PHY 405 – Mathematical Methods in Physics I

COURSE PARTICULARS

Course Code: PHY 405
Course Title: Mathematical Methods in Physics I
No. of Units: 3
Course Duration: Three hours of theory per week for 15 weeks.
Status: Compulsory
Course Email Address: oladelea970@gmail.com
Course Webpage: http://www.fwt.futa.edu.ng/courseschedule.php?coursecode=PHY%20405
Prerequisite: IMC 209

COURSE INSTRUCTOR

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COURSE DESCRIPTION

This course is designed to provide the mathematical skills needed by physics students to de well in their career. It consists of training topics in linear algebra and functional analysis such as transformation in linear vector space and matrix theory, Hilbert space and complete sets of orthogonal functions, etc. Special function of mathematical physics such as the gamma function, hyper-geometric functions, Legendre functions, Bessel functions, Hermite and Laguerre functions and Dirac Delta function are given prominence. A part of the course treats Integral transforms, Fourier Series and Fourier transforms as well as Laplace transform. The last part of the course is devoted to applications of transform methods to the solution of elementary differential equations of interest (especially initial-value problems) in Physics and Engineering.

COURSE OBJECTIVES

The objectives of this course are to:

- introduce students to the use of mathematical methods to solve physics problems; and
- provide students with basic skills necessary for the application of mathematical methods in physics

COURSE LEARNING OUTCOMES / COMPETENCIES

Upon completion of this course, students should be able to:

(Knowledge based)

- identify various types of matrices and explain how one type of matrix differs from another;
- explain the differences between matrices and determinants;
- identify different special mathematical functions;
- explain linear dependence and linear combination of vectors as quantities in physics;
- differentiate between Fourier transform and Laplace transform.

(Skills)

- use matrices and determinants to solve sets of simultaneous linear equations arising from physical problems;
- apply special mathematical function appropriately in solving problems in physics;
- use Fourier transform to obtain the Fourier series of periodic functions in physics; and
- apply transform methods to solve elementary differential equations of interest in physics and engineering.

GRADING SYSTEM FOR THE COURSE

This course will be graded as follows:

Assignments	10%
Test(s)	20%
Final Examination	70%
TOTAL	**100%**

GENERAL INSTRUCTIONS

Attendance: Every student is expected to be in class for all lectures. Attendance records will be kept and used to determine each student's qualification to write the examination for the course at the end of the semester. In case of illness or other unavoidable cause of absence from lecture, affected student must communicate as soon as possible with course lecturer, indicating the reason for the absence.

Academic Integrity: Infringements of academic integrity, including lying and cheating in assignments, tests, examinations, or other academic performances are not allowed. Some cases of academic dishonesty may be reported to the University Management for appropriate punishment as spelt out in the Students' and University Handbooks.

Assignments and Group Work: Students are expected to honour deadlines on submission of assignments and group works. A student who fails to submit an assignment, as at when due, will be scored zero for the assignment. Late submission of assignments will only be tolerated when a student notifies the course lecturer latest on the deadline date/day.

Code of Conduct in Lecture Room: Students are expected to dress decently to the lecture room/hall. They should turn off their cell phones and shut down their laptops during lectures. Students are not allowed to engage in other activities such as texting, watching videos, discussion, and their likes during lectures. Eating, drinking and smoking are not allowed in the lecture rooms/halls.

READING LIST

[1,2]Stroud, B. (2003). *Advanced Engineering Mathematics*. Fouth Edition. Published by Palgrave Macmillan, New York, N.Y.

[1,2]Seymour Lipschutz, T. O. (2005). 3000 Solved Problems in Linear Algebra. Schaum,s Solved Problem Series. Published by Tata McGraw-Hill Publishing Company Limited, New Delhi.

[4]PArchbold, J. W. (1978). Algebra. 4th Edition. Low-price Edition, Pitman Publishing Limited, London, UK.

[1,4]Erwin Kreyszig. (1979). *Advanced Engineering Mathematics*. Fourth Edition. John Wiley & Sons Inc, Canada.

Legend

1- Available in the University Library
2- Available in Departmental/School Libraries
3- Available on the Internet.
4- Available as Personal Collection
5- Available in local bookshops.

COURSE OUTLINE

Week	Topic	Remarks
1	Introduction and Course Overview	Students will be encouraged to be up and doing and work toward making good grade in the course from this very beginning.
2 & 3	Nuclear radiations and radiation sources. Natural and artificial sources of radiation. Alpha particle, beta particle, gamma ray, their nature and properties. Excitation and ionization. Nuclear instrumentation. Charged and uncharged particles and their interaction with matter.	Students will be made to know that we all live in natural radioactive environment. The differences between excitation and ionization will be explained to the students
4 & 5	Nuclear radiation detectors. Scintillation detector (NaI(Tl)), High Purity Germanium detector (HPGe), Thermoluminescence detector (TLD), Solid State Nuclear Track detectors (SSNTD)	When learning about radiation detectors, students will be taught the principles of operation of each, energy and efficiency calibration technique, resolution calculation and relevant areas of application of each detector. The lecture on detectors will touch on nuclear spectroscopy. A typical gamma spectrum from a mixed radionuclide sample will be shown to students. .
6 & 7	Neutron Physics – Production, detection, properties and uses of neutrons.	The differences between neutron and other nuclear particles (charged and uncharged) will be examined and emphasised. The properties of neutron that make it very useful will also be explained.
8 & 9	Nuclear reactor. Reactor design. Nuclear accident.	Ten (10) different types of reactor will be listed and described. The functions of the control rod, moderator and other components of a nuclear reactor will be explained to students. Examples of reactor fuel types – fissile and fertile fuels will be given. MID-SEMESTER TEST
10 & 11	Nuclear energy. Nuclear fission and fusion	The process of production of nuclear energy from fission and fusion will be explained. Students will be encouraged to calculation the amount of nuclear energy that would be produced by fission of one atom of

		^{238}U. Comparison of nuclear energy from fission and fusion will be done.
12 & 13	Elementary Particles. Conservation laws	Students will be introduced to particle physics. Classification of particles in fermions and bosons will be done. The different subdivisions under the two classes – leptons, hadrons, baryons, mesons, pions etc. will be explained using a comprehensive chart/table of elementary particles. Conservation laws e.g. charge, energy, momentum, baryon number, etc will be explained and applied.
13 & 14	Strong electromagnetic and weak interactions	Fundamental forces like gravitational force, weak interaction, electromagnetic and nuclear forces will be explained with the known laws. The theory of strong interactions such as those which lead to the formation of the nucleus will be explained to students.
15	REVISION	This is the week preceding the final examination. At this time, evaluation will be done to assess how far the students' expectations for the course have been met.