UNIVERSITY OF SOUTHERN MINDANAO

COURSE SYLLABUS for Qualified Elective (Coding Theory)

Course Number	AMath Elec 03	Rev. No.	0	Page 1 of 9

EFFECTIVE DATE	REV. NO.	REVISION TYPE	CHANGE DESCRIPTION	PAGE AFFECTED	ORIGINATOR
July 04, 2023	Ø	New	Newly established in accordance to the Quality Management System Requirements	ALL	Jupiter G. Pilongo

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Author:	Reviewer:	Verifier:	Validator:	Final Approver:	DCC USE ONLY
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INSTITUTIONAL POLICIES	
Vision	Quality and relevant education for its clientele to be globally competitive, culture sensitive and morally responsive human resources for sustainable development.
Mission	Help accelerate socio-economic development[M1], promote harmony among the diverse cultures[M2] and improve quality of life[M3] through instruction, research, extension and resource generation in Southern Philippines.
Core Values	**G**-Goodness, **R**-Responsiveness, **E**-Excellence, **A**-Assertion of Right and **T**-Truth
USM Quality Policy Statement	The University of Southern Mindanao, as a premier university, is committed to provide quality instruction, research development and extension services and resource generation that exceed stakeholders' expectations through the management of continual improvement efforts on the following initiatives. 1. Establish key result areas and performance indicators across all mandated functions; 2. Implement quality educational programs; 3. Guarantee competent educational service providers; 4. Spearhead need-based research outputs for commercialization, publication, patenting, and develop technologies for food security, climate change mitigation and improvement in the quality of life; 5. Facilitate transfer of technologies generated from research to the community for sustainable development; 6. Strengthen relationship with stakeholders; 7. Sustain good governance and culture, sensitivity; and 8. Comply with customer, regulatory and statutory requirements.
Goals of the College	1. The College of Science and Mathematics of the University of Southern Mindanao is committed to the comprehensive preparation of the next generation of scientists and mathematicians in this part of the country. 2. The College supplies a condition in which faculty can advance and support high-quality research programs in which students can collaborate and contribute to new knowledge that improves quality of life. 3. The College aspires to be the center of excellence in Science and Mathematics in order to serve diverse students, preparing them for their future careers in line with the vision and mission of the University. 4. The College serves the community and the industry as an impartial source of quality graduates in Science and Mathematics that provides education, literacy, innovation and solution generation to challenges.
Department Objectives	The Department of Mathematics and Statistics aims to: 1. produce students with mastery in the core areas of mathematics and statistics, including algebra, analysis, and geometry; 2. develop students' skills in pattern recognition, generalization, abstraction, critical analysis, synthesis, problem-solving and rigorous argument; 3. express an enhanced perception of the vitality and importance of mathematics in the modern world including inter-relationships within math and its connection to other disciplines;and

	4. develop students' skills in creating and evaluating mathematical conjectures and arguments, and in validating their own mathematical thinking.

PROGRAM INFORMATION					
Degree Program	**Bachelor of Science Major in Applied Mathematics**	CHED CMO Reference	**48 series of 2017**	BOR Approval	**BOR Res. No. 24, s 2020**

COURSE DETAILS					
Course Title	**Coding Theory**				
Course Number	**AMath Elec 03**		Curriculum Component	**Major subject**	
Credit (--Unit)	**3 Units**	LECTURE (Unit-Hours)	**3 Units - 3 Hours**	LABORATORY (Unit-Hours)	**0 Units - 0 Hours**
Prerequisites	**None**	Co-requisites	**None**	Year Level/Semester Offered	**4th - First Semester**
Course Description	Explore the fascinating realm of Coding Theory in this introductory course designed to equip students with a solid foundation in the principles and applications of error detection and correction codes. Coding Theory is a fundamental branch of computer science and information theory that deals with the study of efficient ways to transmit and store data while ensuring its integrity in the presence of errors and noise.				
Faculty in charge					
Consultation Hours			Contact Information		

PROGRAM EDUCATIONAL OBJECTIVES (PEO)		**MISSION**		
In 3-5 years, the **BS Applied Math** graduates of USM shall:		***M1***	***M2***	***M3***
PEO 1	Provide leadership in various development programs both public and private	✓		
PEO 2	Equip with technical, conceptual and human resource skills	✓		✓
PEO 3	Pursue entrepreneurial activities	✓		✓
PEO 4	Able to adapt to diverse culture		✓	

PEO 5	Pursue advanced studies in emerging related fields		✓	✓

NOTE: The PEO's are based on the professional, industry, local, national and international needs and requirements of the program identified through consultation with constituents and stakeholders.

