COURSE SPECIFICATION

Mathematical Physics

Phy-251

2013-14

Course Specification

Institution :*King Khalid University, Abha, Kingdom of Saudi Arabia*
College/Department : *College of Science, Department of Physics*

A Course Identification and General Information

1. Course title and code: ***Mathematical Physics (Phy-251)***
2. Credit hours: *3 (Per week)*
3. Program(s) in which the course is offered. (If general elective available in many programs indicate this rather than list programs) • *B.Sc. (Physics)*
4. Name of faculty member responsible for the course: 1. ***Dr. Mohammad Ajmal Khan***
5. Level/year at which this course is offered: *Level-4*
6. Pre-requisites for this course (if any): *None*
7. Co-requisites for this course (if any): *None*
8. Location if not on main campus: *Not applicable*

B Objectives

1. Summary of the main learning outcomes for students enrolled in the course.

The purpose of this course is to teach the students fundamentals of mathematical methods in physical sciences. After completion of this course, students will have the knowledge of following;

1. *Complex Numbers*
2. *Linear Algebra*
3. *Fourier Series and Transforms*
4. *Ordinary differential equation*

2. Briefly describe any plans for developing and improving the course that are being implemented. (e.g. increased use of IT or web based reference material, changes in content as a result of new research in the field)

- *The course contents will be periodically reviewed by the Course Committee to include new materials of relevance and to improved teaching method.*
- *We have dedicated computational physics lab in our department. Now, we are planning to introduce some mathematical software (e.g. Mathmatica)to enhance the mathematical skills of the students and provide them better understanding of the mathematical methods used in physic.*

C. Course Description (Note: General description in the form to be used for the Bulletin or Handbook should be attached)

1 Topics to be Covered

Topic	**No of Weeks**	**Contact hours**
Unit 1: Complex Numbers *Introduction, Real and Imaginary Parts of a Complex Numbers, The Complex Plane, Terminology and Notation, Complex Algebra, Eulers Formula, Power and Roots of Complex Numbers, The Exponential and Trigonometric Functions, Hyperbolic Functions, Logarithms, Complex Roots and Powers, Inverse Trigonometric and Hyperbolic Functions.*	03	09
Unit 2: Linear Algebra *Introduction, Matrices; Row reduction, Determinants; Cramer's Rule, Matrix Operations, Linear Combinations, Linear Functions, Linear Operators, Linear Dependence and Independence, Special Matrices and Formulas, Eigenvalues and Eigenvectors, Diagonalizing Matrices.*	03	09
Unit 3: Fourier Series and Transforms *Introduction, Simple Harmonic Motion and Wave Motion; Periodic Functions, Application of Fourier Series, Average Value of a Function, Fourier Coefficients, Drichlet Conditions, Complex form of a Fourier Series, Other Intervals, Even and Odd Functions, An Application to Sound, Parseval's Theorem*	04	12
Unit 4: Ordinary Differential Equations *Introduction, Separable Equations, Linear First Order Equations, Other Methods for First-Order Equations, Second Order Linear Equations With Constant Coefficients and Zero Right-Hand Side, Second Order Linear Equations With Constant Coefficients and Right-Hand Side Not Zero, Other Second Order Equations.*	04	12

2 Course components (total contact hours per semester):

Lecture:	**Tutorial:**	**Practical/Fieldwork/Internship:**	Other:
42 hours/semester	*N.A.*	*N.A.*	

3. Additional private study/learning hours expected for students per week. (This should be an average: for the semester not a specific requirement in each week)

28 hours/semester

4. Development of Learning Outcomes in Domains of Learning

for each of the domains of learning shown below indicate:

- A brief summary of the knowledge or skill the course is intended to develop;
- A description of the teaching strategies to be used in the course to develop that knowledge or skill;
- The methods of student assessment to be used in the course to evaluate learning outcomes in the domain concerned.

a. Knowledge

(i) Description of the knowledge to be acquired

This course covers fundamentals of mathematical methods in physical science. It covers Complex Numbers, Linear Algebra, Fourier Series and Transforms and Ordinary Differential Equations. A part of this course also deals with problems related to different areas of physics like Thermodynamics, Electricity & Magnetism, Waves and Sound, Quantum Mechanics etc.

(ii) Teaching strategies to be used to develop that knowledge

- *Structured course materials delivered through a sequential delivery of lectures, with an introductory lecture focusing on the significance of the course.*
- *Interactive learning process through questions and answers in class.*
- *Practice problem sheets to help the students to understand concepts of basic mathematical methods applied in physical sciences.*

(iii) Methods of assessment of knowledge acquired

- *Exams and homework are used to assess the acquired knowledge on the subject.*
- *Short quizzes at the end of each topic are used to evaluate the student understanding*.

b. Cognitive Skills

(i) Cognitive skills to be developed

- *Students will be able to apply the knowledge which they have acquired in this course, in solving problems of Quantum Mechanics, Advanced*

Mathematical Physics, Solid State Physics, Thermodynamics etc in higher level courses.

