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| For Academic Affairs and Research Use Only | |
| CIP Code: |  |
| Degree Code: |  |

**New Course Proposal Form**

**[ ] Undergraduate Curriculum Council**

**[X] Graduate Council**

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| **[X] New Course or [ ]Experimental Course (1-time offering) (Check one box)** |

Signed paper copies of proposals submitted for consideration are no longer required. Please type approver name and enter date of approval.

Email completed proposals to [curriculum@astate.edu](mailto:curriculum@astate.edu) for inclusion in curriculum committee agenda.

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| Suzanne Melescue 1/23/2018 **Department Curriculum Committee Chair** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…  **COPE Chair (if applicable)** |
| Amanda Lambertus 7/5/2018 **Department Chair:** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…  **Head of Unit (If applicable)** |
| David F. Gilmore 9/6/2018 **College Curriculum Committee Chair** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…  **Undergraduate Curriculum Council Chair** |
| Anne Grippo 9/6/2018 **College Dean** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…  **Graduate Curriculum Committee Chair** |
| |  |  | | --- | --- | | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Enter date |   **General Education Committee Chair (If applicable)** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Enter date…  **Vice Chancellor for Academic Affairs** |

1. Contact Person (Name, Email Address, Phone Number)

Suzanne Melescue [scmelescue@astate.edu](mailto:scmelescue@astate.edu), x8167 Jeongho Ahn, [jahn@astate.edu](mailto:jahn@astate.edu), x8181

2. Proposed Starting Term and Bulletin Year

Spring 2019

3. Proposed Course Prefix and Number (Confirm that number chosen has not been used before. For variable credit courses, indicate variable range. *Proposed number for experimental course is 9*. )

MATH 5413

4. Course Title – if title is more than 30 characters (including spaces), provide short title to be used on transcripts. Title cannot have any symbols (e.g. slash, colon, semi-colon, apostrophe, dash, and parenthesis). Please indicate if this course will have variable titles (e.g. independent study, thesis, special topics).

Partial Differential Equations

5. Brief course description (40 words or fewer) as it should appear in the bulletin.

A study of the method of separation of variables to solve some standard partial differential equations; Fourier series; boundary value problems; Sturm-Liouville theory; and the method of characteristics

6. Prerequisites and major restrictions. (Indicate all prerequisites. If this course is restricted to a specific major, which major. If a student does not have the prerequisites or does not have the appropriate major, the student will not be allowed to register).

1. **Yes** Are there any prerequisites?
   1. If yes, which ones?

MATH4403 (Differential Equations)

* 1. Why or why not?

Techniques of solving ordinary differential equations (ODEs) are needed in order to solve partial differential equations (PDEs) that have been separated into multiple ODEs.

1. **No** Is this course restricted to a specific major?

7. Course frequency(e.g. Fall, Spring, Summer).

Spring, odd

8. Will this course be lecture only, lab only, lecture and lab, activity, dissertation, experiential learning, independent study, internship, performance, practicum, recitation, seminar, special problems, special topics, studio, student exchange, occupational learning credit, or course for fee purpose only (e.g. an exam)? Please choose one.

Lecture only

9. What is the grade type (i.e. standard letter, credit/no credit, pass/fail, no grade, developmental, or other [please elaborate])

Standard letter

10. **Yes** Is this course dual listed (undergraduate/graduate)?

MATH 5413 is dual listed with the newly proposed undergraduate course MATH 4413.

11. **No** Is this course cross listed?

12. **No** Is this course in support of a new program?

13. **No** Does this course replace a course being deleted?

14. **No** Will this course be equivalent to a deleted course?

15. **Yes** Has it been confirmed that this course number is available for use?

16. **No** Does this course affect another program?

**Course Details**

17. Outline (The course outline should be topical by weeks and should be sufficient in detail to allow for judgment of the content of the course.)

