VISAYAS STATE UNIVERSITY

DEPARTMENT OF MATHEMATICS
1/F Old Library Building
VSU, Visca, Baybay City, Leyte, 6521 Philippines
Phone: +63 53-565-0600 loc 1030
Email: dmath@vsu.edu.ph
Website: vsu.edu.ph

TRAINING/WORKSHOP/ORIENTATION PROPOSAL

Title:

Lecture Series: Special Topics in Mathematics and Mathematical Modeling with Numerical Implementation using Python

Participants:

- VSU DMath Faculty
- Interested VSU Faculty
- BSMath-3 Students

Date: October 25-26, 2023

Venue: DMath Computer Laboratory Room

Rationale:

Researching and generating new knowledge is one of the functions of a faculty at the University. As one of the academic units of VSU, the Department of Mathematics is expected to deliver specific outputs concerning this function. The department has lacked accomplishments in research and extension for the past years. Hence, as a unit, we are initiating activities that will capacitate us to do research.

The main objective of this in-house lecture and workshop is to introduce novel topics in pure and applied mathematics to the DMath faculty and upper-level BSMath students. Exposure to new researchable areas in mathematics is necessary to inspire faculty and provide them with topics to work on in their research projects.

This activity also aims to provide an introduction to programming with Python – a helpful tool that can accomplish a wide range of research tasks. Python's open-source packages can assist researchers and math teachers in several ways. It can aid math faculty and researchers in complex scientific computations and graphical visualizations. Hence, knowledge of the basics of programming using Python is essential to mathematics educators and researchers.

As part of a research university, we envision building a research culture at the Department of Mathematics. Conducting an activity like this is geared toward this long-term goal.

Objectives:

The objectives of this lecture series are the following:

1. To introduce new topics/areas in pure and applied mathematics for research;
2. To allow faculty to share their research ideas;
3. To give an introduction to programming using Python;
4. To use Python to solve certain equations; and
5. To motivate faculty and students to do research in pure and applied mathematics.

Methodology/Strategy

The proposed lecture series will be composed of two parts. The first part is a lecture on selected pure and applied mathematics topics. In particular, the resource persons will present coding theory, analysis, and mathematical modeling topics. The second part will be a workshop on introducing the Python programming language.

After the lectures and workshop, the participants will create research groups composed of faculty and students. They will brainstorm to conceptualize research topics. After the activity, research groups are expected to draft research proposals for submission to OVPREI for approval and registration.

The participants will be required to submit and present activity outputs to receive a certificate of participation.

Resources Needed

- AV equipment
- Lecture hall
- Food/snacks
- Computer lab/laptops

Expected Outcome:

1. The participants will be able to learn new topics and different applications of mathematics and develop a renewed interest in mathematics; thus, they will be more motivated to teach and learn pure and applied math.
2. The faculty may find new researchable areas and topics.
3. The lecture series will give a lasting impression on the VSU/DMath faculty for them to work together and develop the research capabilities of the department.
4. The faculty are expected to craft research proposals from the topics presented in this lecture series.

Estimated Budget:

Particulars	Cost in peso (Php)
Training materials	2 400.00
Honorarium and token for the resource persons	6 000.00
Snacks for the participants (4 snacks @80 each for 30 pax)	9 600.00
Meals for the participants (lunch for two days @ 200 each for 30 pax)	12 000.00
TOTAL	**30 000.00**

Prepared by:

EUSEBIO R. LINA, JR.
Head, DMath

CRISANTO L. ABAS
Faculty, DMath

Availability of funds:

ALICIA M. FLORES
Head, Budget Office
charged to STF- Educ. Development Training

Approved by:

MA. THERESA P. LORETO
Dean, CAS

PROGRAM

Day 1: October 25, 2023

8:00 AM	Opening Program	
	Prayer	AVP
	National Anthem	AVP
	Opening Remarks	Dr. Ma. Theresa P. Loreto Dean, CAS
8:30 AM	Talk 1: *Introduction to Coding Theory and LCD Codes*	Dr. Eusebio R. Lina Jr.
10:30 AM	Snack Break	
10:45 AM	Talk 2: *Integral Representation and Explicit Formula at Rational Arguments for Apostol-Tangent Polynomials*	
12:30 PM	Lunch Break	
1:30 PM	Talk 3: The Reaction-Diffusion-Advection Equations and Introduction to Python	Asst. Prof. Crisanto L. Abas
3:00 PM	Snack break	
3:20 PM	Continuation of Talk 3	Asst. Prof. Crisanto L. Abas

