

LSC Use Only

Number: 181

Action: A

Date: 4-1-93

UWUCC Use Only

Number: _____

Action: _____

Date: _____

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. Title/Author of Change

Course/Program Title: MA 241 Differential Equations

Suggested 20 Character Course Title: Diff Equations

Department: Mathematics

Contact Person: Gerald Buriok

II. If a course, is it being Proposed for:

_____ Course Revision/Approval Only

_____ Course Revision/Approval and Liberal Studies Approval

X Liberal Studies Approval Only (course previously has been approved by the University Senate)

III. Approvals

Albert Davis
Department Curriculum Committee

Gerald Buriok
Department Chairperson

H. K. ...
College Curriculum Committee

W. S. ...
College Dean *

Director of Liberal Studies
(where applicable)

Provost (where applicable)

*College Dean must consult with Provost before approving curriculum changes. Approval by College Dean indicates that the proposed change is consistent with long range planning documents, that all requests for resources made as part of the proposal can be met, and that the proposal has the support of the university administration.

IV. Timetable

Date Submitted
to LSC: _____

Semester to be
implemented: _____

Date to be
published
in Catalog: _____

to UWUCC: _____

LIBERAL STUDIES COURSE APPROVAL, PARTS 1-3: GENERAL INFORMATION CHECK-LIST

I. Please indicate the LS category(ies) for which you are applying:

LEARNING SKILLS:

☐ First Composition Course
☐ Mathematics

☐ Second Composition Course

KNOWLEDGE AREAS:

☐ Humanities: History
☐ Humanities: Philos/Rel Studies
☐ Humanities: Literature
☐ Natural Sci: Laboratory
☐ Natural Sci: Non-laboratory

☐ Fine Arts
☐ Social Sciences
☐ Non-Western Cultures
☐ Health & Wellness
☒ Liberal Studies Elective

II. Please use check marks to indicate which LS goals are primary, secondary, incidental, or not applicable. When you meet with the LSC to discuss the course, you may be asked to explain how these will be achieved.

Prim Sec Incid N/A

- | | | | | |
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--|
| ☒ | ☐ | ☐ | ☐ | A. Intellectual Skills and Modes of Thinking: |
| ☐ | ☒ | ☐ | ☐ | 1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process. |
| ☒ | ☐ | ☐ | ☐ | 2. Literacy--writing, reading, speaking, listening. |
| ☐ | ☐ | ☒ | ☐ | 3. Understanding numerical data. |
| ☒ | ☐ | ☐ | ☐ | 4. Historical consciousness. |
| ☐ | ☐ | ☐ | ☒ | 5. Scientific Inquiry. |
| ☐ | ☐ | ☐ | ☐ | 6. Values (Ethical mode of thinking or application of ethical perception). |
| ☐ | ☐ | ☐ | ☒ | 7. Aesthetic mode of thinking. |
| ☐ | ☐ | ☐ | ☐ | B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person |
| ☐ | ☐ | ☒ | ☐ | C. Understanding the Physical Nature of Human Beings |
| ☐ | ☐ | ☒ | ☐ | D. Collateral Skills: |
| ☒ | ☐ | ☐ | ☐ | 1. Use of the library. |
| ☐ | ☐ | ☐ | ☐ | 2. Use of computing technology. |

III. The LS criteria indicate six ways that courses should contribute to students' abilities. Please check all that apply. When you meet with the LSC, you may be asked to explain your check marks.

- ☐ 1. Confront the major ethical issues which pertain to the subject matter; realize that although "suspended judgment" is a necessity of intellectual inquiry, one cannot live forever in suspension; and make ethical choices and take responsibility for them.
- ☒ 2. Define and analyze problems, frame questions, evaluate available solutions and make choices.
- ☒ 3. Communicate knowledge and exchange ideas by various forms of expression, in most cases writing and speaking.
- ☒ 4. Recognize creativity and engage in creative thinking.
- ☒ 5. Continue learning even after the completion of their formal education.
- ☒ 6. Recognize relationships between what is being studied and current issues, thoughts, institutions, and/or events.