PROGRAM OUTCOMES (PO) Upon graduation, the University of Southern Mindanao **BS Applied Math** students must be able to:	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6	PEO7	PEO8	PEO9	PEO10	...
a) Articulate and discuss the latest development in the specific field of practice.		✓									
b) Effectively communicate orally and in writing using both English and Filipino		✓			✓						
c) Work effectively and independently in multidisciplinary and multi-cultural teams.			✓	✓							
d) Act in recognition of professional, social and ethical responsibility	✓										
e) Preserve and promote "Filipino historical and cultural heritage"				✓							
f) Participate in the generation of new knowledge in research and development projects.		✓									
g.) Articulate the rootedness of education in philosophical, sociocultural, historical and psychological and political context.		✓									
h.) Demonstrate mastery of subject matter/discipline		✓									
i.) Facilitate learning using wide range of teaching methodologies and delivery modes appropriate to specific learners and their environment.		✓	✓								
j.) Develop innovative curricula, instructional plans, teaching approaches, and resources for diverse learners.		✓		✓							
k.) Apply skills in the development and utilization of ICT to promote quality, relevant and sustainable educational practices		✓									
l.) Demonstrate a variety of thinking skills in planning, monitoring, assessing and reporting learning processes and outcomes.		✓									
m.) Practice professional and ethical teaching standards sensitive to the local, national and global realities.	✓			✓							
n.) Pursue lifelong learning for personal and professional growth through varied experiential and field based opportunities					✓						
o.) Exhibit competence in mathematical concepts and procedures		✓									
p.) Exhibit proficiency in relating mathematics to other curricular areas		✓									
q.) Manifest meaningful and comprehensive pedagogical content knowledge (PCK) of mathematics.		✓									
r.) Demonstrate competence in designing, constructing, and utilizing different forms of assessment in mathematics.		✓									
s.) Demonstrate proficiency in problem-solving by solving and creating routine and non-routine problems with different levels of complexity.		✓									
t.) Use effectively appropriate approaches, methods, and techniques in teaching mathematics including technological tools		✓									
u.) Appreciate mathematics as an opportunity for creative work, moments of discovery, and gaining insight.		✓									

NOTE: Minimum PO's shall come from the PSG/CMO of the program if applicable. Other additional PO's may come from consultations with constituents and stakeholders.

COURSE OUTCOMES (CO)		POa	POb	POc	Pod	POe	POf	POg	POh	POi	POj	POk	POl	POm	POn	POo	POp	POq	POr	POs	POt	POu	POv	POw	POx	POy	POz
Upon passing this course, the students must be able to:	**Course Alignment to Program Outcomes**	I																									
CO 1	Demonstrate a comprehensive understanding of the fundamental concepts in coding theory, including codes, codewords, Hamming distance, linear codes, and error detection/correction capabilities.	I																									
CO 2	Design, analyze, and evaluate error-detection and error-correction codes.	I																									
CO 3	Apply coding theory principles to practical scenarios, such as designing error-correcting memory systems, ensuring data integrity in digital communication channels, and optimizing data storage mechanisms.	I																									
CO 4	Enhance their problem-solving abilities and algorithmic thinking.	I																									

* ***Level** (follow the legend used in the most relevant PSG/CMO)*

[I] = Introductory. This introduces the student to the Program Outcome (PO).

[E] = Enabling. This enables the student to attain the Program Outcome (PO).

[D] = Demonstrative. This demonstrates the student's attainment of the Program Outcome (PO)

COURSE LEARNING PLAN

Intended Learning Outcomes (ILO) *By the end of the learning experience*, students must be able to:*	Aligned to CO:	Time Frame *(Week)*	Course Content *(Topics)*	Teaching & Learning Activities (TLA) Teaching Activities	Teaching & Learning Activities (TLA) Learning Activities	Learning Materials	Assessment Tasks (AT)	Suggested Readings
1.1 Explain the vision, mission, UQPS of the University **1.2** Explain the goals and objectives of the college. **1.3** Explain the Program Educational Objectives, Students Outcomes, and Course Outcomes.		**1**	**Orientation on Classroom and University Policies as well as Grading System** • **Discussion on PEO, SO and CO**	*Orientation Lecture/Discussion*	*Reading; Assignment*	*Computer; Chalkboard*	*Recitation*	[10]
2.1 Define fields, polynomial rings and	**CO1,**	**2-3**	**Finite Fields 1**	*Lecture/*	*Reading and*	Instructional	Assignments	[1], [2] p. 31, [4] p. 17,

