| Programme | B.Sc. (Engg.) Energy Engineering | Course Code | NS 124 | Credit Hours | 3 + 0 = 3 |
|---|---|---|---|---|---|
| **Course Title** | **Calculus and Analytical Geometry** | | | | |

**Course Introduction**

Calculus and Analytical Geometry (NS 124) is a foundational course offered in the 2nd semester, designed to introduce students to the essential concepts of calculus and the principles of analytic geometry. This course covers many topics, including limits, derivatives, integrals, and the geometric interpretation of these concepts. Students will explore the differentiation and integration of functions, with a focus on understanding gradients and their applications. By the end of the course, students will be equipped with the skills to apply calculus in solving various engineering problems, enhancing their analytical abilities and preparing them for advanced studies in mathematics and related fields. This three-credit hour course emphasizes theoretical understanding, laying a strong groundwork for future coursework in mathematics and engineering disciplines.

| Mapped SDGs | **SDG-4: Quality Education** |
|---|---|

**Learning Outcomes**

1. **Describe** the concepts of calculus and analytic geometry. (C2)
2. **Discuss** the derivatives and the gradient of functions of several variables. (C2)
3. **Apply** calculus to solve engineering problems. (C3)

| Course Content | | Assignments/Readings |
|---|---|---|
| **Week 1** | **Unit-I Derivatives and their Applications**:<br>1.1 Differentiable function<br>1.2 Differentiation and derivatives | The teacher may assign home assignments/problem-based learning/reading materials/learning activity etc. |
| **Week 2** | **Unit- I Derivatives and their Applications**:<br>1.2.1. Polynomial functions | |
| **Week 3** | 1.2.2. Rational functions<br>1.2.3. Transcendental functions<br>**Unit-II Integration and Definite Integrals**<br>2.1. Techniques of evaluating indefinite integrals | |
| **Week 4** | **Unit-II Integration and Definite Integrals**<br>2.2. Integration by substitution<br>2.3. Integration by parts<br>2.4. Change of variables in indefinite integrals**.** | |
| **Week 5** | **Unit-III Concepts of Analytical Geometry**<br>3.1. Simple Cartesian Curves | |
| **Week 6** | **Unit-III Concepts of Analytical Geometry**<br>3.2. Functions and Graphs<br>3.3. Symmetrical Properties | |

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| **Week 7** | **Unit-III Concepts of Analytical Geometry**<br>3.4. Curve Tracing, Limit and Continuity<br>**Unit-IV Application to Tangent and Normal, Linearization**<br>4.1. Maxima/Minima and Point of Inflexion | |
| **Week 8** | **Unit-IV Application to Tangent and Normal, Linearization**<br>4.2 Taylor and Maclaurin Expansions and their convergence.<br>4.4 Indefinite Integration of Simple Functions. | |
| **Week 9** | **Unit-IV Application to Tangent and Normal, Linearization**<br>4.3 Integral as Anti-derivative<br>4.4 Indefinite Integration of Simple Functions.<br>4.5 Methods of Integration | |
| **Week 10** | **Unit-IV Application to Tangent and Normal, Linearization**<br>4.6 Integration by Substitution, by Parts, and by Partial Fractions<br>4.7 Definite Integral as Limit of a Sum | |
| **Week 11** | **Unit-IV Application to Tangent and Normal, Linearization**<br>4.8 Application to Area | |
| **Week 12** | **Unit-IV Application to Tangent and Normal, Linearization**<br>4.9 Arc Length and Volume | |
| **Week 13** | **Unit-V**<br>**Application to solve engineering problems**<br>5.1. Applications of Derivatives<br>5.1.1. Monotonic functions<br>5.1.2 Optimization problems | |
| **Week 14** | **Unit-V Application to solve engineering problems**<br>5.2. Applications of Integration<br>5.2.1 Area under the curve<br>5.2.2. Area between curves<br>5.2.3. Solids of Revolution | |
| **Week 15** | **Unit-VI Infinite Sequence and Series**<br>6.1. Convergence and Divergence of sequences and series<br>6.2 Integral Test<br>6.3 Basic Comparison Test | |

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| **Week 16** | **Unit-VI Infinite Sequence and Series**<br>6.4. Limit Comparison Test<br>6.5 Ratio and Root tests<br>6.6. Alternating series<br>6.7. Absolute and Conditional Convergence | |

**Textbooks and Reading Material**

**1. Textbooks.**


1.1 Ochieng, F. O. (2022). Calculus For Scientists and Engineers. (n.p.): Amazon Digital Services

1.2 Nonlinear Functional Analysis and Its Applications. (2021). Switzerland: MDPI AG.

1.3 Velleman, D. J. (2017). Calculus: A rigorous first course. Courier Dover Publications.

1.4 Lang, S. (2012). A first course in calculus. Springer Science & Business Media.

1.5 Vittal, P. R. (2013). Analytical geometry: 2D and 3D. Dorling Kindersley.

1.6 Varolin, D. (2011). Riemann surfaces by way of complex analytic geometry (Vol. 125) American Mathematical Society


**2. Suggested Readings**


1.1 Kristály, A., Rădulescu, V. D., & Varga, C. (2010). Variational principles in mathematical physics, geometry, and economics: Qualitative analysis of nonlinear equations and unilateral problems (Vol. 136). Cambridge University Press.

1.2 Thomas, G.B. and R. L. Finney. (2010) Calculus And Analytical Geometry,9/e. Pearson Education.


**Teaching Learning Strategies**

1. **Multimodal Instruction**: Utilize lectures with multimedia and white/blackboard platforms to deliver content and facilitate understanding.
2. **Interactive and Collaborative Learning**: Engage students through group discussions, project-based learning, and presentations to develop critical thinking and communication skills.
3. **Assignments and Assessments**: Assign individual and group tasks, reading and writing assignments to assess comprehension and encourage independent study.
4. **Practical Application**: Integrate real-world projects and case studies to bridge theory and practice, enhancing problem-solving and practical skills.

**Assignments: Types and Number with Calendar**

| **Week** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
|---|---|---|---|---|---|---|---|---|
| **Activity** | - | Quiz 1 | - | - | Assignment 1 | - | - | Quiz 2 |

| **Week** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
|---|---|---|---|---|---|---|---|---|
| **Activity** | - | - | Assignment 2 | - | Quiz 3 | - | - | Quiz 4 |

The abovementioned schedule of assignments/quizzes/presentations is tentative. The

schedule will be provided to the students at the start of semester.

| Assessment | | | |
|---|---|---|---|
| **Sr. No.** | **Elements** | **Weightage** | **Details** |
| 1. | Midterm Assessment | 35% | Written assessment at the mid-point of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work, report writing, and viva-voce examination, etc. |
| 2. | Sessional Assessment | 25% | This assessment may include classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc. |
| 3. | Final Assessment | 40% | Written assessment at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work, report writing, and viva-voce examination, etc. |