



SULTAN QABOOS UNIVERSITY

COURSE OUTLINE

PROGRAM: B.Sc. in Engineering

1. Course Code	MATH3171	
2. Course Title	Linear Algebra and Multivariate Calculus for Engineers	
3. Credits	3 Workload: 9 hours (6 contact hours in classroom and 5 hours self-study)	
4. Pre-requisite Course(s)	MATH2108-Calculus II	
5. Co-requisite Course(s)		
6. Equivalent Course(s)		
7. Incompatible Course(s)		
8. Course Category	University Requirement	University Elective
	College Requirement	College of Science Elective
	Department Requirement	Department Elective
	Specialization Requirement	Specialization Elective
	Other (specify):	
9. Course Owner	College: Science	Department: Mathematics
10. Course Type	Lecture	Lecture/Lab
	Lecture/Seminar	Lecture/Studio
	Lecture/Tutorial	Lecture/Lab/Tutorial or Seminar
	Tutorial	Laboratory (Practical)
	Field or Work Placement	Studio
	Seminar	Internship
	Workshop	Project
11. Language of Instruction	English	
12. Course Description		
The course covers topics in linear algebra and vector calculus. The linear algebra topics are matrices and determinants, solutions of systems of linear equations, eigenvalues and eigenvectors, special matrices (Hermitian, skew-Hermitian, unitary), diagonalization. The topics in vector calculus are vectors and vector functions, vector differential calculus, gradient, divergence and curl, vector integral calculus (line, double and triple integrals), Green, Gauss and Stokes theorems.		
13. Teaching/Learning Strategies		
1. Applying the theory to real life problems with practical learning experience.		
2. Encouraging students of different abilities to work together.		
3. Posing thought provoking questions to inspire students to think for themselves to become more independent learners.		
4. Encouraging students to ask questions.		
5. Encouraging students to explore their own ideas to have a deeper understanding of academic concepts.		
6. Designing and handing out of worksheets that vary in complexity to differentiate among various groups of students.		
7. Encouraging students to follow logical thinking, analyzing problems, criticizing the ideas and discovering scientific solutions.		
8. Encouraging students to use the information technology for the purpose of distance learning and to use software and interactive environments like Moodle, Google meet, Word, Excel, and LaTeX in their studies.		
9. Developing an atmosphere of discipline and mutual respect in the classroom.		
10. Implementing an effective behavior management in order to provide students equal chances of reaching their optimum potential.		
11. Conducting regular quizzes and exams during the semester to encourage the student for continuous study of the course.		
12. Encouraging the students to independent study and learning by several homework assignments.		
13. Encouraging students to explore their own ideas to have a deep understanding of academic concepts.		

14. Assessment Components and Weight [%]		
Quizzes 15%		Other (specify):
Homework assignments/quiz 5%		Date of the midterm exam: Week 8: 2 / 11 / 2022
Midterm examination 30%	Final examination 50%	Date of the Final Exam: 25 / 12 / 2022
15. Grading Method		
A-F Scale		
16. Textbook(s) and Supplemental Material		
Textbook: Advanced Engineering Mathematics by Erwin Kreyszig, 10th Edition, Wiley, 2011.		

17. Matching Course Objectives with Program Outcomes and SQU Graduate Attributes		
SQU Graduate Attributes		
A. SQU graduates should be able to: <ol style="list-style-type: none"> 1. Apply the knowledge and skills relevant to the specialization. 2. Communicate effectively and use information and communication technologies. 3. Critically analyze complex information and present it in simple clear manner. 	B. SQU graduates possess <ol style="list-style-type: none"> 1. Interpersonal communication skills and alignment with culture of the international labor market to assist them in practical life and in living successfully. 2. Skills and motivation for independent learning and engagement in lifelong learning and research. 3. Work ethics and positive values, and intellectual independence and autonomy 4. Teamwork skills and display potential leadership qualities. 	C. SQU graduates should Relish good citizenship qualities, be conscious of their national identity and be socially responsible, engage in community affairs and be mindful of contemporary issues.

