# Course Specifications

## General Information

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|---|---|
| **Course name** | Introduction to Math. Physics |
| **Course number** | PHYS2301 |
| **Faculty** | |
| **Department** | |
| **Course type** | Major Needs |
| **Course level** | 2 |
| **Credit hours (theoretical)** | 3 |
| **Credit hours (practical)** | 0 |
| **Course Prerequisites** | |

## Course Objectives

1 - The educational approach of this subject suggests combining mathematical concepts and knowledge with the real-world application of physics phenomena, while fostering the development of problem-solving abilities and skills through practical examples. Additionally, interactive forums for student discussions aim to enhance the practical aspects learned during lectures and experiences beyond the classroom environment.

## Intended Learning Outcomes

**Knowledge and Understanding**

* Solve differential equations of first order using graphical, numerical, and analytical methods,
* Solve and apply linear differential equations of second order
* Develop the ability to apply differential equations to significant applied and/or theoretical problems.
* Use matrix algebra and the related matrices to linear transformations,
* Compute and use determinants,
* Compute and use eigenvectors and eigenvalues,
* Differentiate vector fields
* Determine gradient vector fields and find potential functions
* The differential ideas of divergence, curl, and the Laplacian along with their physical interpretations, using differential forms or tensors to represent derivative operations,

## Course Contents

1 - First order ODE: integrating factor, initial value problem, homogenous, physics examples.

2 - Second order ODE: reduction order, homogenous, nonhomogeneous, with constant coefficients, repeated roots, complex roots, Method of undermined coefficients, Wronskian and linear independence, variation of parameters, Cauchy-Euler differential equations, Green's Method, introduction to power series solutions,

3 - Linear Algebra and Vector Calculus (1.5 Month) Vector, Basis, linear combination, Linear Transformation and matrices, Matrix multiplication, The Determinant, Inverse of a Matrix, Dot product, cross product, Eigenvalues and Eigen vectors, trace, Unitary, Hermitian, adjoint, Line integral, Vector filed, gradient, line integral of a vector filed, conservative vector field, Curl or circulation of a vector field, Divergence, Flux, and Green's theorem, Stock's theorem, Laplacian, change coordinates to: cylindrical and spherical.

## Teaching and Learning Methods

1 - lectures

2 - Homeworks

## Students Assessment

| Assessment Method | TIME | MARKS |
|---|---|---|
| Homework | Weekly | 30 |
| Midterm | 60 min | 30 |
| Final | 120 minute | 40 |

## Books and References

Course note

1. Essential Mathematical Methods for Physicists, Arfken, and Weber, Academic Press, 2003.
2. Mathematical Methods for Physics and Engineering, Riley, Hobson, and Bence, Cambridge University Press 2006.
3. Mathematical methods of theoretical Physics, Karl Svozil, third edition, 2015
4. Advanced Engineering Mathematics, Erwin O. Kreyszig, 10th Edition, 2011

## Knowledge and Skills Matrix

| Main Course Contents | Study Week | Knowledge and Understanding | Intellectual Skills | Professional Skills | General Skill |
|---|---|---|---|---|---|
| Differential Equations: (Two Month)<br>First order ODE: integrating factor, initial value problem, homogenous, physics examples.<br>Second order ODE: reduction order, homogenous, nonhomogeneous, with constant coefficients, repeated roots, complex roots, Method of undermined coefficients, Wronskian and linear independence, variation of parameters, Cauchy-Euler differential equations, Green's Method, introduction to power series solutions,<br><br>Part II:<br>Linear Algebra and Vector Calculus (1.5 Month)<br>Vector, Basis, linear combination, Linear Transformation and matrices, Matrix multiplication, The Determinant, Inverse of a Matrix, Dot product, cross product, Eigenvalues and Eigen vectors, trace, Unitary, Hermitian, adjoint, Line integral, Vector filed, gradient, line integral of a vector filed, conservative vector field, Curl or circulation of a vector field, Divergence, Flux, and Green's theorem, Stock's theorem, Laplacian, change coordinates to: cylindrical and spherical. | | | | | |