EFFECTIVE DATE	REV. NO.	REVISION TYPE	CHANGE DESCRIPTION	PAGE AFFECTED	ORIGINATOR
January 24, 2022	Ø	New	Newly established compressed syllabus for BS Applied Mathematics program for use during COVID-19 Pandemic. Flexible mode of instructions is adapted. Suggested readings with corresponding pages\URL and supplemental materials are included.	All	Leonard M. Paleta/ Lawton John A. Yabes
			ELECTRONICALLY RELEASED 2025.07.09		

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Author:	Reviewer:	Verifier:	Validator:	Final Approver:	DCC USE ONLY
LEONARD M. PALETA, PhD\ LAWTON JOHN A. YABES Course Developer	PHILIP LESTER P. BENJAMIN, PhD Subject Expert	JEANETH R. LICAROS, MA Department Curriculum Coordinator	JONALD V. PIMENTEL, PhD CSM Dean	GEOFFRAY R. ATOK, PhD Vice President for Academic Affairs	DOCUMENT CONTROL INDICATOR
Date: 2021.12.13	Date: 2021.12.15	Date: 2021.12.17	Date: 2021.12.20	Date: 2022.01.24	MASTER COPY 2022.02.21

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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.

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PROGRAM INFORMATION

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

COURSE DETAILS

Course Title	Linear Algebra				
Course Number			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	2nd - Second Semester
Course Description					
Faculty in charge	Lawton John A. Yabes, Leonard M. Paleta, PhD				
Consultation Hours			Contact Information		

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

In 3-5 years, the **BSAM** graduates of USM shall:

		M1	M2	M3
		MISSION		
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 **BSAM** 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.) Demonstrate broad and coherent knowledge and undestanding in the core areas of physical and natural sciences.		✓									
h.) Apply critical and problem solving skills using the scientific method.		✓									
i.) Interpret relevant scientific data and make judgements that include reflection on relevant scientific and ethical issues.	✓	✓			✓						
j.) Carry out basic mathematical and statistical computations and use appropriate technologies in the analysis of data.		✓			✓						
k.) Communicate information, ideas, problems, and solutions, both orally and in writing, to other scientists, decision makers, and the public.	✓	✓	✓	✓							
l.) Relate science and mathematics to the other disciplines.		✓	✓	✓	✓						
m.) Design and perform safe and responsible techniques and procedures in laboratory or field practices.		✓									
n.) Critically evaluate input from others.		✓		✓							
o.) Appreciate the limitations and implications of science in everyday life.		✓									
p.) Commit to the integrity of data.		✓			✓	✓					
q.) Gain mastery in the cores areas of mathematics: algebra, analysis, and geometry.		✓			✓						
r.) Demonstrate skills in pattern recognition, generaliztion, abstraction, critical analysis, synthesis, problem-solving and rigorous argument.		✓									
s.) Develop 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.		✓		✓							
t.) Appreciate the concept and role of proof and reasoning and demonstrate knowledge in reading and writing mathematical proofs.		✓			✓						
u.) Make and evaluate mathematical conjectures and arguments and validate their own mathematical thinking.		✓			✓						
v.) Communicate mathematical ideas orally and in writing using clear and precise language.	✓	✓									

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	PO	POn	POo	POp	POq	POr	POs	POt	POu	POv
Upon passing this course, the students must be able to: **Course Alignment to Program Outcomes**	I					I						I						I		I		
CO 1 Discuss linear equations and matrices.	I					I						I						I		I		
CO 2 Perform operations of matrices and its properties and solving linear systems.	I					I						I						I		I		
CO 3 Discuss determinants and vector spaces, and their properties.	I					I						I						I		I		
CO 4 Discuss linear transformations, eigenvectors and diagonalization	I					I						I						I		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	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 of Classroom and University Policies as well as Grading System. • Discussion on PEO, SO and CO	Orientation Lecture/Discussion	Reading; Assignment	Computer; Chalkboard	Recitation	[1]
2.1 Define a system of linear equation 2.2 Discuss the different types of matrices	CO1	1-2	**Linear Equations and Matrices** ▪ System of Linear Equations ▪ Matrices	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 1-39 [3][4][5][6]

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2.3 Perform operations of matrices **2.4** Prove some properties of matrices			• Matrix operations and their properties				
2.5 Discuss some special types of matrices **2.6** Transform a matrix to reduced row echelon form **2.7** Discuss elementary and equivalent matrices	**CO1**	**3-4**	• Special types of matrices • The echelon form of a matrix • Elementary matrices and row equivalence	Lecture/ Video Presentation/addressing student questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 42-52, 86-117 [3][4][5][6]
3.1 Solve linear systems using reduced row echelon form of a matrix **3.2** Find the inverse of a matrix	**CO2**	**5-6**	**Solving Linear Systems** • Matrices on systems of linear equations • The inverse of a matrix	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 95-103 [3][4][5][6]
4.1 Define and discuss properties of determinants **4.2** Determine the cofactor expansion and inverse of a matrix	**CO3**	**7**	**Determinants** • Definition of determinants • Properties of Determinants • Cofactor	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 141-165 [3][4][5][6]
4.3 Find the adjoint of a matrix **4.4** Solve linear systems using Cramer's rule	**CO3**	**8**	• The adjoint of a matrix • Cramer's Rule	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 166-172 [3][4][5][6]
All ILOs covered in Midterm			**Week 9: MIDTERM EXAMINATION**				
5.1 Define vector space **5.2** Define subspace	**CO3**	**10**	**Vector Spaces** • **Definition of vector spaces**	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 177-200 [3][4][5][6]

