SULTAN QABOOS UNIVERSITY

COURSE OUTLINE

PROGRAM: Bachelor of Science Mathematics

1. **Course Code**	MATH3110	
2. **Course Title**	Calculus 3	
3. **Credits**	Credits: 4 Workload: 9 hours (5 contact hours in classroom and 5 hours self-study)	
4. **Pre-requisite Course(s)**	MATH2108-Calculus 2	
5. **Co-requisite Course(s)**		
6. **Equivalent Course(s)**		
7. **Incompatible Course(s)**		
8. **Course Category**	☐University Requirement	☐ University Elective
	☐College Requirement	☐ College Elective
	☒Department Requirement	☐ Department Elective
	☐ Specialization Requirement	☐ SpecializationElective
	☐Other (specify):	
9. **Course Owner**	College:	Department:
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 topics covered include: complex numbers, functions of a complex variable, limits and continuity, analyticity, Cauchy-Riemann equations, harmonic functions, elementary functions of a complex variable, complex integration, Cauchy's theorem, Cauchy's formula and its consequences, Taylor and Laurent series, zeros and singularities, the residue theorem and some of applications.

13. **Teaching/Learning Strategies**

1) Problem solving and Practice exercises.
2) Lecture-Discussion method
3) Cooperative Learning.
4) Organize formative and summative assessments.
5) Analyze students' work and provide feedback.

14. **Assessment Components and Weight [%]**

☒Quizzes 15%	☐Practical	☐Other (specify):
☒Homework assignments 5%	☐Project	
☒In-term examination(s) 30%	☒Final examination 50%	

15. **Grading Method**

☒A-F Scale ☐ Pass/Not passed

16. **Textbook(s) and Supplemental Material**

Textbook: CALCULUS VOLUME 3, EDWIN JED HERMAN AND GILBERT STRANG Download link:https://openstax.org/details/books/calculus-volume-3

17. **Matching Course Objectives with Program Outcomes and SQU Graduate Attributes**		
SQU Graduate Attributes		
A. **SQU graduates should be able to:** 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** 1. interpersonal communication skills and alignment with culture of international labour 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** relishgoodcitizenship 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.	CaPerform manipulations with vectors including addition, substraction, scalar multiplicatoion, the dot and cross products.	The ability to identify, formulate and solve mathematical and/or statistical problems	A1, A3
2.	Find equations for lines and planes in 3-space.	The ability to identify, formulate and solve mathematical and/or statistical problems	A1, A3,B2
3.	Calculate arc-lengths, the unit vector, unit normal vector,binormalvector, and curvature of a parametric curve.	The ability to think analytically and critically, and to engage in innovative applications of mathematics and statistics in diverse areas	A1,B2
4.	Sketch or describe curves and surfaces given by parametric equations.	The ability to apply the knowledge and skills acquired in mathematics and statistics in solving real life problems	A1,A3
5.	Compute double and triple integrals in different coordinates systems (rectangular, polar, cylindrical, spherical).	The ability to think analytically and critically, and to engage in innovative applications of mathematics and statistics in diverse areas	A1,A3, B2
6.	Find exteme values of functions of two or three variables, and find the equations without and with constraint:Lagrange Multipliers Method.	The ability to think analytically and critically, and to engage in innovative applications of mathematics and statistics in diverse areas	A1,B2
7.	Compute double and triple integrals in different coordinates systems (rectangular, polar, cylindrical, spherical).	The ability to apply the knowledge and skills acquired in mathematics and statistics in solving real life problems	A1, A3, B2
8.	Form and investigate Taylor Series, Power Series and Laurent Series of complex functions.	The ability to think analytically and critically, and to engage in innovative applications of mathematics and statistics in diverse areas	A1,B2
9.	Compute line integrals of functions of two and three variables and use the fundamental theorem of line integrals to evaluate the integral of a conservative vector field.	The ability to apply the knowledge and skills acquired in mathematics and statistics in solving real life problems	A1,A3
10.	Apply each of Green's Theorem, Stokes' Theorem and the Divergence Theorem.	The ability to think analytically and critically, and to engage in innovative applications of mathematics and statistics in diverse areas	A1,A3, B2
11.		The ability to think analytically and critically, and to engage in innovative	A1,A3,B2

		applications of mathematics and statistics in diverse areas	
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16. **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 requirement and students` 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) Be responsible for getting help. If you have questions or problems with the work, ask the instructor either in the classroom or during his/her office hours. Your instructor will give you his/her office hours during the first week of the semester. Alternatively, make an appointment with your instructor.