#	Intended Student Learning Outcome /Course Learning Objective	Relevant Program Outcome(s)	Applicable Attribute(s)
1.	Using scalar and vector functions to describe curves and surfaces.	Ability to identify curves and surfaces in real life problems and model them as equations.	A1, A3
2.	To distinguish between line, surface, and volume integrals.	Ability to distinguish lines, surfaces, and volume integral.	A1, A3
3.	Evaluating the work done by a variable force using line integrals.	Ability to apply integrals to find work done by a force field.	A1, A3
4.	Evaluating the flux of a variable force through a surface using surface integrals.	Ability to apply flux surface integral in real life situations.	A1, A3, B2
5.	To formulate the relation between the line, surface, and volume integrals.	Ability to formulate and convert different forms of integral to others.	A1, B2
6.	Explaining the main concepts in linear algebra such as matrices, determinants, eigenvalues, and eigenvectors.	The ability to apply the concepts of linear algebra in real life problems.	A1
7.	Determining the existence of a solution for an algebraic linear system.	The ability to model real life problems as linear systems.	A1, A3
8.	Solving general algebraic linear systems and, justify whether a given algebraic linear system has a unique solution, infinitely many solutions, or no solution.	The ability to solve linear systems in real life problems.	A1, A3, B2
9.	Identify typical applications whose modeling leads to solving algebraic linear systems.	Ability to apply the concept in real life problems	A1, A3
10.	Finding the inverse of a matrix if it exists.	Ability to identify the use of the inverse of a matrix.	A1, A3, B2

11.	Solving eigenvalue problem for matrices.	Ability to compute eigenvalues and eigenvectors.	A1, A3
12.	Performing the diagonalization of a square real matrix.	Ability to identify the concept of diagonalization.	A1, A3
13.	Explaining the main concepts in linear algebra such as matrices, determinants, eigenvalues, and eigenvectors.	Ability to apply the concepts of linear algebra in real life problems.	A1
14.	Discussing the proofs of theorems in all parts	Ability of logical thinking in real life.	A3, C

18. Student Responsibilities

It is the student's responsibility to know and comply with all University Academic Regulations relevant to participation in this course. These regulations specifically include attendance requirements and student's academic code of conduct.

For attendance, it is the student's responsibility to be punctual and to attend all classes.

Students are expected to perform their work with honesty and avoid any academic misconduct, which is defined as the use of any dishonest or deceitful means to gain some academic advantage or benefit. This can take many forms, including but not limited to, the following: copying, plagiarism, collusion, and forging documents. For full details, please refer to the Undergraduate Academic Regulations and to the Student Academic Misconduct Policy.

Additionally, this course requires that you:

- 1) are responsible for getting help, if you have questions or problems. Ask your instructor either in the classroom or during the office hours. Alternatively, make an appointment with your instructor.
- 2) go through the solved examples and do the suggested exercises. Because of the time constraint, all solved examples or suggested exercises cannot be discussed by the instructors in the classroom.
- 3) should check the Moodle regularly for new announcements and postings related to the course updates and for additional useful course materials such as the previous semester Tests and Final exams. To enroll in the Moodle, do the following steps in the SQU website.
 - Choose "Online Services", then "E-Learning".
 - Choose "E-Learning (Academic)", then login using your SQU username and password.
 - From the available courses under "College of Science", "Mathematics", choose "MATH3171 Linear Algebra and Multivariate Calculus for Engineers."

