**Peruvian Computing Society (SPC)**
School of Computer Science
Sillabus 2021-I

## 1. COURSE

MA101. Math II (Mandatory)

## 2. GENERAL INFORMATION

| | | |
|---|---|---|
| **2.1 Credits** | : | 4 |
| **2.2 Theory Hours** | : | 2 (Weekly) |
| **2.3 Practice Hours** | : | - |
| **2.4 Duration of the period** | : | 16 weeks |
| **2.5 Type of course** | : | Mandatory |
| **2.6 Modality** | : | Face to face |
| **2.7 Prerrequisites** | : | MA100. Mathematics I. ($1^{st}$ Sem) |

## 3. PROFESSORS

Meetings after coordination with the professor

## 4. INTRODUCTION TO THE COURSE

The course is focused on developing skills in problem understanding, comprehension and application of mathematical models. To this end, an active and participatory methodology is developed with rational use of technology and collaborative work spaces. The sessions are theoretical and practical associated to contextualized situations that motivate the student to get involved in their understanding and solution. The course aims to address the following main topics which will be monitored every week, these topics are Vectors, Functions of Several Variables, Partial Derivatives, Double Integrals, Series and Ordinary Differential Equations of first order and second or more order

## 5. GOALS

- Ability to apply knowledge of mathematics.
- Ability to apply engineering knowledge.
- Ability to apply computer and mathematical knowledge

## 6. COMPETENCES

**a)** An ability to apply knowledge of mathematics, science. (**Assessment**)

**j)** Apply the mathematical basis, principles of algorithms and the theory of Computer Science in the modeling and design of computational systems in such a way as to demonstrate understanding of the equilibrium points involved in the chosen option. (**Assessment**)

## 7. SPECIFIC COMPETENCES

**a17)** Define functions by recognizing dependent and independent variables by recognizing functions as parameters

**a18)** Build and model functions from a given context.

**a19)** Recognize the behavior of functions through rates of variation.

**a20)** Analyze the extreme values of a function.

**a21)** Recognize the use of integrals defined as differential accumulation.

**j4)** Solve contextualized problems in the area of computing by applying differential and integral calculus techniques.

**j5)** Propose basic models based on a science context using differential equations.

**j6)** Solve differential equations that model problems in different science contexts using different integration techniques.

## 8. TOPICS

| **Unit 1: Vectors (24)** | |
|---|---|
| **Competences Expected: C1,C20** | |
| **Topics** | **Learning Outcomes** |
| • Components, canonical, force or speed problems.<br>• Angle between two vectors, calculate work for a constant force, moment of a force, volume.<br>• Equation of line and plane, Drawing planes, Distance between points, planes and lines.<br>• Calculate work by constant force, moment of a force, volume.<br>• Drawing functions of two and three variables, contour lines. | • Express a vector by its components and use vector operations to interpret the results geometrically, using standard or canonical linear combinations of unit vectors.<br>• Understand the three-dimensional rectangular coordinate system and analyze vectors in space; finding the angle between two vectors and the perpendicular vector between two vectors.<br>• Apply knowledge about vector properties in physical and chemical properties.<br>• Give a set of parametric equations for a line in space.<br>• Give a linear equation to represent a plane in space, using it to draw the plane given by the linear equation.<br>• Find the distances between points, planes and lines in space. |
| **Readings :** [Ste12], [Zil13] | |

| **Unit 2: Derivatives and Integrals (12)** | |
|---|---|
| **Competences Expected: C1,C20** | |
| **Topics** | **Learning Outcomes** |
| • Interpreting the directional derivatives, error analysis, chain rule.<br>• Directional derivative, gradient of a two-variable function, application.<br>• Absolute and relative extremes / criteria of the second partial derivatives.<br>• Areas, volumes and average values.<br>• Double integrals using polar coordinates. | • Understand the notation for a multi-variable function, helping you to draw the graph in space.<br>• Make contour plots of a two-variable function.<br>• Find and use the partial derivatives of a function of two or more variables, to understand the concepts of increments and differentials.<br>• Use a differential as an approximation and use the chain rule for multivariate functions.<br>• Find and use the directional derivatives of a two-variable function, using it to find the gradient of a two-variable function.<br>• Find absolute and relative ends of a two-variable function, using the criterion of the second partial derivatives.<br>• Solve optimization problems with unrestricted and restricted multivariate functions, using the Lagrange multiplier method.<br>• Evaluate and use an iterated integral to find the area of a flat region in Cartesian coordinates. |
| **Readings :** [Ste12], [Zil13] | |

| **Unit 3: Series and Successions (24)** | |
|---|---|
| **Competences Expected: C1,C20** | |
| **Topics** | **Learning Outcomes** |
| • Succession - limit of a succession - recognition of patterns of a succession.<br>• Infinite geometric series - integral and P series criteria.<br>• Quotient criterion / Taylor and Maclaurin polynomials.<br>• Taylor / Maclaurin series. | • Find the mass, center of mass and moments of inertia of a flat sheet using a double integral.<br>• Determine if a succession converges or diverges, using limits and L'Hospital's rule.<br>• Understand the definition of an infinite series using properties to find whether they are convergent or divergent.<br>• Use criteria and properties of the infinite series to determine whether it is convergent or divergent.<br>• Find polynomial approximations of functions using Taylor and Maclaurin polynomials to elementary functions.<br>• Understand the definition of a power series to calculate the radius and range of convergence.<br>• Find a Taylor or Maclaurin series for a function. |
| **Readings :** [Ste12], [Zil13] | |

| Unit 4: Differential Equations (30) | |
|---|---|
| **Competences Expected: C1,C20** | |
| **Topics** | **Learning Outcomes** |
| • Definitions and terminologies / Problems with initial values.<br>• Separable variable - Linear equations.<br>• Linear Models of Growth (Population), Decay (Bacteria - Half-life - Mixtures - Newton's Law.)<br>• Exact Equations - Solutions by substitution.<br>• Nonlinear Models (Falling Chain - Logistic Population Growth - Leaking Cylindrical Tank - Inverted Cone, Solar Collector, Immigration Model.<br>• Radioactive Series - Mixed - Mesh.<br>• Nutrient concentration - Newton's Law.<br>• Problems with initial values - homogeneous and non-homogeneous.<br>• Annulator method - Cauchy Euler equation. | • Understand the definitions and terminology of differential equations with and without initial values<br>• Explain 1st and 2nd order differential equation models.<br>• Solve first-order differential equations by the separable variables method.<br>• Solve the homogeneous and non-homogeneous first-order linear differential equations using the integral factor.<br>• Solve exact first-order differential equations with and without initial values, using the integration factor.<br>• Obtain the general solution of a homogeneous second order linear equation with constant coefficients.<br>• Solve the Euler equation of second order, applying to analyze applications in mechanical vibrations and oscillations in electrical circuits. |
| **Readings :** [Ste12], [Zil13] | |

## 9. WORKPLAN

### 9.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

### 9.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

### 9.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

## 10. EVALUATION SYSTEM

********* EVALUATION MISSING ********

## 11. BASIC BIBLIOGRAPHY


[Ste12] James Stewart. *Cálculo de varias variable Trascendentes tempranas*. Ed. by Cengage Learning Editores S.A. de C.V. 6th. 2012.

[Zil13] Dennis G. Zill. *Ecuaciones diferenciales con valores en la frontera*. Ed. by Cengage Learning Editores. 8th. 2013.