide a good background to follow university level mathematics by taking Advanced Level mathematics topics and relating and enhancing the ideas in them.

2 Some Mathematical References

Technical Terms in Sinhala/Tamil
http://www.languagesdept.gov.lk

Websites
https://en.wikipedia.org(usually the first item in a maths topic search)
http://mathworld.wolfram.com/(usually the second item in a maths topic search)
https://www.wolframalpha.com/(web version of the Mathematica software)
http://www.math.mrt.ac.lk/(department website)

Books(a general reference covering all areas)
Calculus I and II, Tom M. Apostol

Mathematical Software
Mathematica, MatLab, Maple

3 Some Equations from Physics

Velocity $v = \frac{ds}{dt}$, Acceleration $a = \frac{dv}{dt} = \frac{d^2s}{dt^2} = v\frac{dv}{ds}$

Motion under constant acceleration
$v = u + at$, $s = at + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$, $s = \frac{u+v}{2}t$

Newton's law of motion $F = ma$

Newton's law of gravitation $F = \frac{GMm}{r^2}$, Gravitational acceleration $g = \frac{GM}{R^2}$

Angular velocity $\omega = \frac{d\theta}{dt}, \omega = \frac{v}{r}$ if r is constant

Angular acceleration $\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}, \alpha = \frac{a}{r}$ if r is constant

Equation of angular motion $\tau = I\alpha$

Moment of inertia $I = \int r^2 dm$, Radius of gyration $R^2 = \frac{\int r^2 dm}{\int dm}$

Centre of mass $\overline{x} = \frac{\int x dm}{\int dm}$, $\overline{y} = \frac{\int y dm}{\int dm}$

4 Some Equations from Mathematics

Length of a curve $\int \sqrt{1 + (\frac{dy}{dx})^2} dx$, Area under a curve $\int y dx$

Volume of revolution around the x axis $\int \pi y^2 dx, \int 2\pi y x dy$

Integration by parts $\int u dv = uv - \int v du$, Taylor series $f(x) = \sum_{k=0}^{\infty} \frac{f^{(k)}(a)}{k!}(x-a)^k$

L'Hopital rule $\lim \frac{f(x)}{g(x)} = \lim \frac{f'(x)}{g'(x)}$ for the indeterminate forms $\frac{0}{0}$ of $\frac{\infty}{\infty}$

Parabola $y^2 = 4ax$, Ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, Eccentricity $e^2 = 1 - \frac{b^2}{a^2}$ for ellipse

Elliptic integral of the second kind $E(k) = \int_0^{\frac{\pi}{2}} \sqrt{1 - k^2 \cos^2\theta} d\theta$

First order linear ordinary differential equation
$\frac{dy}{dx} + P(x)y = Q(x)$, solution $y = \frac{1}{I(x)} \int Q(x) I(x) dx$ where $I(x) = e^{\int P(x) dx}$.

Example 1. *Answer the questionnaire given.*

Example 2. *An object of mass m is thrown at an acute angle against gravity. Show that the path is a parabola.*

Example 3. *Find the arc length/area/surface area/volume, centre of mass, radii of gyration for the flowing objects*
1. *Curve C given by $y = \frac{x^2}{2}$ from $x = -1$ to 1.*
2. *Region A between $y = \frac{x^2}{2}$ and $y = 1$.*
3. *Surface of revolution of C along x/y axis.*
4. *Volume of revolution of A along x/y axis.*

Example 4. *Do the above example when C is the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.*

Example 5. *An object of mass m is thrown at an acute angle against gravity where the air resistance is kv, k is a constant.*
1. *Find the equation of the trajectory.*
2. *Deduce the trajectory when $k = 0$.*