Please Register in the Moodle according to the Key:

math3171-section number

For instance, for students of section(s) 30/31/32: math3171-30

COURSE INFORMATION					
Course Code	MATH3171	Course Title	Linear Algebra and Multivariate Calculus for Engineers		
Semester/ Year	Fall 2022	Section(s)	Multi-sections		
Office Hours	See Appendix A				
Course Coordinator	Ibrahim Al-Ayyoub				
Office Location	Dep. of Math.	Office Hours	See Appendix A		
Office Tel. Ext.	0235	Email	i.alayyoub@squ.edu.om		
Schedule					
Week	Sec	Topic/Material to be covered			Assessment
		Titles	Examples	Suggested Exercises	
1 11 Sep	7.1	Matrices: Equality of matrices. Addition and scalar multiplication.	1 - 5	8 – 19, 11, 18	
	7.2	Matrix multiplication. Transposition. Special matrices.	1 - 10	11 – 20. 15	
2 18 Sep	7.3	Systems of linear equations. Gauss elimination. Coefficient matrix. Augmented matrix. Elementary row operations. Explain Theorem 1.	1 - 4	1 – 14. 5, 6, 11	
	7.4	Linear independence. Rank of a matrix. Definitions of linear independence and rank. Explain Theorems 1 – 4.	1 - 4	1 – 10 (Find rank), 12 – 16, 17 – 25. 4, 17, 24	
3 25 Sep	7.6, 7.7	Determinants. Cramer’s Rule. Explain Theorems 1 – 4 and rank by determinants.	1, 1-5	7 – 15, 17 – 19, 21 – 25. 13, 17, 22, 23	
	7.8	Finding inverse by Gauss-Jordan method and by method of determinants. Prove Theorem 3 and explain Theorems 1, 2 & 4.	1 - 4	1 – 10, 11 – 15. 8, 14, 15	
4 2 Oct	8.1	The matrix eigenvalue problem. Determining eigenvalues and eigenvectors. Explain Theorems 1 & 3.	1 - 4	1 – 16. 6, 11, 14	Quiz 1 Sun 2/10/2022 Mon 3/10/2022
	8.3	Symmetric, skew symmetric and orthogonal matrices. Prove Theorems 2 & 4 and explain Theorems 1 & 3.	1 - 5	1 – 10, 12 (a), 15, 17. 3, 4, 6, 9	
5 9 Oct	8.4	Diagonalization. Prove Theorems 3 - 4 and explain Theorems 1 – 2. Demonstrate theorems by examples.	1 - 4	1 – 16. 2, 15	
	8.5	Unitary and Hermitian matrices			
6 16 Oct	9.1	Vector algebra in 2-space and 3-space	1, 2, 3	1–31. 4, 7, 14, 21, 24, 28, 31	Quiz 2 Sun 16/10/2022 Mon 17/10/2022
	9.2	Inner product (prove properties: 6 - 8)	1, 2, 3, 5, 6	1–38. 5, 12, 20, 28, 32, 38	
7 23 Oct	9.3	Vector product (prove Theorems 1 & 2)	1, 2, 3, 4, 5, 6	1–34. 4, 12, 25, 27, 28, 31, 32, 34	

