Course Number: PHZ 3113  
Prerequisite(s): MAC 2313  
Course Credit: 3  
College: Arts and Sciences  
Department: Physics  
Course Title: MATHEMATICAL METHODS OF PHYSICS I  
Course Hours: 12:30PM-1:45PM Tue, Thu  
Supplies: NA  
Faculty Name: Khankhasayev, Mikhail  
Term and Year: Spring 2010  
Place and Time: Jones Hall 211F  
Office Location: FHSRC 418  
Telephone: 850-599-8462  
e-mail: Mikhail.khankhasayev@famu.edu  
Office Hours:  
Monday 2:00 – 3:00PM  
Tuesday 2:00 – 3:00PM  
Wednesday 2:00 – 3:00PM  
Thursday 2:00 – 3:00PM  
Friday 2:00 – 3:00PM  
Saturday  

Course Description
This is an Advance Physics course design to give students a understanding the applications of Mathematics to topics such as: Vector and tensor Analysis, matrices and determinants, vector differential calculus, line surface integrals, ordinary and partial differential equations, and Fourier series and integrals.

Course Purpose
The course is to help students and prospective teachers to:
A. Present of physics applications orally and in writing.
B. Extract information from physics text through analytic reading.
C. Calculate and interpret the results of various physics problems.
D. Solve real world engineering problems using physics principles.
E. Develop models of physical problems.
F. Collaborate effectively with team members.
G. Solve problems through skilled time management.

STATE AND NATIONAL PROFESSIONAL STANDARDS FOR TRAINING
This course adheres to guidelines of the National Science Education Standards (NSES) (National Research Council (NRC), 1996), and the National Science Teachers Association (NSTA) Standards for Science Teacher Preparation. The conceptual framework, which guides the work for this course, is the Integrated Model.

F=Florida Educator Accomplished Practices Standards (FEAPS)  
I=Interstate New Teacher Assessment and Support Consortium Standards (INTASC)  
(K)=Knowledge (S)=Skill (D)=Disposition
In response to Florida’s demand for accountability from their public schools, the 1997 State Legislature created the Florida System of School Improvement and Accountability, which is designed to improve student performance. The Physics Department, in response to this initiative, strives to make a positive impact by ensuring that it produces high quality professional specialists in physics education who are committed to improving student performance and who will assist students in meeting the Florida Sunshine State Standards. The Physics Department Physics Education program endeavors to provide a quality program through the implementation of an integrated curriculum based on the guidelines and competencies aligned with the Florida Sunshine State Standards, Florida Accomplished Practices, Florida Adopted Subject Area Competencies, and those guidelines and standards from other learned societies and professional organizations.

The Conceptual Framework in the Professional Education Unit at Florida A&M University’s College of Education is an integrated approach to providing educational experiences that result in exemplary professional educators. The Framework is comprised of many activities and themes with the mission of developing high quality classroom teachers, administrators and support personnel. The term “exemplary” refers to the kind of graduates the unit strives to produce. Figure 1 provides a diagram of the Exemplary Professional Conceptual Framework:

The Unit’s Conceptual Framework is consistent with and complements the College of Education and the University’s Mission statements. The shared vision of the Professional Education Unit is to prepare exemplary professionals who are able to go into the educational institutions of Florida, the nation and the world armed with knowledge, skills, and dispositions that will facilitate learning for students, support interactions and partnerships with community stakeholders, and engender on-going professional development for themselves and others. The conceptual framework provides direction for programs, courses, teaching, candidate performance, scholarship, service, and Unit accountability.

The Physics Education Program at Florida A&M University is committed to training professionals who have expertise in the depth and diversity of both in physics and education.

**CONCEPTUAL FRAMEWORK**

The Conceptual Framework in the Professional Education Unit (PEU) at Florida A&M University is an integrated approach to providing educational experiences that result in exemplary professional educators. The Framework is comprised of six themes with the mission of developing high quality classroom teachers, administrators and support personnel. The term “exemplary” refers to the kind of graduates the PEU strives to produce. The figure below provides a diagram of the Exemplary Professional Conceptual Framework.

