**University of Asia Pacific (UAP)**

Department of Basic Sciences and Humanities

**Lesson Plan**

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| **Program:** | Computer Science and Engineering (CSE) |
| **Course Title:** | Multivariable Calculus |
| **Course Code:** | MTH-201 |
| **Semester:** | Spring-2019 |
| **Level:** | 2nd year 1st Semester |
| **Credit Hour:** | 3.0 |
| **Name & Designation of Teacher:** | Sk. Reza-E-Rabbi, Lecturer (Mathematics), Department of BS&H. |
| **Office/Room:** | Department of BS&H, 2nd floor, UAP City Campus |
| **Class Hours:** | |  |  | | --- | --- | | Sunday | Tuesday | | 2:00 pm - 3:20 pm  (A) | 2:00 pm - 3:20 pm  (B) | |
| **Consultation Hours:** | |  | | --- | | Thursday | | 10.00 am – 11.00 am | |
| **E-mail:** | [rabbi06@uap-bd.edu](mailto:rabbi06@uap-bd.edu), [rezarabbi06@gmail.com](mailto:rezarabbi06@gmail.com) |
| **Mobile:** | 01746-941913, 01976-941913 |
| **Rationale:** | Calculus is the study of how things change. It provides a framework for modeling systems in which there is change, and a way to deduce the predictions of such models. Multivariable calculus is the extension of calculus in one variable to calculus with functions of several variables. Use of multivariable calculus is widespread in science, engineering, business and many other fields. It can be applied to analyze deterministic systems that have multiple degrees of freedom. It is used in the optimal control of continuous time dynamic systems. It also provides tools in regression analysis to derive formulas for estimating relationships among various sets of empirical data. |
| **Pre-requisite** (if any)**:** | MTH 101, MTH 103 |
| **Course Synopsis:** | **Vectors and the Geometry of Space:** Cylinders and Quadric Surfaces. **Vector Functions:** Vector Functions and Space Curves, Derivatives and Integrals of Vector Functions, Arc Length and Curvature, **Motion in Space:** Velocity and Acceleration.  **Partial Derivatives:** Functions of Several Variables, Limits and Continuity, Partial Derivatives, Tangent Planes and Linear Approximations, The Chain Rule, Directional Derivatives and the Gradient Vector, Maximum and Minimum Values, Lagrange Multipliers.  **Multiple Integrals:** Double Integrals over Rectangles, Iterated Integrals, Double Integrals over General Regions, Double Integrals in Polar Coordinates,Applications of Double Integrals, Surface Area, Triple Integrals, Triple Integrals in Cylindrical Coordinates, Triple Integrals in Spherical Coordinates, Change of Variables in Multiple Integrals.  **Vector Calculus:** Vector Fields, Line Integrals, The Fundamental Theorem for Line Integrals, Green’s Theorem, Curl and Divergence, Parametric Surfaces and Their Areas, Surface Integrals, Stokes’ Theorem, The Divergence Theorem. |
| **Course Objectives (CO):** | The objective of this course is to prepare students to be able to   1. Learn to study the equation of cylinders and different types of quadrics and draw them. 2. Evaluate arc length and curvature. 3. Evaluate line integrals and surface integrals. 4. Evaluate partial and directional derivatives. 5. Solve optimization problems and multiple integrals in different coordinate systems. |
| **Learning Outcomes:** | Students who complete the course will have demonstrated the  ability to do the following:   1. Find the arc length and curvature of a space curve using the formulae for vector functions. 2. Calculate partial and directional derivatives and use them to find equations of tangent planes, normal lines to various surfaces. Solve optimization problems using partial derivatives. 3. Use multiple integrals to find area of surfaces and volumes of different types of solids. 4. Evaluate curl and divergence of a vector field and interpret them. 5. Interpret Green’s theorem, divergence theorem & Stoke’s theorem and use them to various practical situations. |

**Teaching-learning and Assessment Strategy:** Lectures, assignments, Presentation, quizzes, exams

**Assessment Methods& their Weights:**

|  |  |
| --- | --- |
| **Assessment Method** | **(%)** |
|  |  |
| Quiz/Presentation | 15 |
| Class attendance | 10 |
| Assignment | 5 |
| Midterm Exam | 20 |
| Final Exam | 50 |

