Faculty	Natural Sciences
Home Department	Mathematics and Applied Mathematics
Module Topic	Advanced Calculus
Generic Module Name	Mathematics 211
Alpha-numeric Code	**MAT211**
NQF Level	6
NQF Credit Value	20
Duration	Year
Proposed semester to be offered	Both Semesters
Programmes in which the module will be offered	BSc (Mathematical and Statistical Sciences) (3227, 3031) BSc (Chemical Sciences) (3220, 3019) BSc (Physical Science) (3233, 3120) BSc (Computer Science) (3221,3023)
Year level	2
Main outcomes:	On completion of this module students should be able to: Advanced Calculus • Know how to use the Principle of Mathematical Induction to prove statements. • Understand infinite sequences and series; be familiar with different tests for convergence of sequences and series. • Perform power series expansion of functions and find its interval and radius of convergence. • Use functions of several variables, surfaces and coordinate transformations, contours, level surfaces and traces. • Determine tangent planes and linear approximations, partial differentiation, implicit differentiation, limits, continuity and differentiability of functions of several variables. • Use Lagrange multipliers, maxima and minima, Second derivative test for functions of several variables, chain rule for functions of several variables. • Perform double and triple integrals, iterated integrals, surface integrals, the Jacobian, change of variables for double and triple integrals. • Perform basic operations in Vector Algebra. • Determine vector function, tangent vector, acceleration, TNB-gframe and osculationg sphere on a curve. • Evaluate and interpret line integrals. • Understand Independence of Path. • Be familiar with the properties of vector fields, as well as grad, div and curl differential operators. • Use Green's Theorem to evaluate line integrals and double integrals. • Apply Stokes' Theorem to vector fields. • Understand Surface Independence. • Use the Divergence Theorem to evaluate surface integrals, volume integrals and the flux of a vector field across a surface. • Solve integral problems in mechanics.
Main content:	**Part One:** • Limits, continuity and differentiability of functions of several variables [in-depth theoretical approach, combined with application, using visualisation as a technique in the Cartesian plane for different coordinate systems, mapping diagram technique]

<table>
<tr><td></td><td colspan="4">• Quadric surfaces, polar coordinates and parametric equations, spherical and cylindrical coordinates [Klein bottle, Mobius strip, embedding in R^4]
• Partial derivative; chain rule, maxima and minima of functions of two and three variables, Lagrange Multipliers [Clairaut's theorem, consequences exposure to PDE application problems]
• Multiple Integrals, surface integrals, multiple integrals in polar, spherical and cylindrical coordinates [double and triple Riemann sums, iterated integrals, Fubini's theorem, change order of integration in 2 and 3 dimensions, regions of integration, Jacobians, surface area]
• Sequences and series [epsilon-delta definition, applications; infinite series, alternating series, power series, Taylor and Maclaurin series, convergence tests, absolute convergence, conditional convergence, examples].
Part Two:
• Vector Algebra and vector function of curves and surfaces
• Tangent-Normal-Binormal frame and osculating sphere
• Vector fields
• Line integrals and independence of path and Green's theorem
• Grad, div and curl [geometrical interpretation, 2- and 3-dimensional Laplace operator]
• Oriented surfaces, connected regions [Klein bottle, Mobius strip, embedding in R^4]
• Surface integrals and flux, Stokes' theorem and divergence theorem [applications of divergence theorem to gravity, electromagnetism, fluid flow and heat].</td></tr>
<tr><td>Pre-requisite modules</td><td colspan="4">MAT105 or (MAT103 and MAT104) or (MAM151 and MAM152)</td></tr>
<tr><td>Co-requisite modules</td><td colspan="4">None</td></tr>
<tr><td>Prohibited module Combination</td><td colspan="4">None</td></tr>
<tr><td>Breakdown of Learning Time</td><td>Hours</td><td colspan="2">Timetable Requirement per week</td><td>Other teaching modes that does not require time-table</td></tr>
<tr><td>Contact with lecturer / tutor:</td><td>84</td><td>Lectures p.w.</td><td>2</td><td rowspan="7">Practicals - Every alternate week</td></tr>
<tr><td>Assignments & tasks:</td><td>40</td><td>Practicals p.w.</td><td>1</td></tr>
<tr><td>Assessment</td><td>14</td><td>Tutorials p.w.</td><td>0</td></tr>
<tr><td>Practicals:</td><td>27</td><td></td><td></td></tr>
<tr><td>Selfstudy</td><td>35</td><td></td><td></td></tr>
<tr><td>Other: Please specify Tutorials</td><td>46</td><td></td><td></td></tr>
<tr><td>Total Learning Time</td><td>200</td><td></td><td></td></tr>
<tr><td>Methods of Student Assessment</td><td colspan="4">Continuous Assessment (CA): 70%
Final Assessment (FA): 30%</td></tr>
<tr><td>Assessment Module type</td><td colspan="4">Continuous and Final Assessment (CFA)</td></tr>
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