finite fields 2.2	CO4		▪ Fields ▪ Polynomial rings	*Video Presentation/addressing students questions*	*Solving*	Module	Quizzes Exams Reflective paper	[5] p. 298, [6] p. 51
3.1 Discuss structure of Finite fields 3.2 Solvoe minimal polynomials	CO1, CO4	4	**Finite Fields 2** ▪ Structure of Finite fields ▪ Minimal Polynomials	*Lecture/ Video Presentation/addressing students questions*	*Reading and Solving*	Instructional Module	Assignments Quizzes Exams Reflective paper	[1], [4] p. 26, [5] p. 300, [6] p. 54
4.1 Define vector spaces 4.2 Solve the spanning set of a given set of vectors 4.3 Determine the dimension of a vector space 4.4 Perform inner product of two vectors 4.3 Determine if two vectors are orthogonal	CO1, CO4	5	**Vector Spaces** ▪ Vector space ▪ Spanning set ▪ Dimension ▪ Inner product ▪ Orthogonality	*Lecture/ Video Presentation/addressing students questions*	*Reading and Solving*	Instructional Module	Assignments Quizzes Exams Reflective paper	[1], [2] p. 33, [3] p. 88, [4] p. 39, [5] p. 299, [7] p. 2
5.2 Define matrices 5.3 Perform operations of matrices 5.4 Prove some properties of matrices 5.5 Discuss some special types of matrices 5.6 Discuss some matrix transformations	CO1, CO4	6-7	**Matrices** ▪ Definition of matrices ▪ Algebraic Properties of Matrix Operations ▪ Special types of matrices ▪ Matrix transformation	*Lecture/ Video Presentation/addressing students questions*	*Reading and Solving*	Instructional Module	Assignments Quizzes Exams Reflective paper	[1], [3] p. 42, [7] p. 18
6.1 Define codes and linear codes 6.2 Define Hamming weights 6.3 Construct simple codes 6.4 Determine bases for linear codes	CO1, CO4	8	**Linear Codes Part 1** ▪ Linear codes ▪ Hamming weight	*Lecture/ Video Presentation/addressing students questions*	*Reading and Solving*	Instructional Module	Assignments Quizzes Exams Reflective paper	[1], [2] p. 37, [4] p. 45, [5] p. 14, [8] p. 12, [9] p. 33
All ILOs covered in Midterm			**Week 9: MIDTERM EXAMINATION**					
7.1 Obtain generator matrxi from a linear code 7.2 Obtain Parity-check matrix from a	CO3, CO4	10-12	**Linear Codes Part 2** ▪ Bases for linear codes ▪ Generator matrix	*Lecture/ Video Presentation/addressing*	*Reading and Solving*	Instructional Module	Assignments Quizzes Exams	[1], [4] p. 52, [5] p. 27

linear code			▪ Parity-check matrix	*students questions*			Reflective paper	
8.1 Determine if the two codes are equivalent **8.2** Provide examples of equivalent codes **8.3** Discuss BCH and Reed-Solomon Codes	**CO_3, CO_4**	**13**	**Linear Codes Part 3** ▪ Equivalence of linear codes ▪ BCH Codes ▪ Reed-Solomon Codes	*Lecture/ Video Presentation/addressing students questions*	*Reading and Solving*	Instructional Module	Assignments Quizzes Exams Reflective paper	[1], [2] p. 98, [4] p. 56, [5] p. 74, [6] p. 114, [8] p. 36, [9] p. 54
9.1 Define the bounds of a code **9.2** Determine the bounds of a code using Sphere-covering, Gilbert-Varshamov and Hamming bound	**CO_2, CO_4**	**14-15**	**Bounds in Coding theory** ▪ Lower bounds ▪ Sphere-covering bounds ▪ Gilbert-Varshamov bounds ▪ Hamming bound	*Lecture/ Video Presentation/addressing students questions*	*Reading and Solving*	Instructional Module	Assignments Quizzes Exams Reflective paper	[1], [2] p.73, [4] p. 75, [9] p. 64
10.1 Define cyclic codes **10.2** Obtain generator polynomial of cyclic codes **10.3** Determine if the given linear code is cyclic	**CO_2, CO_4**	**16-17**	**Cyclic codes** ▪ Definitions ▪ Generator polynomials	*Lecture/ Video Presentation/addressing students questions*	*Reading and Solving*	Instructional Module	Assignments Quizzes Exams Reflective paper	[1], [4] p. 133, [5] p. 62, [8] p. 45, [6] p. 67, [9] p. 81
All ILOs covered in the Course			**Week 18: FINAL EXAMINATION**					