**CRITICAL THINKING**

**CF4**

Through this focal area, the FAMU professional education candidate will:

| CF: 4.5 (S) | Demonstrate the use of higher order thinking skills. | F: 4 | I: 4 |

**PROFESSIONALISM**

**CF 5**

Through this focal area, the FAMU professional education candidate will:

| CF: 5.1 (K) | Know the content | F: 8 | I: 1 |

**NATIONAL AND STATE STANDARDS ADDRESSED IN THE COURSE**

F=Florida Educator Accomplished Practices Standards (FEAPS)
I=Interstate New Teacher Assessment and Support Consortium Standards (INTASC)
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Interstate New Teacher Assessment and Support Consortium (INTASC) Standards

**Standard 1: Subject Matter:** The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students.

1.10 **Knowledge**
1.12 The teacher understands how students' conceptual frameworks and their misconceptions for an area of knowledge can influence their learning.

1.13 The teacher can relate his/her disciplinary knowledge to other subject areas.

1.20 **Dispositions**
1.24 The teacher is committed to continuous learning and engages in professional discourse about subject matter knowledge and children's learning of the discipline.

1.30 **Performances**
1.35 The teacher develops and uses curricula that encourage students to see, question, and interpret ideas from diverse perspectives.

**Standard 4: Instructional Strategies:** The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills.

4.10 **Knowledge**
4.11 The teacher understand the cognitive processes associated with various kinds of learning (e.g. critical and creative thinking, problem structuring and problem solving, invention, memorization and recall) and how these processes can be stimulated.

4.12 The teacher understands the principles and techniques, along with advantages and limitations, associated with various instructional strategies (e.g. cooperative learning, direct instruction, discovery learning, whole group discussion, independent study, interdisciplinary instruction).

4.13 The teacher knows how to enhance learning through the use of a wide variety of materials as well as human and technological resources (e.g. computers, audio-visual technologies, videotapes and discs, local experts, primary documents and artifacts, texts, reference books, literature, and other print resources).

4.20 **Dispositions**
4.21 The teacher values the development of students' critical thinking, independent problem solving, and performance capabilities.

4.23 The teacher values the use of educational technology in the teaching and learning process.

4.30 **Performances**
4.31 The teacher carefully evaluates how to achieve learning goals, choosing alternative teaching strategies and materials to achieve different instructional purposes and to meet student needs (e.g. developmental stages, prior knowledge, learning styles, and interests).

4.33 The teacher constantly monitors and adjusts strategies in response to learner feedback.

4.34 The teacher varies his or her role in the instructional process (e.g. instructor, facilitator, coach, audience) in relation to the content and purposes of instruction and the needs of students.

4.36 The teacher uses educational technology to broaden student knowledge about technology, to deliver instruction to students at different levels and paces, and for advanced levels of learning.

**Standard 8: Assessment:** The teacher understands and uses formal and informal assessment strategies to evaluate and ensure the continuous intellectual, social and physical development of the learner.

8.10 **Knowledge**

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8.11 The teacher understands the characteristics, uses, advantages, and limitations of different types of assessments (e.g. criterion-referenced and norm-referenced instruments, traditional standardized and performance-based tests, observation systems, and assessments of student work) for evaluating how students learn, what they know and are able to do, and what kinds of experiences and technology will support their further growth and development.

8.12 The teacher knows how to select, construct, and use assessment strategies, technology and instruments appropriate to the learning outcomes being evaluated and to other diagnostic purposes.

8.13 The teacher understands measurement theory and assessment-related issues, such as validity, reliability, bias, and scoring concerns.

8.20 Dispositions
8.21 The teacher values ongoing assessment as essential to the instructional process and recognizes that many different assessment strategies, accurately and systematically used, are necessary for monitoring and promoting student learning.

8.22 The teacher is committed to using assessment to identify student strengths and promote student growth rather than to deny students access to learning opportunities.

8.30 Performance
8.31 The teacher appropriately uses a variety of formal and informal assessment techniques (e.g. observation, portfolios of student work, teacher-made tests, performance tasks, projects, student self-assessments, peer assessment, and standardized tests) to enhance her or his knowledge of learners, evaluate student's progress and performances, and modify teaching and learning strategies.

8.32 The teacher solicits and uses information about students' experiences, learning behavior, needs, and progress from parents, other colleagues, and the students themselves.

8.33 The teacher uses assessment strategies to involve learners in self-assessment activities, to help them become aware of their strengths and needs, and to encourage them to set personal goals for learning.

8.34 The teacher evaluates the effect of class activities on both individuals and the class as a whole, collecting information through observation of classroom interactions, questioning, and analysis of student work.

8.35 The teacher monitors her/his own teaching strategies and behavior in relation to student success, modifying plans and instructional approaches accordingly.

8.36 The teacher maintains useful records of student work and performance and can communicate student progress knowledgeably and responsibly, based on appropriate indicators, to students, parents/guardians, and other colleagues.