Day 2: October 26, 2023

8:00 AM	Workshop: Numerical Implementation using Python	Asst. Prof. Crisanto L. Abas
10:30	Break	
10:50	Continuation of Workshop	Asst. Prof. Crisanto L. Abas
12:30	Lunch	
1:30	Creation of Research Groups and Conceptualizing Research Topics	Participants (to be facilitated by the department research facilitator)
3:00 PM	Break	
3:20 PM	Presentation of Workshop Outputs	
4:30	Closing Program	

Emcees: Ms. Jenelyn V. Valenzona
Asst. Prof. Jerum H. Sidaya

Talk Abstracts

Talk 1: *Introduction to Coding Theory and LCD Codes*

Eusebio R. Lina, Jr.
Department of Mathematics, Visayas State University, Baybay City, Leyte 6521, Philippines

Error-correcting codes play a central role in digital communication processes. They guarantee the flawless transmission of digital information over a noisy channel. This concept is the scope of Coding Theory that uses classical and modern algebraic techniques involving finite fields, group theory, and polynomial algebra. This talk gives an overview and introduction of error-correcting codes. In particular, this includes a discussion of the basic terminologies, definitions, and theorems in Coding Theory.

Because of their algebraic properties, linear codes are easier to describe, encode, and decode than nonlinear codes. So, these codes are studied the most. This talk will also discuss a particular class of codes called linear complementary dual codes, abbreviated as LCD codes. Recently, LCD codes have been widely studied in the literature. In addition, there is a renewed interest in these codes due to the discovery of their application in cryptography. This talk will present an overview of this type of code and specific research directions.

Talk 2: *Integral Representation and Explicit Formula at Rational Arguments for Apostol-Tangent Polynomials*

Cristina B. Corcino[1], Roberto B. Corcino[1], Baby Ann Damgo[1], and Joy Ann Cañete[2]
[1]*Research Institute for Computational Mathematics and Physics, Cebu Normal University, Cebu City 6000, Philippines*
[2]*Department of Mathematics, Visayas State University, Baybay City, Leyte 6521, Philippines*

The Fourier series expansion of Apostol-Tangent polynomials was successfully derived using the Cauchy Residue Theorem by showing first that the integral over *a circle* C_N *about the origin of radius* $\frac{1}{2}[(2N-1)\pi - \log(\lambda)]$, $N \in \mathbb{Z}$

$$\int_{C_N} \frac{2e^{xz}}{(\lambda e^{2z}+1)z^{n+1}}\, dz$$

converges to 0. Consequently, by taking $\lambda = e^{2\pi i\xi}$ $(\xi \in \mathbb{R},\ |\xi| < 1)$, the integral representation for the Apostol-tangent polynomials $T_n(x,\lambda)$ was established and the explicit formula for Apostol-tangent polynomials $T_n\left(\frac{2p}{q},\ e^{2\pi i\xi}\right)$ with rational arguments was obtained where $q \in \mathbb{N}$ and $p \in \mathbb{Z}$.

Talk 3 and Workshop: *The Reaction-Diffusion-Advection Equations with Numerical Implementation using Python*

Crisanto L. Abas
Department of Mathematics, Visayas State University, Baybay City, Leyte 6521, Philippines

The Reaction-diffusion-advection (RDA) equations are PDE models that are used to represent the evolution of a substance (e.g., a drug) in a medium described by spatial coordinates involving privileged transport (or advection) according to a physical or chemical force represented by a velocity vector, diffusion, that is, random motion of the substance molecules in the medium, and reaction (e.g., chemical) with other constituents present in the medium represented by source or loss terms in the equations. These RDA models are used to describe complex dynamical systems and intensively studied due to its multiple application in practical problems, i.e., heat transfer, substance transfer in blood system, pollutants in river system, waves propagation, traffic system, and many more. To be able to derive and solve these practical problems will be of great contribution in decision making. However, solving the RDA equations requires coding skills in MATLAB, Python or R. In this lecture, we are going to introduce the RDA equations including its derivation and solutions using different analytical and numerical methods (FEM and/or FDM). The second part of the talk is a workshop on the introduction of Python and the numerical solutions of the RDA equations.