Course outline for Physics 111: Mathematical Physics I

Francis N. C. Paraan (F313, R301)*

National Institute of Physics

(Dated: August 2016)

I. COURSE INFORMATION

Description: Mathematical methods for physicists I. Abstract linear spaces and operators; matrix algebra, vector and tensor analysis.

Web: `www.nip.upd.edu.ph/sand/physics111`

References: Arfken $5^{\text{th}}/6^{\text{th}}$ (AR).

Corequisite: Math 55.

Credits: 3.0

Section: THU-1 (TTh 10:00–11:30 AM).

Location: F207

II. CLASS POLICIES

Attendance: University rules state that students that accumulate six or more absences shall be given a failing grade (5.0) if they do not drop the course.

Long Exams: There will be three sit-in long examinations of equal weights, which constitute 3/4 of the final grade. One make up exam replaces an exam missed due to a documented excused absence. Further missed exams and unexcused missed exams will be given a grade of zero.

Raw score x	**Point grade**
$90\% \leq x \leq 100\%$	1.00
$85\% \leq x < 90\%$	1.25
$80\% \leq x < 85\%$	1.50
$75\% \leq x < 80\%$	1.75
$70\% \leq x < 75\%$	2.00
$65\% \leq x < 70\%$	2.25
$60\% \leq x < 65\%$	2.50
$55\% \leq x < 60\%$	2.75
$50\% \leq x < 55\%$	3.00
$45\% \leq x < 50\%$	4.00
$x < 45\%$	5.00

Problem Sets: Problem sets and attendance quizzes make up the remaining 1/4 of the final grade. Late sets will not be given any credit.

Academic honesty: Any form of cheating in examinations or any act of dishonesty in relation to studies, such as plagiarism, shall be subject to disciplinary action.

III. LECTURE OUTLINE

First day of classes : T 09 Aug 2016.

A. Linear algebra

1. Matrices and vectors. Index notation. Kronecker delta.
2. Matrix algebra.
3. Determinants. Levi Cevita symbol.
4. Matrix inversion.
5. Orthogonal matrices.
6. Hermitian and unitary matrices.
7. Complex vector spaces. Bra-ket notation.
8. Eigenvalue problem.
9. Diagonalization.
10. Diagonalization of Hermitian matrices.
11. Non-degenerate and degenerate eigenvalues.
12. Functions of matrices.

First LE : Th 15 Sep 2016

B. Vector calculus

1. Definitions
2. Rotation of coordinate axes. Vector spaces.
3. Scalar and vector products.

* fparaan@nip.upd.edu.ph

4. Triple products. Gradient fields.
5. Divergence and curl.
6. Vector integration.
7. Integration theorems.
8. Potential theory.
9. Gauss's Law.
10. Dirac delta function

Second LE : Th 20 Oct 2016

C. Curvilinear coordinates and tensor analysis

1. Orthogonal coordinates. Metric. Jacobians. Scale factors.
2. Differential operators in orthogonal coordinate systems.
3. Cylindrical and spherical coordinates.
4. Orthogonal matrices and transformations.
5. Tensors I. Contravariant and covariant tensors
6. Tensors II. Contraction and direct products
7. Tensors III. Covariant formulation of EM

D. Random variables

1. Stochastic variables.
2. Moments and cumulants.
3. Generating functions.

Third LE : Th 01 Dec 2016