COQUITLAM COLLEGE
Established 1982

# COURSE OUTLINE

**Last Revised:** November 2011

## COURSE INFORMATION

**Course Title:** Introduction to Ordinary Differential Equations **Course Number:** MATH 215 **Credits:** 3

**Total Weeks:** 14 (Fall, Spring)
12 (Summer)

**Total Hours:** 39

**Course Level:** ☐ First Year ☒ Second Year
☐ New ☐ Revised Course
☐ Replacement Course

**Department:** Math/Statistics **Department Head:** G. Belchev **Former Course Code(s) and Number(s) (if applicable):** N/A

**Pre-requisites (If there are no prerequisites, type NONE):** MATH 102; MATH 232 recommended

**Co-requisite Statement (List if applicable or type NONE):** NONE

**Precluded Courses:** N/A

## COURSE DESCRIPTION

In this course topics include first order differential equations, second and higher order linear equations, series solutions, an introduction to Laplace transformation, systems and numerical methods, phase plane analysis, and applications in the physical, biological, and social sciences.

## LEARNING OUTCOMES

Upon successful completion of the course, students will be able to:

- Solve separable, homogeneous, exact, and linear first-order differential equations with and without initial conditions.
- Determine regions of the plane over which a given first-order differential equation will have a unique solution.
- Solve application problems modeled by separable, homogeneous, exact, linear first-order differential equations, and equations reducible to first order differential equations.
- Learn to solve linear differential equations of higher order.
- Determine if a set of functions is linearly dependent or independent by definition and by using the Wronskian.
- Construct a second solution of a differential equation from a known solution.
- Solve homogenous linear equations with constant coefficients.
- Solve non-homogeneous linear equations with constant coefficients using the methods of undetermined coefficients and variation of parameters.
- Solve application problems modeled by linear differential equations.
- Solve simple harmonic motion problems.
- Solve damped motion problems.
- Solve forced motion problems.
- Recognize and solve Cauchy-Euler equations.
- Use power series methods to solve differential equations about ordinary points.
- Use the Method of Frobenius to solve differential equations about regular singular points.
- Find the Laplace transform of a function using the definition.

- Find the inverse Laplace function of a function.
- Use the Translation Theorems to find Laplace transforms.
- Find the Laplace transform of derivatives, integrals, and periodic functions.
- Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients.
- Use the method of Laplace transforms to solve systems of linear first-order differential equations.
- Solve a linear system by the method of substitution.
- Write an nth order differential equation as a first-order system.
- Solve a first-order initial value problem using Euler's method.
- Solve a first-order initial value problem using a second order Runge-Kutta method.

## INSTRUCTION AND GRADING

Instructional (Contact) Hours:

| Type | Duration |
|---|---|
| Lecture | 39 |
| Seminars/Tutorials | |
| Laboratory | |
| Field Experience | |
| Other (*specify):* | |
| Total | 39 |

**Grading System:** Letter Grades ☒ Percentage ☐ Pass/Fail ☐ Satisfactory/Unsatisfactory ☐ Other ☐

**Specify passing grade:** 50%

**Evaluation Activities and Weighting** (total must equal 100%)

| | | | |
|---|---|---|---|
| Assignments: % *Specify number of, variety, and nature of assignments:* | Lab Work: % | Participation: % *Specify nature of participation:* | Project: % *Specify nature of project:* |
| Quizzes/Test: 25% | Midterm Exam: 35% | Final Exam: 40% | Other: % *Specify:* |

## TEXT(S) AND RESOURCE MATERIALS

Provide a full reference for each text and/or resource material and include whether required/not required.

Elementary Differential Equations, Latest Edition, Boyce, W.E. and Di Prime, R.C., John Wiley.

## COURSE TOPICS

List topics and sequence covered.

| Week | Topic |
|---|---|
| Week 1 | First Order Differential Equations<br>Linear equations; separable equations, exact equations. |
| Week 2 | First Order Differential Equations continued<br>Integrating factors; homogeneous equations; applications of first order equations. |
| Week 3 | Second Order Differential equations<br>Fundamental solutions; linear independence and Wronskians. |
| Week 4 | Second Order Differential equations continued<br>Homogenous and nonhomogeneous equations with constant coefficients; variation of parameters; applications. |
| Week 5 | Second Order Differential equations continued<br>Higher order linear equations. |
| Week 6 | Systems of Differential Equations<br>Linear systems. |
| Week 7 | **MIDTERM EXAM** |
| Week 8 | Systems of Differential Equations continued<br>Solution by eigenvalues. |
| Week 9 | Laplace and Fourier Transforms<br>Brief introduction to Laplace and Fourier transforms. |
| Week 10 | Series Solutions<br>Review of power series. |
| Week 11 | Series Solutions continued<br>Series solution near an ordinary point and near a regular singular point. |
| Week 12 | Numerical Methods<br>Euler method; higher order methods. |
| Week 13 | Phase Plane Analysis |
| Week 14 | **FINAL EXAM** |

## NOTES

1. Students are required to follow all College policies. Policies are available on the website at: Coquitlam College Policies
2. To find out how this course transfers, visit the BC Transfer Guide at: bctransferguide.ca