2) Check Moodle regularily for course updates and announcements. To enroll yourself in the Moodle page of the course do the following steps in SQU website.

3) All quizzes will be conducted in the beginning of tutorials. Home work will be assessed by a quiz in the tutorial.

➢ Choose "Online Services", then "E-Learning".

➢ Choose "E-Learning (Academic)", then login using your SQU user name and password.

➢ From the available courses under "College of Science", "Mathematics", choose "MATH3110-Calculus III Fall21-".

➢ The Enrolment key: math3110

3) An "Absentee Warning Notice" will be issued if a student is absent for more than 10% of teaching hours. An "Absentee Withdrawal Notice" will be issued and the student will be deemed to have withdrawn from the course with an 'FW' grade if a student is absent for more than 20% of teaching hours

COURSE INFORMATION			
Course Code	MATH3110	**Course Title**	Calculus 3
Semester/ Year	FALL 2021	**Section(s)**	Multi
Day, Time, and Place			

Course Coordinator	Dr. Sanjiv Gupta		
Office Location	Room Number 0223	**Office Hours**	Monday 10 am-11:30 am, Tuesday 10 am-11:30am
Office Tel. Ext.	2342	**Email**	gupta@squ.edu.om

Tentative Schedule

Week	Lecture #	Topic/Material to be covered	Assessment
1	2.1: Vectors in the plane 2.2: Vector in Three Dimensions	Geometric Vectors: Definition, Addition and Substraction. Vectors in a Coordinate Plane: Components, Position vector, Component Arithmetic (Definition on page 111), Properties of Vector Arithmetic (Theorem 2.1), Magnitude, Unit vectors, The i, j vectors. Rectangular Coordinates System in 3-Space, Octants, Distance Formula, Midpoint Formula, Vector in 3-Space, Component Arithmetic (Rule on page 138), The i, j, k Vectors.	
2	2.3 The Dot Product 2.4 The Cross Product 2.5 Equations of Lines and Planes in Space	Component Form of the Dot Product (Definition 2.3), Propertiers of the Dot Product (Theorem 2.3), Alternative Form of the Dot Product (Theorem 2.4), Angles Between Vectors, Orthogonal Vectors, Criterion for Orthogonal Vectors (Theorem 2.5), Direction Cosines, Component of a vector on another, Projection of a vector onto another, Physical Interpretation of the Dot Product. Cross Product of Two Vectors (Definition 2.9), Properties of the Cross Product (Theorem 2.6), Criteria for Parallel Vectors, Alternative Form of the Cross Product (Theorem 2.7), Special Products, Areas, Volume of a Parallelepiped, Coplanar Vectors. Vector Equation, Parametric Equations of a Line, Symmetric Equations, Perpendicular and Parallel Lines.	
3	2.5 Equations of Lines and Planes in Space 2.6 Quadric Surfaces	Rectangular Equation, Plane and Normal Vector, Parallel and Perpendicular Planes, Graphs. Cylinder, Sphere, Trace of a Surface. Ellipsoid, Elliptic Cone, Elliptic Paraboloid, Hyperbolic Paraboloid, Hyperboloid of One Sheet, Hyperboloid of Two Sheets, Variation of the Equation, origin at (h, k, l), Surfaces of Revolution.	
4	3.1 Vecctor Functions	Vector-Valued Functions	Quiz 1

	3.2 Calculus of Vector-Valued Functions	Limits and Continuity, Limit of a Vector Function (Theorem 3.1), Limit Properties, Continuity, Derivative of a Vector Function (Definition 3.5), Differentiation (Theorem 3.2), smooth Curves, Geometric Interpretation of r'(t), Higher-Order Derivatives, Rules of Differentiation (Theorem 3.3), Integrals of Vector Functions.	
	3.3 Arc Length and Curvature	Length of a Space Curve, Arc Length Function, Curvature (Definition), Tangential (aT) and Normal (aN) Components of Acceleration, The Binormal, Formulas for aT, aN, and Curvature, Radius of Curvature.	
	3.4 Motion in Space	Velocity and Acceleration.	
5	4.1 Functions of Several Variables	Function of Two Variables (Definition); Polynomial and Rational Functions, Graphs, Level Curves, Function of Three or More Variables.	
	4.2 Limits and Continuity	Limit of Functions of Two Variables, Properties of Limits (Theorem 4.1), Using Polar Coordinates, Continuity: Polynimial and Rational Functions, Functions of Three or More Variables.	
	4.3 Partial Derivatives	First-Order Partial Derivatives, Computing a Partial Derivative, Alternative Symbols, Geometric Interpretation, Functions of Three or More Variables, Higher-Order and Mixed Derivatives, Alternative Symbols, Equality of Mixed Partials (Theorem 4.5), Implicit Partial Differentiation	
	4.4 Tangent planes and Linear Approximations	Differentiability of Functions of Two Variables (Definition 4.26), Sufficient Conditions for Differentiability (Theorem 4.7), (Theorem 4.6), Linearization, Local Linear Approximation (Definition 4.25), Differentials (Definition 13.4.3).	