Week 1: Classification of Differential Equations; Derivation of the One-Dimensional Heat Equation; Boundary Conditions

Week 2: Equilibrium Temperature Distribution; Principle of Superposition

Week 3: Separation of Variables for the One-Dimensional Heat Equation with Zero Temperatures at Finite Ends

Week 4: Separation of Variables for the One-Dimensional Heat Equation with Insulated Ends

Week 5: Separation of Variables for Laplace’s Equation in a Rectangle and in a Circular Disk; Mean Value Theorem; Max/Min Principles; Wellposedness

Week 6: Fourier Convergence Theorem; Sketch Fourier Series, Fourier Sine Series, and Fourier Cosine Series; Determine Fourier coefficients

Week 7: Term-by-Term Differentiation of Fourier Series; Method of Eigenfunction Expansion; Term-by-Term Integration of Fourier Series

Week8: Wave Equation: Vibrating Strings and Membranes

Week 9: Sturm-Liouville Eigenvalue Problems; Major Theorems for Regular Sturm-Liouville Eigenvalue Problems

Week 10: Apply Theorems to Examples; Self-Adjoint Operators; Proofs of Major Theorems

Week 11: Boundary Conditions of the Third Kind; Introduction to Higher Dimensional PDEs

Week 12: Multidimensional Eigenvalue Problems; Vibrating Rectangular Membrane; Vibrating Circular Membrane and Bessel Functions

Week 13: Nonhomogeneous Problems; Method of Eigenfunction Expansion

Week 14: Method of Characteristics for Linear Wave Equations

18. Special features (e.g. labs, exhibits, site visitations, etc.)

None

19. Department staffing and classroom/lab resources

None

1. Will this require additional faculty, supplies, etc.?

No. The course has been in the rotation as a special topics subject. Its addition to the bulletin as a regular course will have no impact on department staffing or resources.

20. **No** Does this course require course fees?

**Course Justification**

21. Justification for course being included in program. Must include:

a. Academic rationale and goals for the course (skills or level of knowledge students can be expected to attain)

Understanding connections between mathematics and applied sciences is essential for students who seek careers in industry, government, research, or academia. This course material exposes students to applications that demonstrate connections and includes methods (and the theorems that support them) to solve applied problems.

Course Goals:

* Classify partial differential equations.
* Identify and interpret types of boundary conditions.
* Model using partial differential equations.
* Determine equilibrium temperature distribution.
* Use the method of separation of variables to solve linear homogeneous partial differential equations with various boundary conditions.
* Find the Fourier series, Fourier sine series, and Fourier cosine series representations of a piece-wise smooth function.
* Apply theorems to determine convergence, continuity, differentiability, and integrability of Fourier series.
* Identify a regular Sturm-Liouville eigenvalue problem and apply major theorems.
* Solve Sturm-Liouville eigenvalue problems.
* Solve nonhomogeneous partial differential equations.
* Use the method of characteristic to solve linear first order partial differential equations and the one-dimensional wave equation.
* See how mathematics is used in applied sciences and statistics.

1. How does the course fit with the mission established by the department for the curriculum? If course is mandated by an accrediting or certifying agency, include the directive.

This course provides an elective course for students who seek to major or minor in mathematics.

This course enhances the mission of the Department of Mathematics to “prepare students for a variety of future endeavors and careers in business, industry, government, research, and academia.” This course will require students to

* Employ mathematical terminology and notation accurately.
* Communicate mathematics effectively.
* Read and interpret written material in mathematics effectively.
* Possess the skills to read, interpret, and analyze applied mathematical problems.
* Employ appropriate techniques, methods, and procedures in solving applied mathematical problems.

1. Student population served.

Graduate

The course enhances options for graduate students interested in applied mathematics.

d. Rationale for the level of the course (lower, upper, or graduate).

The course covers topics that require high-level mathematical skill and mathematical maturity and is beneficial to graduate students who are interested in PhD program in applied mathematics and other graduate programs in applied sciences. This course differs from undergraduate section of the course in the following ways. (1) Graduate students will be required to complete a project, which provides a valuable opportunity to develop necessary skills to write a mathematical paper. (2)  Graduate students will apply high-level mathematical tools to real-world application problems.

**Assessment**

**Relationship with Current Program-Level Assessment Process**

22. What is/are the intended program-level learning outcome/s for students enrolled in this course? Where will this course fit into an already existing program assessment process?

Program-level Learning Outcomes:

1. Be able to think analytically and critically and formulate advanced problems, solve them, interpret their solutions, and frame generalizations
2. Be able to communicate advanced mathematics with clarity and effective exposition

The course will be assessed along with other graduate courses.

23. Considering the indicated program-level learning outcome/s (from question #22), please fill out the following table to show how and where this course fits into the program’s continuous improvement assessment process.