Standard 9: Reflection and Professional Development: The teacher is a reflective practitioner who continually evaluates the effects of her/his choices and actions on others (students, parents, and other professionals in the learning community) and who actively seeks out opportunities to grow professionally.

9.10 Knowledge
9.11 The teacher understands the historical and philosophical foundations of education.

9.12 The teacher understands methods of inquiry that provide him/her with a variety of self-assessment and problem solving strategies for reflecting on his/her practice, its influences on students' growth and learning, and the complex interactions between them.

9.13 The teacher is aware of major areas of research on teaching and of resources available for professional learning (e.g. professional literature, colleagues, professional associations, professional development activities).

9.20 Dispositions
9.21 The teacher values critical thinking and self-directed learning as habits of mind.

9.22 The teacher is committed to reflection, assessment, and learning as an ongoing process.

9.23 The teacher is willing to give and receive help.

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9.24 The teacher is committed to seeking out, developing, and continually refining practices that address the individual needs of students.

9.25 The teacher recognizes her/his professional responsibility for engaging in and supporting appropriate professional practices for self and colleagues.

**9.30 Performance**

9.31 The teacher uses classroom observation, information about students, and research as sources for evaluating the outcomes of teaching and learning and as a basis for experimenting with, reflecting on, and revising practice.

9.32 The teacher seeks out professional literature, colleagues, and other resources to support her/his own development as a learner and a teacher.

9.33 The teacher draws upon professional colleagues within the school and other professional arenas as supports for reflection, problem-solving and new ideas, actively sharing experiences and seeking and giving feedback.

**Standard 10: Collaboration, Ethics, and Relationships:** The teacher communicates and interacts with parents/guardians, families, school colleagues, and the community to support students' learning and well-being.

**10.10 Knowledge**

10.11 The teacher understands schools as organizations within the larger community context and understands the operations of the relevant aspects of the system(s) within s/he works.

10.12 The teacher understands how factors in the students' environment outside of school (e.g. family circumstances, community environments, health and economic conditions) may influence students' life and learning.

10.13 The teacher understands and implements laws related to student's rights and teacher responsibilities (e.g. for equal education, appropriate education for students with disabilities, confidentiality, privacy, appropriate treatment of students, reporting in situations related to possible child abuse).

**10.20 Dispositions**

10.21 The teacher values and appreciates the importance of all aspects of a child's experience.

10.22 The teacher is concerned about all aspects of child's well-being (cognitive, emotional, social, and physical), and is alert to signs of difficulties.

10.23 The teacher respects the privacy of students and confidentiality of information.

10.24 The teacher is willing to consult with other adults regarding the education and well-being of her/his students.

10.25 The teacher is willing to work with other professionals to improve the overall learning environment for students.

**10.30 Performances**

10.31 The teacher participates in collegial activities designed to make the entire school a productive learning environment.

10.32 The teacher makes links with the learners' other environments on behalf of students, by consulting with parents, counselors, teachers of other classes and activities within the schools, and professionals in other community agencies.

10.33 The teacher can identify and use community resources to foster student learning.

10.34 The teacher establishes respectful and productive relationships with parents and guardians from diverse home and community situations, and seeks to develop cooperative partnerships in support of student learning and well being.

10.35 The teacher talks with and listens to the student, is sensitive and responsive to clues of distress, investigates situations, and seeks outside help as needed and appropriate to remedy problems.

10.36 The teacher acts as an advocate for students.

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Florida Educator Accomplished Practices (FEAP)

4. Uses appropriate techniques and strategies, which promote and enhance critical, creative, and evaluative thinking capabilities of students. CRITICAL THINKING
8. Demonstrates knowledge and understanding of the subject matter. SUBJECT MATTER KNOWLEDGE

Competencies and Skills required for Teacher Certification in Florida (FTCE)

1. Knowledge of Nature of Scientific Investigation and Instruction In Physics
   1.4 Relate the historical development of the major concepts, models, and investigations in physics to current knowledge (e.g., force and motion, conservation principles, fields, quantum theory).
   1.5 Distinguish between scientific theories and laws in terms of their specific roles and functions.

2. Knowledge of the Mathematics of Physics
   2.1 Determine the validity of a formula based on dimensional analysis.
   2.2 Combine vectors using graphic and trigonometric methods.
   2.3 Determine the dot product and cross product of two vectors.
   2.4 Convert between units of a given quantity (e.g., length, area, volume, mass, time, temperature).
   2.5 Identify prefixes in the metric system and standard units of measure (e.g., newtons, meters, kilowatt-hours, teslas, electron volts, calories, horsepower).
   2.6Estimate the order of magnitude of a physical quantity.
   2.7 Interpret the slope of a graph or area under the curve in relation to physical concepts.
   2.8 Apply the concepts of accuracy, precision, uncertainty, and significant figures to measurements and calculations.