** any interaction, course, program, or other experience in which learning takes place (https://www.edglossary.org/learning-experience/).*

Textbook/References

[1] Coding Theory Module
[2] Guruswami, V., Rudra, A., Sudan, M. (2022). *Essential Coding Theory*. University of Buffalo, NY.
[3] Lang, S., & Murrow, G. (2021). Linear Algebra: A First Course with Applications (4th ed.).
[4] Ling,S., Xing, C. (2004). *Coding Theory, a first course*. Cambridge University Press, UK.
[5] Neubauer, A., Hollmann, H. D. L., & Abdulajalil, M. (2022). Coding Theory: Algorithms, Architectures, and Applications
[6] Pless, V. (1998). *Introduction to the theory of error-correcting codes* (3rd ed.), John Wiley and Sons, New York etc.
[7] Strang, G. (2021). Introduction to Linear Algebra (6th ed.).
[8] Tilborg, H. (1993). *Coding Theory, a first course*. Eindhoven University of Technology, Netherlands.
[9] Van Lint, J.H. (1991). *Introduction to Coding Theory, Third Edition*. Springer-Verlag, NY.
[10] USM Student Manual

Life-long Learning Opportunity

Embark on a lifelong learning adventure tailored to your evolving interests. With an extensive library of courses, expert-led workshops, and interactive seminars, you'll delve into diverse subjects, from coding theory to philosophy and beyond. Connect with a global community of fellow learners, engage in thought-provoking discussions, and receive personalized guidance from mentors. Embrace the joy of continuous discovery and intellectual growth, making every moment a stepping stone in your unending pursuit of knowledge.

Course Evaluation

Course Outcomes (CO)	Assessment Task Addressing CO	Weight (%)	Satisfactory Rating	Target Standard
CO 1: Demonstrate a comprehensive understanding of the fundamental concepts in coding theory, including codes, codewords, Hamming distance, linear codes, and error detection/correction capabilities.	Quizzes/Assignments/Others	60	60	90% of the class obtained a satisfactory rating
	Major Exam	40		
CO 2: Design, analyze, and evaluate error-detection and error-correction codes.	Quizzes/Assignments/Others	60	60	90% of the class obtained a satisfactory rating
	Major Exam	40		
CO 3: Apply coding theory principles to practical scenarios, such as designing error-correcting memory systems, ensuring data integrity in digital communication channels, and optimizing data storage mechanisms.	Quizzes/Assignments/Others	60	60	90% of the class obtained a satisfactory rating
	Major Exam	40		
CO 4: Enhance their problem-solving abilities and algorithmic thinking.	Quizzes/Assignments/Others	60	60	90% of the class obtained a satisfactory rating
	Major Exam	40		

Grading System

Midterm Grade

Quizzes---------- ----------30%
Assignments/Others----------30%
Midterm Exam----------40%

Final Term Grade

Quizzes/Summative Exams----------30%
Assignments/Others----------30%
Final Exam---------- 40%

Final Grade

50% Midterm Grade+50% Final Term Grade

Passing Grade

75%

Classroom Policies
1. Come to class prepared for recitation, class discussions, or unannounced quizzes always. Demonstrate personal responsibility by obtaining notes and finding out any instructions/important announcements given on the class period missed. 2. Absence is not student a right, nor a privilege. The University Code on absence and tardiness applies. 20% of the total class hours means you are DROPPED from the course. Absences can be excused only after presenting official documents due to sickness or other valid reasons. 3. All submissions must be your original work. Cite sources properly. Plagiarism and any form of academic cheating get a corresponding grade of 5.0 (Failed), and can be grounds for suspension or expulsion. 4. Class participation throughout the class duration is highly encouraged. 5. For class consultation, you may approach your class mayor for your concerns, and the class mayor will relay these concerns to the concerned professor. Students may also opt to personally approach their concerned professors for their concerns either in the classroom or in the professor's office. 6. Observe proper decorum inside and outside the classroom. 7. Observe CLAYGO (Clean As You Go) before leaving the classroom.