*For further assistance, please see the ‘Expanded Instructions’ document available on the UCC - Forms website for guidance, or contact the Office of Assessment at 870-972-2989.*

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| **Program-Level Outcome 1 (from question #22)** | Be able to think analytically and critically and formulate advanced problems, solve them, interpret their solutions, and frame generalizations |
| Assessment Measure | Project; Comprehensive examinations at end of degree program. |
| Assessment  Timetable | This program-level outcome will be assessed each year the course is taught. |
| Who is responsible for assessing and reporting on the results? | Course instructor in coordination with the department assessment committee. |

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| **Program-Level Outcome 2 (from question #22)** | Be able to communicate advanced mathematics with clarity and effective exposition |
| Assessment Measure | Project; Comprehensive examinations at end of degree program |
| Assessment  Timetable | This program-level outcome will be assessed each year the course is taught. |
| Who is responsible for assessing and reporting on the results? | Course instructor in coordination with the department assessment committee. |

**Course-Level Outcomes**

24. What are the course-level outcomes for students enrolled in this course and the associated assessment measures?

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| **Outcome 1** | Classify partial differential equations and types of boundary conditions. |
| Which learning activities are responsible for this outcome? | In class lectures and homework assignments |
| Assessment Measure | Rubric to score course evaluations (homework and exams) |

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| **Outcome 2** | Model using partial differential equations. |
| Which learning activities are responsible for this outcome? | In class lectures and homework assignments |
| Assessment Measure | Rubric to score course evaluations (homework and exams) |

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| **Outcome 3** | Find the Fourier series, Fourier sine series, and Fourier cosine series representations of a piece-wise smooth function. |
| Which learning activities are responsible for this outcome? | In class lectures and homework assignments |
| Assessment Measure | Rubric to score course evaluations (homework and exams) |

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| **Outcome 4** | Solve Sturm-Liouville eigenvalue problems. |
| Which learning activities are responsible for this outcome? | In class lectures and homework assignments |
| Assessment Measure | Rubric to score course evaluations (homework and exams) |

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| **Outcome 5** | Employ theories and techniques within a real-world application problem. |
| Which learning activities are responsible for this outcome? | Course project |
| Assessment Measure | Rubric to score project |

*(Repeat if needed for additional outcomes)*

**Bulletin Changes**

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| **Instructions** |
| **Please visit** [**http://www.astate.edu/a/registrar/students/bulletins/index.dot**](http://www.astate.edu/a/registrar/students/bulletins/index.dot) **and select the most recent version of the bulletin. Copy and paste all bulletin pages this proposal affects below. Follow the following guidelines for indicating necessary changes.**  **\*Please note: Courses are often listed in multiple sections of the bulletin. To ensure that all affected sections have been located, please search the bulletin (ctrl+F) for the appropriate courses before submission of this form.**  - Deleted courses/credit hours should be marked with a red strike-through (~~red strikethrough~~)  - New credit hours and text changes should be listed in blue using enlarged font (blue using enlarged font).  - Any new courses should be listed in blue bold italics using enlarged font (***blue bold italics using enlarged font***)  *You can easily apply any of these changes by selecting the example text in the instructions above, double-clicking the ‘format painter’ icon 🡪 , and selecting the text you would like to apply the change to.*  *Please visit* [*https://youtu.be/yjdL2n4lZm4*](https://youtu.be/yjdL2n4lZm4) *for more detailed instructions.* |

**MATH 5123. Special Topics in Math and Science Education** Content-specific topics as they are related to mathematics and Science education. Does NOT apply to credit toward coursework required for the MS or MSE in Mathematics.

**MATH 5413. Partial Differential Equations** A study of the method of separation of variables to solve some standard partial differential equations; Fourier series; boundary value problems; Sturm-Liouville theory; and the method of characteristics. Prerequisite: MATH 4403

**MATH 5423. Modern Algebra II** A continuation of MATH 3303. Prerequisite: MATH 3303.

**MATH 5513 Applied Mathematics** A study of topics from ordinary and partial differential equations, vector analysis, and functions of a complex variable, with physical applications. Prerequisite: MATH 3254.

**MATH 5533. Numerical Methods** Algebraic, transcendental, ordinary and partial differential equations, finite differences, and integral equations. Numerical integration, error analysis, and/or other topics of numerical analysis utilizing high speed computer techniques. Prerequisites: MATH 2214 and a high level programming language.

**MATH 5553. Advanced Calculus I** The calculus of one and of several variables. Limits, continuity, sequences, differentiation, partial differentiation, integration, and infinite series. Prerequisite: MATH 3254.

**MATH 5563. Advanced Calculus II** A continuation of MATH 5553. Prerequisite: MATH 4553.