Part IV (MA 241)

A. There will be a common syllabi of topics that should be covered by each of the individual instructors teaching this course. Such common syllabi should include but not be limited to topics which introduce the student to deductive reasoning, develop in the student problem solving skills, and enable the student not only to understand the underlying principles of formulae but also have the ability to use and interpret numerical data.

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to mathematics by women and racial minorities. MA 241 is a technical courses in which problems assigned to students are normally gender neutral. Past enrollment data shows a reasonably good gender balance for students taking this course. It is impossible to determine from this data the number of minority students who have taken this course, but typically very few minority students are enrolled in departments that direct students into MA 241. Regarding women enrolled in MA 241, the faculty of the Mathematics Department recognize that the classroom environment and the attitude of the instructor toward women mathematicians and scientists are probably the most significant factors in overcoming gender bias. The department will continue to keep a high level of awareness of these factors.

C. The Math/Applied Math Curriculum Committee of the Mathematics Department will provide a minimum reading list for this course. Instructors will be encouraged to supplement this reading list with appropriate magazine/journal/etc. articles pertinent to the mathematical material discussed in this course. Additionally, instructors could require the students to report in writing on articles they have discovered through their reading which pertain to mathematics and/or applications of mathematics.

D. The thrust of MA 241 is to introduce the study of differential equations to students who generally are majors in mathematics or one of the natural sciences. An additional goal is to develop in the student an awareness of and appreciation for the power and usefulness of mathematics and its important role in a technological society. In particular, it should prepare the student for the further study of other mathematics courses and/or natural science courses. The emphasis in this course will be applications of the topics studied. These topics would provide the course with a suitable mathematical strata that would improve the mathematical maturity of students to the point where they would be prepared to enroll in other mathematics or natural science courses which require MA 241 as a prerequisite. Additionally, this course would enable the students to develop confidence in handling numerical problems, would present the student with an opportunity to develop an appreciation for mathematics, and would allow the introduction to students of computer technology for solving differential equations.

CHECK LIST -- LIBERAL STUDIES ELECTIVES

Knowledge Area Criteria which the course must meet:

- ☒ Treat concepts, themes and events in sufficient depth to enable students to appreciate the complexity, history and current implications of what is being studied; and not be merely cursory coverage of lists of topics.
- ☒ Suggest the major intellectual questions/problems which interest practitioners of a discipline and explore critically the important theories and principles presented by the discipline.
- ☒ Allow students to understand and apply the methods of inquiry and vocabulary commonly used in the discipline.
- ☒ Encourage students to use and enhance, wherever possible, the composition and mathematics skills built in the Skill Areas of Liberal Studies.

Liberal Studies Elective Criteria which the course must meet:

- ☒ Meet the "General Criteria Which Apply to All Liberal Studies Courses."
- ☒ Not be a technical, professional or pre-professional course.

Explanation: Appropriate courses are to be characterized by learning in its broad, liberal sense rather than in the sense of technique or preprofessional proficiency.. For instance, assuming it met all the other criteria for Liberal Studies, a course in "Theater History" might be appropriate, while one in "The Craft of Set Construction" probably would not; or, a course in "Modern American Poetry" might be appropriate, while one in "New Techniques for Teaching Writing in Secondary Schools" probably would not; or, a course on "Mass Media and American Society" might be appropriate, while one in "Television Production Skills" probably would not; or, a course in "Human Anatomy" might be appropriate, while one in "Strategies for Biological Field Work" probably would not; or, a course in "Intermediate French" might be appropriate, while one in "Practical Methods for Professional Translators" probably would not.

COURSE SYLLABUS

MA 241 DIFFERENTIAL EQUATIONS

Catalogue Description

Emphasis is placed on techniques of solution and elementary physical applications. A thorough study is made of differential equations classified as order one-degree one, linear and nonhomogeneous. Solution techniques involving reduction of order techniques, the differential operator, and infinite series are introduced.