6. Knowledge of electricity and magnetism
   6.1 Determine the electric force on a point charge due to one or more other charges.
   6.2 Determine the electric potential difference between two points in an electric field.
   6.5 Apply Gauss's law to determine or characterize an electric field.
   6.6 Analyze charge distributions in conductors and nonconductors.
   6.12 Analyze problems involving the direction and magnitude of the magnetic force acting on moving charges (e.g., mass spectrometer).
   6.16 Predict the magnetic fields associated with current-carrying conductors (e.g., long straight wires, loops, solenoids).

National Science Teachers Association Standards (NSTA)

1. Understand and can successfully convey to students the major concepts, principles, theories, laws and interrelationships of their fields of licensure and supporting fields as recommended by the National Science Teachers Association. (NSTA 1.0a)
2. Use multiple assessment tools and strategies to achieve important goals for instruction that are aligned with methods of instruction and needs of students. (NSTA 8.0a)
3. Reflect constantly upon their teaching and identify ways and means through which they may grow professionally (NSTA 10.0b)

Professional Organization/Learned Society Standards

National Society of Science Teachers Association; American Association of Physics Teachers
Florida Teacher Certification Examination (FTCE) Subject Area Examination (SAE) Competencies and Skills
American Physics Society (APS)
National Society of Black Physicists (NSBP)

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<table>
<thead>
<tr>
<th>Assignment</th>
<th>Behavioral objectives</th>
<th>INTASC Standards</th>
<th>NSTA For Teachers of Physics</th>
<th>FEAPs</th>
<th>FTCE SAE</th>
<th>PEU Conceptual Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework # 1</td>
<td>Students will 1. Demonstrate knowledge of the lecture material, and 2. Develop and enhance the skill of analytical analysis and problem solving</td>
<td>1.10, 4.10, 8.10</td>
<td>1C.5: 2.0; 1.5.b:14.0; 1.5.c.: 26.0</td>
<td>4.1: 4.a,4.b; 8.1:8.a,8b.</td>
<td>2.1 - 2.8; 6.1; 6.2; 6.12; 6.13</td>
<td>CF 4.5(S), CF 5.1(K),</td>
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<tr>
<td>Homework # 2</td>
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<td>Homework # 7</td>
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<tr>
<td>Review</td>
<td>Each homework assignment will address course content and is aimed at development problem solving skills.</td>
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<td></td>
<td>Four tests will given: Test # 1: Vector Analysis; Test # 2: Tensor, Determinants, and Matrices Test # 3: Group Theory and Infinite Series Test # 4: Functions of a Complex Variables I Final Exam is cumulative</td>
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<td></td>
<td>Students will demonstrate knowledge (Chapters 1-16) and problem solving skill attaining a grade of 70% or higher.</td>
<td>1.10, 4.10, 8.10</td>
<td>1C.5: 2.0; 1.5.b:14.0; 1.5.c.: 26.0</td>
<td>4.1: 4.a,4.b; 8.1:8.a,8b.</td>
<td>2.1 - 2.8; 6.1; 6.2; 6.12; 6.13</td>
<td>CF 4.5(S), CF 5.1(K),</td>
</tr>
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Artifacts

<table>
<thead>
<tr>
<th>Standards</th>
<th>Name of the Artifact 1</th>
<th>Name of the Artifact 2</th>
<th>Name of the Artifact 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEU CF</td>
<td>Problem Set (10 problems) on Vector Analysis</td>
<td>Problem Set (10 problems) on Tensors and Determinants</td>
<td>Problem Set (10 problems) on Functions of Complex Variable</td>
</tr>
<tr>
<td>FEAP</td>
<td>CF 5.1(K), CF 4.5(S)</td>
<td>CF 5.1(K), CF 4.5(S)</td>
<td>CF 5.1(K), CF 4.5(S)</td>
</tr>
<tr>
<td>INTACS</td>
<td>1.10, 4.10, 8.10</td>
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<td>1.10, 4.10, 8.10</td>
</tr>
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<td>1C.5: 2.0; 1.5.b:14.0; 1.5.c: 26.0</td>
<td>1C.5.b: 26.0</td>
<td>1C.5.c: 26.0</td>
</tr>
<tr>
<td>FTCE SAE</td>
<td>2.1 – 2.3</td>
<td>2.1 - 2.3</td>
<td>2.1 - 2.8</td>
</tr>
</tbody>
</table>