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			• Subspaces				
5.3 Determine the linear combination of vectors 5.4 Determine the spanning set of a matrix 5.5 Determine if the vector is linearly independent or not	CO4	11	• **Linear Combination and spanning sets** • **Linear Independence**	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 201-226 [3][4][5][6]
7.6 Define basis and dimension 7.7 Determine the basis of a given vector set 7.8 Determine the dimension of a given vector set 7.9 Determine the rank of matrix	CO4	12	• **Basis and dimension** • **Rank of matrix**	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 229-281 [3][4][5][6]
6.1 Determine if two vector spaces are isomorphic 6.2 Define linear transformation 6.3 Determine the kernel of a linear transformation 6.4 Solve problems of linear transformations	CO4	13	**Linear transformations** • Isomorphism of vector spaces • Definition of linear transformation • Kernel of a linear transformation	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 363-387 [3][4][5][6]
6.5 Determine the range, nullity, and rank of a matrix 6.6 Define the dimension theorem 6.7 Determine if a matrix singular or nonsingular	CO4	14	• Range, nullity, and rank • Dimension theorem • Nonsingular linear transformation	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2][3][4][5][6]
6.8 Determine the matrix if a linear transformation 6.9 Determine if two matrix are similar	CO4	15	• Matrix of a linear transformation • Similarity	Lecture/ Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 389-413 [3][4][5][6]
7.1 Define eigenvalues and eigenvectors		16	**Eigenvalues and eigenvectors**	Lecture/	Reading and Solving	Instructional Module	Assignments Quizzes Exams	[2] Page 436-450 [3][4][5][6]

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7.2 Determine the characteristic polynomial of a matrix 7.3 Determine all the eigenvalues and the corresponding eigenvectors of the given matrix	CO4		• Definition of Eigenvalues and eigenvectors • Characteristic polynomial	Video Presentation/addressing students questions			
7.4 Define the Hamilton-Cayley theorem 7.5 Determine if the linear transformation is diagonalizable linear transformation	CO4	17	• Hamilton-Cayley theorem • Diagonalization	Lecture/Video Presentation/addressing students questions	Reading and Solving	Instructional Module	Assignments Quizzes Exams Reflective paper	[2] Page 452-461 [3][4][5][6]
All ILOs covered in the Course		18		FINAL EXAMINATION			

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

Textbook References

[1] USM Student Manual

[2] Kolman, B and Hill, D. Elementary Linear Algebra with Applications, 9th Edition. 2008. Pearson.

[3] Woerdeman,H.J. Linear Algebra What You Need to know. 2021. CRC Press Taylor and Francis.

[4] Suzuki,J. Linear Algebra, An Inquiry-Based Approach. 2021. CRC Press Taylor and Francis.

[5] DeBonis,M.J. Introduction to Linear Algebra (Computation, Application and Theory) . 2021.CRC Press Taylor and Francis.

[6] Benjamin, PL. Linear Algebra Workbook, Department of Mathematics and Statistics, University of Southern Mindanao

Online References

[1] Lipschutz, S. and Lipsun, M.L. 2009. Schaum's Outline Linear Algebra, 4th Ed. 2009. Available at:
http://www.astronomia.edu.uy/progs/algebra/Linear_Algebra,_4th_Edition__(2009)Lipschutz-Lipson.pdf

[2] Nering, E.D. Linear Algebra and Matrix Theory, 1969. Available at https://download.tuxfamily.org/openmathdep/algebra_linear/Linear_Algebra_and_Matrix_Theory-Nering.pdf

Life-long Learning Opportunity

Apply linear algebra to other fields of mathematics such as coding theory and functional analysis.

Course Evaluation

Course Outcomes (CO)	Assessment Task Addressing CO	Weight (%)	Satisfactory Rating	Target Standard
CO 1: Discuss linear equations and matrices.	Quizzes/Assignments/Others	60	60	90% of the class obtained a satisfactory rating
	Major Exam	40		
CO 2: Perform operations of matrices and its properties and solving linear systems.	Quizzes/Assignments/Others	60	60	90% of the class obtained a satisfactory rating
	Major Exam	40		
CO 3: Discuss determinants and vector spaces, and their properties.	Quizzes/Assignments/Others	60	60	90% of the class obtained a satisfactory rating
	Major Exam	40		
CO 4: Discuss linear transformations, eigenvectors and diagonalization	Quizzes/Assignments/Others	60	60	90% of the class obtained a satisfactory rating
	Major Exam	40		

Grading System

Midterm Grade

Quizzes--40%

Assignments/Others---------------------------30%

Midterm Exam---------------------------------- 30%

Final Term Grade

Quizzes/Summative Exams------------------40%

Assignments/Others--------------------------30%

Final Exam------------------------------------- 30%

Final Grade

50% Midterm Grade+50% Final Term Grade

Passing Grade

75%

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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 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.

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. During online class, students are expected to:
   a. Show up on a scheduled time and wait to be admitted into the class.
   b. Be always respectful. If your video is on, avoid hand gestures or inappropriate language.
   c. Stay on mute. Click a raise hand button if you have a question or something to share.
   d. Stay focused and on task so you don't miss anything the speaker says.
   e. Class participation is highly encouraged.

5. Consultation: You can approach your class mayor for your concerns so he/she will relay them once to your professor

6. All information and queries regarding our class will be posted in our official group chat or facebook group. Refrain from posting unrelated topics in these platforms as these will take up space in the messenger box and will make it difficult to backread important messages.

7. Observe proper decorum when sending messages to your professors.

8. Avoid sending messages online outside office hours or during evening.

9. All submissions must be in USM VLE. Submissions made outside VLE will not be accepted.

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