.	9.4	Vector and scalar functions and their fields... (prove properties 11, 12, 13 and provide examples for each property)	1, 2, 4, 5	1 – 7, 9 – 14, 15 – 20, 22 – 24. 11, 20, 24	
8 30 Oct	9.5	Curves. Tangents. Arc Length.	1 - 6	1 - 20, 24 – 28, 29 – 34. 5, 8, 12, 18, 26, 30, 33	Midterm Wed 2/11/2022
	9.6	Calculus Review: Functions of several variables	1 - 2		
9 6 Nov.	9.7	Gradient of a scalar field. Directional Derivative. (Prove theorem 1 and explain its consequences). Explain: Theorems 2 & 3. Equations of tangent plane, normal line and Laplacian with examples.	1 - 2	1 – 26, 30 - 42. 8, 30, 39	Homework Handout
	9.8	Divergence of a vector field. Explain incompressible fluid by using eq. of continuity.	1, 2	1 – 9. 5, 9(b-c), 11, 13, 19	
10 13 Nov	9.9	Curl of a vector field. Explain Theorem 1 with example. Prove Theorem 2.	1 - 3	4 – 20. 5, 14 (c, d, e)	
	10.1	Line Integrals. Explain Theorem 2.	1 - 5	2 – 11, 15 – 20. 5, 16, 19	
11 20 Nov	10.2	Path independence of line integrals. Prove Theorem 1. Explain Theorems 2, 3* & 3.	1 - 3	3 – 9, 13 – 19. 4, 9, 18	Quiz 3 Sun 20/11/2022 Mon 21/11/2022
	10.3	Calculus Review: Double integrals. Explain change of order. Change of variables.	1, 2	2 - 8, 9 – 11, 12 – 16 17 – 20. 3, 8, 12	
12 27 Nov	10.4	Green's Theorem in the plane. Explain Green's Theorem.	1 - 3	1 – 10. 3, 9, 10	
	10.5	Parametric surfaces. Explain Theorem 1 with examples.	1 - 5	1 – 19.	
13 4 Dec	10.6	Surface integrals.	1 - 4	1 – 10, 12 – 16. 3, 10, 15	HW Quiz Sun 4/12/2022 Mon 5/12/2022
	10.7	Triple integrals. Divergence theorem of Gauss. Explain Theorem 1.	1 - 2	9 – 18. 11, 14, 15	
14 11 Dec	10.9	Stokes's theorem. Explain Theorem 1 and its relation to Green's theorem	1 - 5	1 – 10, 13 – 20. 3, 7, 15	
15 18 Dec	There will be no classes, but the students can contact their instructors to ask questions				
16 25 Dec	Final Exam 25 / 12 / 2022				

APPENDIX A: INSTRUCTORS OF MULTIPLE SECTIONS					
Sec.	Instructor	Day, Time, and Place	Office # Location	Email	Office Hours
10/11	Ibrahim Al Ayyoub	SUN/TUE 16:15-18:05	0235	i.alayyoub@squ.edu.om	Sun,Tue 10:00-11:50
12	Ibrahim Al Ayyoub	MON 12:00-13:50			
20/21	Kamel Nafa	SUN/THU 10:00-11:50	0234	nkamel@squ.edu.om	Tue 3:00- 4:00 Wed 12:00 – 1:00
22	Kamel Nafa	MON 16:15-18:05			
30/31	Mohamed Boudelloua	MON/WED 08:00-09:50	0237	boudell@squ.edu.om	Mon, Wed 10:00-11:00
32	Mohamed Boudelloua	SUN 14:15-16:05			
50/51	Mohammad Shahryari	MON/WED 12:00-13:50	0127	m.ghalehlar@squ.edu.om	Wed 10:00-12:00
52	Mohammad Shahryari	SUN 16:15-18:05			
60/61	Ibrahim Al Ayyoub	SUN/TUE 08:00-09:50	0235	i.alayyoub@squ.edu.om	Sun,Tue 10:00-11:50
62	Ibrahim Al Ayyoub	MON 14:15-16:05			
70/71	Mohammad Shahryari	SUN/TUE 12:00-13:50		m.ghalehlar@squ.edu.om	Wed 10:00-12:00
72	Mohammad Shahryari	MON 16:15-18:05			
APPENDIX B: ADDITIONAL INFORMATION					
<p>1) There will be NO make-up quizzes or tests if you missed any scheduled quiz or test. If a student misses a quiz or test without a valid excuse, the mark in that component will be ZERO. If within ONE week after a test, a student (who misses the test) brings a valid excuse supported by proper documents that proves the reason of absence, his/her grade will be based on the remaining part of the assessment components.</p> <p>2) Model solutions for the test will be posted on Moodle when marks are announced. Students should check their total marks and see whether all their answers have been marked or not.</p> <p>3) Any requests to review the answers must be made immediately to their instructor within two days after the announcement of marks.</p> <p>4) Final exam is comprehensive and includes all parts of the course.</p>					