Topical Outline

- Week 1,2,3,4 Vector Analysis
- Week 5,6 Vector Analysis in Curved Coordinates and Tensor
- Week 7,8 Determinants and Matrices
- Week 9,10 Group theory
- Week 11,12 Infinite Series
- Week 13,14,15 Functions of a Complex Variables I
- Week 16 Review

Tentative Course Calendar

1st Class meeting ------------------------------- 8/23
Week 5, Sept 21 ------------------------ TEST #1
Week 9, Oct 14 ------------------------ TEST #2
Week 12, Nov 4 ------------------------ TEST #3
Week 16, Nov 30 ------------------------ TEST #4

HOLIDAYS
Labor Day ------------------------------- 9/6
Veterans Day ------------------------------- 11/11
Thanksgiving ------------------------------- 11/25-11/26

Last Day to Withdrawal ------------------------ 10/29
Last Day of Classes ------------------------------- 12/3
Final Exam ------------------------------- 12/6

Teaching Methods

During lecture mathematical theory and concepts will be explain with physics sample problems to reinforce the understanding of subject. Given the nature of the subject it is to student responsibility to attend class. Solving

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problems is vital part of learning physics, at the end of each chapter, problems will be assigned. All assignments will be due on the due date. A week after the assignments is given. Absolute no late assignments will be accepted.

**Course Evaluation**

**Homework Assignments:** Problems from each section of the text will assigned each class. Unless otherwise stated they will be due one week after being assigned. Each homework assignment will address course content and is aimed at increasing your problem solving skills.

**Class Participation and Student Led Discussions:** Participation in class will be monitored and counts towards each student's grade.

**Course Examinations/ Final Examination:** There will be four (4) in-class Tests and a Final Exams. These tests will be given to assess your content knowledge on major concepts, theorems and problem solving skills.

**Methods of Evaluations**

- 4 TEST ( each of 10 points)----------------------------- 40 points
  Test # 1
  Week 1,2,3  Vector Analysis  
  Week 4,5  Vector Analysis in Curved Coordinates and Tensor
  Test # 2
  Week 6,7  Tensor, Determinants  
  Week 7,8  Matrices
  Test # 3
  Week 10,11  Group Theory  
  Week 12  Infinite Series
  Test # 4
  Week 13,14,15  Functions of a Complex Variables I
  Week 16  Review

- 6 Homework ------------------------------------------- 30 points
  Homework # 1  Vector Analysis
  Homework # 2  Vector Analysis in Curved Coordinates and Tensor
  Homework # 3  Determinants and Matrices
  Homework # 4  Group theory
  Homework # 5  Infinite Series
  Homework # 6  Functions of a Complex Variables I

- 1 Final Exam ------------------------------------------ 30 points
  100 points

**Grading**

100 - 90 = A  
98 - 80 = B  
79 – 70 = C  
69 – 60 = D  
< 59 = F

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Course Policies

ATTENDANCE:
Given the nature of the subject it is to student responsibility to attend class. Each Student is expected to be prepared. Prepared means have text and any supplemental reading distributed, Ready to listen because “if you are not listening you are not learning”.

WITHDRAWAL FROM CLASS WITHOUT PENALTY OF “F”

To withdrawal from class, you must fill out and return in to the records office a drop form on or prior the midterm date listed on the front of the syllabus. If you stop coming to class without going to the proper withdrawal procedure will result in the assignment of a grade of “F” for the semester.

ASSIGNMENT OF AN INCOMPLETE “I”

An “I” will be assigned only to students, who fail to complete the course due to illness, Injury or other non-academic emergency. Only those students who were doing satisfactory work will be eligible for the “I” grade. An “I” must be satisfactorily removed during the following academic quarter or the symbol “I” will be changed to “F” by the Records office. In unusual circumstances, an instructor may extend an incomplete beyond the one-quarter deadline – not to exceed a total of three consecutive calendar quarters. In order to remove an “I”, student will not be permitted to re-register for the course.

Please contact me if you should have extended illness or some other unavoidable non-academic emergencies.

ACADEMIC DISHONESTY:

Cheating may consist of stealing someone else’s answer on an exam to using notes of a “crib” sheet during exam. Should cheating be detected you will receive a zero on the given exam. Plagiarism may consist by presenting the work of others as your own work. Same as cheating, it will be penalized with a zero on the assignment.

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