- *\Students will be able to apply acquired knowledge from this course to real world science and engineering problems.*

(ii) Teaching strategies to be used to develop these cognitive skills

- *Lectures are followed by numerous examples, some of which are practical in nature, to illustrate the applications.*
- *Engage students in classroom interaction with questions and answers.*
- *Practice problems are given to increase their understanding of the subject.*
- *To increase the understanding of the subjects, students are encouraged to solve the unsolved problems given in the books.*

(iii) Methods of assessment of students cognitive skills

- *Exams and homework will include problems, solution of which requires critical and original thinking and identification of correct and optimum method to find the solution.*

c. Interpersonal Skills and Responsibility

(i) Description of the interpersonal skills and capacity to carry responsibility to be developed

- *Punctual attendance of classes.*
- *Student will take the responsibility to solve given assignments on their own and submit the solution on time.*
- *Students learn to manage their time in self study of the course materials.*

(ii) Teaching strategies to be used to develop these skills and abilities

- *Assignment is given to the students at regular intervals for them to solve and submit. 10% of the final grade is allocated to the assignments. Late or no submission of assignments carries penalties or loss of grade points.*
- *At the starting of each lecture, questions related to the topic that was taught on the last lecture are asked and students are always encouraged to participate in classroom discussions.*

(iii) Methods of assessment of students interpersonal skills and

capacity to carry responsibility

- *Class attendance of students at the beginning of the lecture is recoded.*
- *Regular evaluation of acquired knowledge by assignment, quizzes and group tasks*.

d. Communication, Information Technology and Numerical Skills

(i) Description of the skills to be developed in this domain.

- *Mathematical softwares will be extensively used to impart in-depth knowledge of the subject.*
- *Ability of the students to apply basic knowledge of Mathematical Methods in computing and Use of computer in problem solving exercises.*

(ii) Teaching strategies to be used to develop these skills

- *Questions of tests and assignments require students' knowledge in Basic Mathematical Methods for solving problems.*

(iii) Methods of assessment of students numerical and communication skills

- *Through the students' aggregate score in all tests and assignments.*

e. Psychomotor Skills (if applicable)

(i) Description of the psychomotor skills to be developed and the level of performance required.

Not Applicable

(ii) Teaching strategies to be used to develop these skills

NA

(iii) Methods of assessment of students psychomotor skills

NA

5. Schedule of Assessment Tasks for Students During the Semester

Assessment	**Assessment task (e.g. essay, test, group project, examination etc.)**	**Week due**	**Proportion of Final Assessment**
1.	*Home Assignments & quizzes*	*Weekly basis*	*10%*
2.	*First mid-term exam*	*Within the sixth week*	*20%*
3.	*Second mid-term exam*	*Within the twelfth week*	*20%*
4.	*Final Exam*	*End of semester*	*50%*

D. Student Support

1. Arrangements for availability of faculty for individual student consultations and academic advice. (include amount of time faculty are available each week)

- *Weekly work-load of every faculty includes 10 hours of office hours meant for individual students consultation. students are encouraged to consult the teacher in case of any problem related to the lectures/Assignment/Home-Work/Exercises.*

E. Learning Resources

1. Required Text(s)

1. Mathematical Methods in the Physical Sciences
Mary L. Boas
Publisher: Wiley International Edition
ISBN-0-471-19826-0

2. Essential References

1. ***Fundamentals of Mathematical Physics (Dover Books on Physics)***
   Edgar A. Kraut
   ISBN: 0486458091
   Publisher: Dover Publication (Reprint of the McGraw-Hill, Inc., New York, 1967 edition)

2. **Mathematical Methods for the Physical Sciences: An Informal Treatment for Students of Physics and Engineering**
   K. F. Riley
   ISBN: 0 521 20390 2
   Cambridge University Press

3- Recommended Books and Reference Material (Journals, Reports, etc) (Attach List)

4-.Electronic Materials, Web Sites etc

1. http://people.uncw.edu/hermanr/phy311/MathPhysBook/index.htm
2. http://physics.syr.edu/~trodden/courses/mathmethods/

5- Other learning material such as computer-based programs/CD, professional standards/regulations:

F. Facilities Required

Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access etc.)

1. Accommodation (Lecture rooms, laboratories, etc.)
   - *Lecture room and laboratory* ***(Sufficient)***
   - *Lab and lecture room should be equipped with required teaching aids; LCD projector, whiteboard, internet connection etc.*

3. Computing resources

The subject lab should be equipped with computers, which should have the configuration that must be sufficient to install and operate the subject related software.

3. Other resources (specify --e.g. If specific laboratory equipment is required, list requirements or attach list)

G. Course Evaluation and Improvement Processes

1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching • *Student course evaluation at the conclusion of the course*
2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department • *Faculty assessment of the course and effectiveness of teaching delivery.* • *Periodic self- assessment of the program*.
3 Processes for Improvement of Teaching • *Course Committee will review deficiencies based on the student evaluation, faculty input, course file, and program assessment.* • *Feedback from employers and alumni surveys and graduating students' input are used to identify any deficiencies in students' ability in applying knowledge of Basic Mathematical Methods.* • *Organize workshop on effective teaching methods to enable instructors to improve their teaching skill.* • *Teaching method will focus on students' learning and on course learning outcomes.*
4. Processes for Verifying Standards of Student Achievement (e.g. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution) • *Course Committee will review samples of student work in this course to check on the standard of grades and achievements.* • *A faculty member from another university will evaluate the course material and the students' work to compare the standard of grades and achievements with those at his university*.
5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. • *To monitor the quality of course content keeping the modern requirement in mind, it is required to organize syllabus designing workshop every alternate year. Participants in the workshop should be from the scientific industry and subject experts from the other universities. Recommendations of the experts and industry people should be taken into consideration to revise the syllabus.*