Pokhara University
Faculty of Science and Technology

Course Code: MTH 252	Full Marks: 100
Course title: Numerical methods (2-1-2)	Pass Marks: 45
Nature of the Course: Theory and Practical	Total Lectures: 30 hours
Level: Bachelor	Program: BE

1. Course Description

This course explains how to utilize a computer to solve issues that calculus and algebra might not be able to. It fosters the development of mathematical relationships that can be utilized to model real-world situations and the problem-solving skills necessary to study other engineering courses.

2. General Objectives

The general objectives of this course is to equip students with knowledge and tools required to solve different equations that are applicable in the fields of engineering.

3. Methods of Instructions:

Lecture, Tutorial, Discussion, Readings and Practical works

4. Contents in Detail

Specific Objectives	Contents
Solve non-linear equations by different numerical methods.	Unit 1: **Solution of Non-linear equations (5 hrs)** 1.1. Introduction, Importance of Numerical Methods 1.2. Approximation and Errors in computation 1.3. Bisection Method 1.4. Secant method 1.5. Newton Raphson method 1.6. Fixed point iterative method
Visualize and solve mathematical relationships of practical observations.	Unit 2: **Interpolation and approximation (5hrs)** 2.1. Lagrange interpolation 2.2. Finite differences (forward, backward, and divided difference) 2.3. Newton's Interpolation (forward, backward) 2.4. Least square method of fitting linear and nonlinear curve for discrete data and continuous function 2.5. Cubic Spline Interpolation
Calculate definite integration and differentiation numerically.	Unit 3: **Numerical Differentiation and Integration (4 hours)** 3.1. Numerical Differentiation formulae 3.2. Trapezoidal, Simpson's 1/3, 3/8 rule 3.3. Romberg integration

	3.4. Gaussian integration (2- point and 3- point formula)
Solve the system of linear equations by different techniques.	Unit 4: **Solution of system of linear algebraic equations (6 hours)** 4.1. Gauss elimination method and concept of pivoting 4.2. Ill-conditioned system of linear equations 4. 3. LU Factorization method (Dolittle, Crout's, Cholesky's) 4.4. Iterative methods (Jacobi method, Gauss-Seidel method) 4.5. Eigen value and Eigen vector using Power method
Solve the ordinary differential equations which may exist in the field of engineering.	Unit 5: **Solution of ordinary differential equations (6 hours)** 5.1. Review of ordinary differential equations 5.2. Runge-Kutta methods (first, second and fourth) for first and second order differential equations 5.3. Solution of boundary value problem by shooting method
Solve numerically the partial differential equations which exist in the field of engineering.	Unit 6: **Numerical solution of Partial differential Equation (4 hours)** 6.1. Classification of partial differential equation (elliptic, parabolic and hyperbolic) 6.2. Solution of Laplace equation (standard 5-point formula with iterative methods) 6.3. Solution of Poisson equation (finite difference approximation method) 6.4. Solution of one-dimensional Heat equation by Schmidt method

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

5. List of Tutorials

The following tutorial activities of 15 hours per group of maximum 24 students should be conducted to cover all the required contents of this course.

S.N.	List of Tutorials	
1	Determination of a root by all methods and their comparison.	3 hrs
2	Finding of different interpolating polynomials, regression curve and Cubic-spline.	2 hrs
3	Determination of the first and second order derivatives by difference method and its comparison with exact value. Integration by Trapezoid, Simpson's rules, Romberg method, Gaussian method and comparison with exact value.	2 hrs

4	Solution of system of linear equations by Gauss Elimination, matrix factorization, Jacobi, Gauss-seidel method Finding Eigen value and Eigen vector by power method.	4 hrs
5	Solution of first and second order differential equation by RK methods, and Shooting method.	2 hrs
6	Solution of Laplace, and Poisson's equations by five-point formula.	2 hrs

6. List of Practical

SN	List of Practicals
1.	Solution of nonlinear equations.
2.	Interpolation and regression.
3.	Differentiation and Integration.
4.	Linear system of equations and power method.
5.	Ordinary differential equations.

By using MATLAB/C/C++ or any other relevant high level programming languages.

7. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of assignments, attendance, term-exams, lab reports and projects etc. The tabular presentation of the internal evaluation is as follows:

Internal Evaluation	**Weight**	**Marks**	**External Evaluation**	**Marks**
Theory		**30**	**Semester End**	**50**
Attendance & Class Participation	10%			
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Practical		**20**		
Attendance & Class Participation	10%			
Lab Report/Project Report	20%			
Practical Exam/Project Work	40%			
Viva	30%			
Total Internal		**50**		
Full Marks: 50 + 50 = 100				

Students' Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical 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) 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.

8. Prescribed Books and References

Text Books

1. C.F. Gerald and P.O. Wheatley *Applied Numerical Analysis (7^{th} edition),* New york.
2. B. S. Grewal, *Numerical Methods in Engineering and Science* Khanna Publication, (10th edition)
3. S.S. Sastry *Introductory Methods of Numerical Analysis (4^{th} edition),* Prentice-Hall of India, New Delhi, 2008.

References:

1. Richard L. Burden, J. Douglas Faires, "Numerical Analysis 7th edition", Thomson / Brooks/Cole
2. E. Balagurusamy *Numerical methods.* New Delhi; Tata McGraw Hill, 2010.
3. Dr. V. N. Vedamurthy & Dr. N. Ch. S. N. Iyengar *Numerical Methods,* Noida, Vikash Publication House 2009.
4. Rudra Pratap *Getting Started with MATLAB,* Oxford University Press 2010