UNIVERSITY COLLEGE of the FRASER VALLEY

COURSE IMPLEMENTATION DATE: September 1994
COURSE REVISED IMPLEMENTATION DATE:
COURSE TO BE REVIEWED: September 1998
(Four years after implementation date) (MONTH YEAR format)

OFFICIAL COURSE OUTLINE INFORMATION

Students are advised to keep course outlines in personal files for future use.
Shaded headings are subject to change at the discretion of the department and the material will vary - see course syllabus available from instructor

FACULTY/DEPARTMENT: **MATHEMATICS**

MATH 316		**4**
COURSE NAME/NUMBER	FORMER COURSE NUMBER	UCFV CREDITS

NUMERICAL ANALYSIS
COURSE DESCRIPTIVE TITLE

CALENDAR DESCRIPTION:

Discussion, construction and application of numerical computing solutions to mathematical problems, inc. linear algebra and eigenvalues, differentiation and integration, non-linear equations, the approximation of functions and ordinary differential equations.

PREREQUISITES: **Math 112 or 114, Math 221 and knowledge of a programming language acceptable to the department.**

COREQUISITES:

SYNONYMOUS COURSE(S)
(a) Replaces: ____________ *(Course #)*
(b) Cannot take: ____________ *(Course #)* for further credit.

SERVICE COURSE TO:
____________ *(Department/Program)*
____________ *(Department/Program)*

TOTAL HOURS PER TERM: **75**
STRUCTURE OF HOURS:

Lectures:	**45**	Hrs
Seminar:		Hrs
Laboratory:	**30**	Hrs
Field Experience:		Hrs
Student Directed Learning:		Hrs
Other (Specify):		Hrs

TRAINING DAY-BASED INSTRUCTION
LENGTH OF COURSE:
HOURS PER DAY:

MAXIMUM ENROLLMENT:
EXPECTED FREQUENCY OF COURSE OFFERINGS:

WILL TRANSFER CREDIT BE REQUESTED? (lower-level courses only)	☒ Yes	☐ No
WILL TRANSFER CREDIT BE REQUESTED? (upper-level requested by department)	☐ Yes	☐ No
TRANSFER CREDIT EXISTS IN BCCAT TRANSFER GUIDE:	☐ Yes	☐ No

AUTHORIZATION SIGNATURES:

Course Designer(s): ____________ Chairperson: ____________ *(Curriculum Committee)*

Department Head: ____________ Barry Garner Dean: ____________

PAC Approval in Principle Date: PAC Final Approval Date: October 27, 1993

LEARNING OBJECTIVES / GOALS / OUTCOMES / LEARNING OUTCOMES:

1. Understand the inherent limitations of floating point representation and machine accuracy, and the notion of a condition number for both a given problem and for a particular algorithm.

2. Become acquainted with the mathematics of some of the basic 'classical' techniques for finding solutions to numerical problems.

3. Know how to proceed to write appropriate software algorithms and how to use a software package pertaining to the programming language known (e.g. Borland's Numerical Methods, NAG and IMSL routines.)

METHODS:

PRIOR LEARNING ASSESSMENT RECOGNITION (PLAR):

Credit can be awarded for this course through PLAR (Please check :) ☐ Yes ☐ No

METHODS OF OBTAINING PLAR:

TEXTBOOKS, REFERENCES, MATERIALS:

[Textbook selection varies by instructor. An example of texts for this course might be:]

Text TBA.

Basic references:

Germund Dahlquist & Ake Bjork, Numerical methods. Prentice-Hall (1974)

C.F. Gerald and P.O. Wheatley, Applied Numerical analysis (4^{th} edition). Addison-Wesley (1989).

Burden & Faires, Numerical analysis (4^{th} edition). Nelson (Wadsworth)

SUPPLIES / MATERIALS:

STUDENT EVALUATION:

[An example of student evaluation for this course might be:]

Assignments	20%
In-class tests	40%
Final Examination	40%

COURSE CONTENT:

[Course content varies by instructor. An example of course content might be:]

Overview of methods: iteration (x = g(x)), local approximation, Newton-Raphson, the secant method, linear interpolation, numerical integration by the trapezoidal rule, Richardson extrapolation, approximate solution of differential equations by Euler's method, differences, simulation, algorithms, numerical instability.

Error: sources, absolute and relative, rounding and truncation, propagation, cancellation of terms, of error. Floating and fixed point representation of numbers. The condition number for the algorithm, for the problem.

Numerical use of series: alternating series, power series, acceleration of convergence, Euler-Maclaurin's summation formula, Aitken extrapolation, asymptotic series.

Approximation of functions: linear, polynomial interpolation, Lagrange's formula, inverse interpolation, equidistant interpolation and the Runge phenomenon, Chebycheff abscissae, orthogonal polynomials, economized power series, rational functions, splines; use of trigonometric series and transforms (if time allows).

Numerical linear algebra: Gaussian elimination, pivoting strategies, LU-decomposition, inverse calculation, interative methods; symmetric positive-definite matrices, large sparse systems, eigenvalues.

Numerical integration: the rectangle rule, the trapezoidal rule and Romberg's method, Simpson's formula; singularities, infinite intervals, the Euler-Maclaurin summation formula, Stirling's asymptotic formula for ln(m!), Gaussian quadrature.

Differences, numerical differentiation.

Non-linear equations: Bisection, secant, Newton-Raphson, $x = g(x)$ where $g(x)$ is a contraction mapping, Aitken extrapolation. Multi-dimensions, the Nelder-Mead simplex method (as time allows).

Initial value problems: Euler's method with repeated Richardson extrapolation, the modified midpoint, power-series, and Runge-Kutta methods; predictor-corrector methods, stiff problems.