Course Objectives

The students are expected to gain facility in the solving of basic differential equations, gain visual understanding of the relationship between the mathematical model and the actual phenomena it represents, and learn how to construct simple models based on the basic laws of the science being studied. The students will learn to use various computer packages such as CAS (Computer Algebra Systems) software in conducting projects which will extend and enhance the material presented. The students will need to produce written reports of their investigations. Some of these projects will not be in closed form (There may not be only one answer.) and the students must justify their conclusions.

Course Outline

- I. Introduction (1 week)
 - A. Applications: SIR (Susceptible-Infected-Removed) epidemics
 - B. Terminology
 - C. Mathematica notebooks and modeling
- II. Approximating Solutions (2 weeks)
 - A. Applications: SIR (Susceptible-Infected_Removed) epidemics, growth models
 - B. Direction fields
 - C. Euler's method and Runge-Kutta method
 - D. Notebooks on approximating solutions
- III. First Order Differential Equations (2 weeks)
 - A. Applications: SIR models with births and deaths, SIS (Susceptible-Infected_Susceptible) models, radioactive dating
 - B. Existence and Uniqueness
 - C. Methods of solutions: separable, exact, integrating factors, linear, substitutions, reduction of order

Project 1 due

- IV. Systems of First Order Differential Equations (2 weeks)
 - A. Applications: Low level bombing, bungee diving, Lanchester's combat models, effect of vaccination in SIR diseases, motion of a space station, pollution models
 - B. Direction fields
 - C. Phase plane analysis
- V. Higher Order Linear Differential Equations (3 weeks)
 - A. Applications: Springs, damped and forced oscillators, resonance, simple pendulum, electrical circuits
 - B. Homogeneous linear equations with constant coefficients,
 - C. Classification of solutions by phase plane analysis
 - D. Non-homogeneous equations: undetermined coefficients, variation of parameters

Project 2 due

- VI. Linear Differential Equations with Variable Coefficients (3 weeks)
 - A. Applications: Aging springs, pendulum revisited, spring pendulum
 - B. Classification of ordinary and singular points
 - C. Series solutions near ordinary points
 - D. Cauchy-Euler equations

Tests (1 week)

Evaluation Methods

The students will be evaluated based on total points earned by test and quiz scores during the semester (60%), the final (30%), and the written projects (10%). It should be mentioned that the above percentages can only be an approximate distribution as each faculty member may vary the weights according to variations in emphasis.

Required Text, Supplemental Books and Reading

Basic Text: A First Course in Differential Equations
 Dennis G. Zill
 Fifth Edition (1993)
 PWS-Kent

Supplemental Books: Derive: A Mathematical Assistant for Your Personal Computer
 SoftWarehouse

Mathematica
 Stephen Wolfram
 Addison Wesley

Readings: The readings will be based on the particular projects assigned to each group.

Special Resource Requirements

The students will be expected to have a scientific calculator. It would be beneficial if the calculator was programmable and could do graphics and matrix operations. The University will make available the necessary computers and software needed.

Bibliography

A First Course in Differential Equations

Dennis G. Zill
Fifth Edition (1993)
PWS-Kent

Derive A Mathematical Assistant for Your Personal Computer

SoftWarehouse

Mathematica

Stephen Wolfram
Addison Wesley

Exploring Calculus with Derive

David C. Arney
Addison-wesley

Student Research Projects in Calculus

Cohen, Gaughan, Knoebel, Kurtz, Pengelley
The Mathematical Association of America

Derive Laboratory Manual for Differential Equations

David C. Arney
Addison-Westley

Differential Equations: An Introduction

Daniel A. Marcus
William C. Brown Publishers

Advanced Engineering Mathematics

Erwin Kreyszig
John Wiley and Sons