

## HIGHER COURSE: TOPICS

### Note for the examination:

In the case of results marked with an asterisk (\*), formal proofs may be examined; in the case of other results stated in the syllabus, proofs will not be examined.

<u>Functions and calculus</u>	
<p>1. Functions: Finding the period and range of a continuous periodic function, given its graph on scaled and labeled axis.</p> <p>Informal treatment of limits of functions; rules for sums, products and quotients.</p> <p>2. Differential calculus: *Derivations from first principles of <math>x^2</math>, <math>x^3</math>, <math>\sin x</math>, <math>\cos x</math>, <math>\sqrt{x}</math>, and <math>1/x</math>. First derivatives of: – polynomials, rational, power and trigonometric functions; – <math>\tan^{-1}</math>, <math>\sin^{-1}</math>, exponential and logarithmic functions; – *sums; *products; differences; *quotients; compositions of these.</p> <p>*Proof by induction that <math>\frac{d}{dx}(x^n) = n x^{n-1}</math>.</p> <p>Application to finding tangents to curves. Simple second derivatives. First derivatives of implicit and parametric functions. Rates of change. } Maxima and minima. }</p> <p>Curve sketching of polynomials and of functions of the form <math>\frac{a}{x+b}</math> and <math>\frac{x}{x+b}</math>, with reference to turning points, points of inflections, and asymptotes.</p> <p>Newton-Raphson method for finding approximate roots of cubic equations.</p>	<p>Range a closed interval <math>[a, b]</math>, <math>a, b \in \mathbb{Z}</math>; period <math>\in \mathbb{N}_0</math>.</p> <p>Periodic graph need not necessarily be trigonometric in type: e.g. saw-tooth graph.</p> <p>Problems involving modelling <u>excluded</u>.</p>

3. Integral calculus:

Integration techniques (integrals of sums, multiplying constants, and substitution) applied to:

- a.  $x^n$
- b.  $\sin nx, \cos nx, \sin^2 nx, \cos^2 nx$ ;
- c.  $e^{nx}$
- d. functions of the form:

$$\frac{1}{x+a}, \frac{1}{a^2+x^2}, \frac{1}{\sqrt{a^2-x^2}}, \sqrt{a^2-x^2}.$$

Definite integrals with applications to areas and volumes of revolution (confined to cones and spheres).

Integration by parts  
and partial  
fractions excluded.