6	4.5 The Chain Rule 4.6 Directional Derivative and the Gradient	Chain Rule for Ordinary Derivatives (Theorem 4.8), Chain Rules for Partial Derivatives (Theorem 4.9), Implicit Differentiation (Theorem 4.11). The Gradient of a Function (Definition 4.39), Directional Derivative (Definition 4.36), Computing a Direction Derivative (4.38), Functions of Three Variables, Maximum Value of the Directional Derivative (Theorem 4.13). Geometric Interpretation of the Gradient, Tangent Planes (Definition is in section 4.4), Theorem 4.14, Surfaces Given by z=f(x,y), Normal Line.	Quiz 2
7	Section 4.7 Maxima/ Minima Problems 4.8 Lagrange Multipliers	Extrema (definition), Relative Extrema (Theorem 4.16), Critical Points (Definition), Second partial Test (Theorem 4.17), Extrema on Closed Bounded Sets (Theroem 4.19). Lagrange Theorem for Functions of Two Variables (Theorem 4.20), Functions of Three Variables.	
8	5.1 The Double Integral over Rectangular Regions 5.2 Double Integrals over General Regions 5.3 Double Integrals in Polar Coordinates	The Double Integral, (Definition), Properties (Theorem 5.1). Fubini's Theorem (Theorem 5.2), Regions of Type I and II, Interated Integrals. Reversing the Order of Integration Surface Area (Definition), Differential of Surface Area. Change of Variables: Rectangular to Polar Coordinates.	MID TERM TEST, 31/10/2022, 6:15 pm-7:25pm
9	5.4 Triple Integrals 5.5 Tiple Integrla in Cylindric	.The Triple Integral (Definition), Evaluation of Iterated Integrals, Applications, Changing the Order of Integration. Tiple Integral in Cylindrical and Spherical Coordinates	

	al and Spherical Coordinates		
10	5.6 Calculating Centres of Mass and Moments of Inertia 5.7 Change of Variables in Multiple Integrals	Lamina with Variable Density-Center of Mass; Moments of Inertia. Change of Variables (Theorem 5.14), Change of Variables in a Triple Integral (Theorem 5.15)	Home Work
11	6.2 Line Integrals 6.3 Conservative Vector fields	Line Integrals in the Plane (Definition 6.5), Geometric Interpretation, Method of Evaluation, Properties, Line Integrals in Space, Method of Evaluation. Vector Filelds, Connection with Line Integrals, Work, Circulation, Gradient Fields, Conservative Vector Fields. A Fundamental Theorem (Theorem 6.7), Path Independence, (Theorem 6.8, Theorem 6.9), Integrals around Closed Paths, Test for a Conservatrive Field (Theorem 6.10), Conservative Vector Fields in 3-space	
12	6.4 Green's Theorem 6.5 Curl and Divergence	Green's Theorem (Theorem 6.12) Curl of a Vector Field (Definition), Conservative Vector Field (Theorem 6.17, 6.18), Divergence (Definition). Parametric Surfaces, Tangent Plane to a Parametric Surface, Area of a Surface (Definition 6.18).	

13	6.6 Surface Integrals 6.7 Stokes Theorem	Surface Integral (Definition), Method of Evaluation, Parametric Surfaces, Oriented Surfaces, Integral of Vector Fields, Flux through a Surface. Stokes' Theorem (Theorem 6.19).	Quiz 3
14	6.8 The Divergence Theorem	Divergence Theorem (Theorem 6.20).	
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APPENDIX A: INSTRUCTORS OF MULTIPLE SECTIONS					
Section	**Instructor**	**Day, Time, and Place**	**Office Location and Extension**	**Email**	**Office Hours**

APPENDIX B: ADDITIONAL INFORMATION

1) Students must NOT share pencils, erasers, calculators, … during Quizzes, Tests and Final exam.

2) 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 Quiz or Test will be ZERO. If within ONE week after a Test, a student (who misses a 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.

3) Model solutions for Tests should have been posted on the Moodle page by the time Test papers are returned during a class. Students should check their totals and that all their answers have been marked. Any requests to review the answers must be made immediately to their instructor while in the classroom. NO request will be accepted after it leaves the classroom.