UNIVERSITY OF THE FRASER VALLEY

**OFFICIAL UNDERGRADUATE COURSE OUTLINE (page 1)**

COURSE IMPLEMENTATION DATE: January 2006
COURSE REVISED IMPLEMENTATION DATE: January 2013
COURSE TO BE REVIEWED: September 2011
*(six years after UEC approval)* *(month, year)*

## OFFICIAL UNDERGRADUATE 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 – see course syllabus available from instructor

| MATH 440 | Mathematics and Statistics | 3 |
|---|---|---|
| COURSE NAME/NUMBER | FACULTY/DEPARTMENT | UFV CREDITS |

Fourier Analysis
COURSE DESCRIPTIVE TITLE

**CALENDAR DESCRIPTION:**
Fourier analysis involves the breakdown of functions into sine and cosine components. This can be done on the circle, real line, or on groups. These expansions have many applications in mathematics to areas such as signal processing and rapid numerical computations. Topics will include Fourier series and their properties, Fourier transforms, types of convergence, distributions, filtering, noise reduction, reconstruction of musical tones, and Fast Fourier transform. This will be a seminar-based course. Students will develop their presentation skills, will engage in in-depth class discussion of the course materials, and will write an independently-researched paper.

PREREQUISITES: MATH 211, MATH 265, and one of MATH 152 or MATH 221
COREQUISITES:
PRE or COREQUISITES:

**SYNONYMOUS COURSE(S):**
(a) Replaces:
(b) Cross-listed with:
(c) Cannot take: for further credit.

**SERVICE COURSE TO:** *(department/program)*

**TOTAL HOURS PER TERM:** 45
STRUCTURE OF HOURS:

| | | |
|---|---|---|
| Lectures: | | Hrs |
| Seminar: | 45 | Hrs |
| Laboratory: | | Hrs |
| Field experience: | | Hrs |
| Student directed learning: | | Hrs |
| Other (specify): | | Hrs |

TRAINING DAY-BASED INSTRUCTION:
Length of course:
Hours per day:

**OTHER:**
Maximum enrolment: 24
Expected frequency of course offerings: Every three years.
*(every semester, annually, every other year, etc.)*

| | | |
|---|---|---|
| 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 |

Course designer(s): Erik Talvila
Department Head: Cynthia Loten — Date approved: **April 2, 2012**
Supporting area consultation — Date of meeting: **April 20, 2012**
Curriculum Committee chair: **David Fenske** — Date approved: **June 22, 2012**
Dean/Associate VP: Lucy Lee — Date approved: **September 7, 2012**
Undergraduate Education Committee (UEC) approval — Date of meeting: **September 28, 2012**

**LEARNING OUTCOMES:**

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

1. Prove properties of Fourier expansions in three settings: the circle, the line, and finite Abelian groups.
2. Compute Fourier series and Fourier transforms of representative functions and distributions.
3. Demonstrate the differences and uses of pointwise, mean-square and summability convergence.
4. Implement the Fast Fourier Transform and use it to quickly compute products of large numbers.
5. Construct a digital filter using convolutions.
6. Conduct a seminar on a topic agreed upon with the instructor.
7. Conduct independent research on a top topic agreed upon with the instructor, write their results in a research paper and present these results to the class in a seminar.

**METHODS:** *(Guest lecturers, presentations, online instruction, field trips, etc.)*

Lectures, facilitated discussion, student-led discussion, student presentations, individual assistance in producing a seminar, and a research project.

**METHODS OF OBTAINING PRIOR LEARNING ASSESSMENT RECOGNITION (PLAR):**

☐ Examination(s) ☐ Portfolio assessment ☐ Interview(s)

☒ Other (specify): Please see departmental challenge policy

☐ PLAR cannot be awarded for this course for the following reason(s):

**TEXTBOOKS, REFERENCES, MATERIALS:** *[Textbook selection varies by instructor. Examples for this course might be:]*

The text is chosen by a departmental curriculum committee.

Recommended texts are:
D. Kammler. 2000. A First Course in Fourier Analysis. Prentice-Hall
T.W. Korner. 1998. Fourier Analysis. Cambridge University Press.
E.M. Stein and R. Shakarchi. 2003. Fourier Analysis. Princeton University Press.
A. Vretblad. 2003. Fourier Analysis and its Applications. Springer-Verlag.

**SUPPLIES / MATERIALS:**

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

| | |
|---|---|
| Assignments | 20% |
| Seminar presentation and research project | 20% |
| Term tests | 20% |
| Final exam | 40% |

Students must achieve at least 40% on the final exam in order to pass this course.

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

1. Periodic functions, Fourier coefficients, differentiation and integration of Fourier series. Proofs of basic properties.
2. Pointwise convergence, summability of Fourier series.
3. Orthogonal functions, mean-square convergence, Parseval equality, Bessel inequality, Hilbert spaces.
4. Fourier transforms, Riemann-Lebesgue Lemma, convolution.
5. Applications chosen from: isoperimetric problem, Poisson summation formula, Weierstrass approximation theorem, etc.
6. Distributions: linear functionals, test functions, Fourier analysis of tempered distributions.
7. Discrete Fourier analysis, Fast Fourier Transform, Fourier analysis on groups.
8. Signal processing: filtering, noise reduction, applications to musical tones.