Pokhara University
Faculty of Science and Technology

Course No.: xxx xxx
Course title: Calculus I (3-2-0)
Nature of the course: Theory
Level: Undergraduate

Full marks: 100
Pass marks: 45
Time per period: 1 hour
Total Periods: 45
Program: BE

1. Course Description

This course is designed for developing competency of the students on the fundamental concepts, principals and applications of differential and integral calculus for solving engineering problems. It is equipped with differential calculus, integral calculus and ordinary differential equations. The review part of the content is based on previous learning in the school level. The course will be delivered through lecture method, assignment on practically base engineering problems and class tests.

2. General Objectives

The course is designed with the following general objectives:

- To acquaint the students with applications of differential and integral calculus in engineering.
- To expose the students with the application of differential equations for modeling engineering problems.

3. Methods of Instruction

Lecture, tutorials and assignments

4. Contents in Detail

Specific objectives	Contents
• Explain the importance of limit and continuity in differential problems and use Leibnitz theorem to evaluate higher derivatives.	**Unit I: Limit Continuity and Derivatives (5 hrs)** 1.1 Introduction 1.2 Limit, continuity and differentiability 1.3 Higher order derivatives by Leibnitz method.
• Apply derivatives in mean value theorem, series expansion, asymptotes and trace curve for the given function.	**Unit II: Applications of Derivatives (8 hrs)** 2.1 Mean value theorems: Rolle's theorem, Lagrange's Theorem (Geometrical interpretation and verification) and applications 2.2 Higher order mean value theorem: Taylor's Series, Maclaurin's Series expansion of function. 2.3 Asymptotes to Cartesian curves up to four degrees. 2.4 Curve tracing in Cartesian form and parametric form 2.5 Curvature
• Evaluate Proper and improper integrals.	**Unit III: Integral Calculus (6 hrs)** 3.1 Introduction 3.2 Review on Indefinite Integral and fundamental theorem

	of integral calculus. 3.3 Definite integral and its properties 3.4 Improper Integrals; comparison test. 3.5 Reduction formula, Beta Gamma functions
• Evaluate arc length, area, and volume through integration.	**Unit IV: Application of Integral (6 hrs)** 4.1 Application of integrals for finding area beneath a curve and between two curves and arc length 4.2 Surface and volume of solid of revolution in the plane for Cartesian and parametric curves.
• Understand and compute partial derivatives with the concept of total differentials.	**Unit V: Partial Differentiation (3 hrs)** 5.1 Introduction 5.2 Partial Derivatives 5.3 Homogeneous function and Euler's theorem for the function of two and three variables 5.4 Total Derivatives and Differentiation of Implicit functions.
• Define extreme value and compute its value for two and three variables through partial derivatives.	**Unit VI: Application of Partial Differentiation (4 hrs)** 6.1 Extrema of functions of two and three variables. 6.2 Lagrange's method of undetermined Multipliers (up to 2 multipliers)
• Able to solve first order differential equations.	**Unit VII: First Order Ordinary Differential Equations (6 hrs)** 7.1 Review of separable, homogeneous and exact differential equation with engineering applications 7.2 Linear, Bernoulli equation and Riccati's equation with engineering application. 7.3 Mathematical modeling of engineering problems using first order equation.
• Solve the second order differential equations in relation to engineering problems.	**Unit VIII: Second Order Ordinary Differential Equations (7 hrs)** 8.1 Second order Homogeneous ODE with constant and variable coefficients, Euler-Cauchy equation. 8.2 Existence and uniqueness of solutions, Wronskian and general solutions for solving ODE. 8.3 Non-homogeneous second order ODE and Solution by undetermined coefficients and variation of parameters and engineering application

Note: The figures in the parentheses indicate the approximate periods for the respective units.

5. List of Tutorials

Tutorial work covers the work to be done in tutorial. This will enable the students to compute the mathematics problem under the supervision of the course leader. The major tutorial works are as follows:

1. Problems on Limit and continuity (1 hr)
2. Show that differentiability implies continuity but the converse may not be true (1 hr)
3. Evaluation of higher order derivatives by Leibnitz method (1 hr)

4. Problems in Mean value theorems: Rolle's theorem, Lagrange's Theorem (1 hr)
5. Expand the functions through Taylor's Series, and Maclaurin's Series (2 hrs)
6. Evaluation of Asymptotes to Cartesian curves. (2 hrs)
7. Trace Curve for the equations in Cartesian form and parametric form (2 hrs)
8. Problems in Curvature (1 hr)
9. Evaluation of Indefinite Integrals, Definite integrals, Improper Integrals; (2 hrs)
10. Deduce Reduction formula, and solve problems related to Beta Gamma functions (2 hrs)
11. Evaluation of area, arc length, Surface and volume of solid of revolution in the plane for Cartesian and parametric curves. (3 hrs)
12. Prove Euler's theorem for the function of two and three variables (1 hr)
13. Calculate total derivatives and differentiation of Implicit functions. (1 hr)
14. Evaluation of Extrema of functions of two and three variables and Lagrange's method of undetermined Multipliers (up to 2 multipliers) (2 hrs)
15. Solution of separable, homogeneous and exact differential equation Linear, Bernoulli equation and Riccati's equation with engineering applications (2 hrs)
16. Mathematical modeling of engineering problems using first order equation. (1 hr)
17. Solve second order homogeneous ODE with constant and variable coefficients, Euler-Cauchy equation. (3 hrs)
18. Solve non-homogeneous second order ODE by undetermined coefficients and variation of parameters in engineering application (2 hrs)

6. Evaluation System and Students' Responsibilities

Evaluation System

Internal evaluation is done as follows:

External Evaluation	Marks	Internal Evaluation	Weight	Marks
Semester-End Examination	50	Attendance & Class Participation	10%	
		Assignments	20%	
		Presentations/Quizzes	10%	
		Term exam	60%	
		Total Internal		50
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks in internal evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such score will be given NOT QUALIFIED (NQ) and the student will not be eligible to appear the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

7. Prescribed Books and References

Text Books

1. Stewart, J. *Calculus, Early Transcendental*. India; Cengage Learning.
2. Kreyszig, E. *Advance Engineering Mathematics,* New Delhi: John Wiley and Sons Inc.

References

1. Thomas, G. & Finney, R. *Calculus and Analytical Geometry*. New Delhi: Narosa Publishing House.
2. Mishra, P., Mishra, R., Mishra, V. P., & Mishra, M. *Advance Engineering Mathematics*. New Delhi: V. P. Mishra Publication.
3. Dass, H. K. & Verma R. *Higher Engineering Mathematics*. New Delhi: S Chand Publishing.