**Minimum attendance:** 70% class attendance is mandatory for a student in order to appear at the final examination.

**Lecture Schedule**

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| --- | --- | --- |
| **Lectures** | **Topics** | **Assignments** |
| 1,2 | Functions of Several Variables, Limits and Continuity, Partial Derivatives. | **Assignment 1** |
| 3 | Tangent Planes and Linear Approximations, The Chain Rule. |
| **QUIZ 1** | | |
| 4,5 | Directional Derivatives and the Gradient Vector, Maximum and Minimum Values. | **Assignment 2** |
| 6 | Maximum and Minimum Values using Lagrange Multipliers. |
| 7 | Review of Midterm Exam |  |
| **MIDTERM EXAM** | | |
| 8,9 | Double Integrals over Rectangles, Iterated Integrals, Double Integrals over General Regions. | **Assignment 3** |
| 10,11 | Double Integrals in Polar Coordinates,Applications of Double Integrals, Surface Area. |
| **QUIZ 2/Presentation** | | |
| 12,13 | Triple Integrals, Triple Integrals in Cylindrical Coordinates, Triple Integrals in Spherical Coordinates, Change of Variables in Multiple Integrals. | **Assignment 4** |
| 14 | Review of Final Exam Syllabus |  |
| **FINAL EXAM** | | |

**Required References:**

1. James Stewart, Multivariable Calculus [7th Ed.], Cengage Learning.

2. H. Anton, I. Bivens & S. Davis, Calculus [10th Ed.], John Wiley & Sons.

**Grading System:** As per the approved grading scale of University of Asia Pacific (Appendix-1).

**Student’s Responsibilities:** Students must come to the class prepared for the course material covered in the previous class(es).

They must submit their assignments on time.

They must be aware of the *Plagiarism Policy* as spelt out in the curriculum.

No late or partial assignments will be acceptable. There will be no make-up quizzes.

**Attendance/Participation Rubric**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Criteria** | **Unsatisfactory-Beginning** | **Developing** | **Accomplished** | **Exemplary** | **Total** |
| **Attendance** | **0-5 points** | **6-7 points** | **8-9 points** | **10 points** | **/10** |
| 3 or more unexcused absences | 2 unexcused absences | 1 unexcused absences | Attended all class sessions or received approval for all necessary absences |  |
| **Frequency** | **0-5 points** | **6-7 points** | **8-9 points** | **10 points** | **/10** |
| Students does not initiate contribution needs instructor to solicit input | Students initiates contribution at least in half of the class sessions | Students initiates contribution once in each recitation | Students initiates contribution more than once in each class session |  |
| **Quality** | **0-5 points** | **6-7 points** | **8-9 points** | **10 points** | **/10** |
| Comments are uninformative, lacking inappropriate terminology. Heavy reliance on opinion & personal taste ,e.g., “I love you”, “I hate you”, ”It’s bad” etc. | Comments are sometimes constructive, with occasional signs of insight. Student does not use Appropriate terminology; comments not always relevant to the discussion. | Comments mostly insightful & constructive; mostly uses appropriate terminology. Occasionally comments are general or not relevant to the discussion. | Comments always insightful & constructive; uses appropriate terminology. Comments balanced between general impression, opinions & specific, thoughtful criticisms or contributions. |  |
| **Listening** | **0-5 points** | **6-7 points** | **8-9 points** | **10 points** | **/10** |
| Does not listen to the others; regularly talks while others speak or does not pay attention while others speak; detracts from discussion; sleeps, etc | Student is often inattentive and needs reminder of focus of class. Occasionally makes disruptive comments while others are speaking. | Student is mostly attentive when others present ideas, materials, as indicated by comments that reflects & build on others remarks. | Student listens attentively when others present materials, perspectives, as indicated by comments that build on other’s remarks, i.e., student hears what others say & contribute to the dialogue. |  |
|  |  |  |  | **TOTAL** | **/40** |

**Quiz/Mid/Final Rubric**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Score**  **Category** | **10** | **8/9** | **6** | **4** | **2** | **1** | **0** |
| **Type-I**  **(Definition)** |  |  |  |  | Writes the definition clearly | Writes the definition but not so clear | Not correct/  not relevant |
| **Type-II**  **(Problem)** | All steps of calculation and the result are correct, supporting diagram is provided | All steps of calculation are correct, supporting diagram is provided but result is wrong | Most steps of calculation are correct | Some steps of calculation are correct | Starts with correct formula and others work are not aligned with the problem |  | Entire calculation and result is wrong or no response given |
| **Type-III**  **(Theory)** | Statement, relevant diagram and proof with all steps | Statement, relevant diagram and most of the steps of proof | Statement, relevant diagram and some of the steps of proof | | Statement and relevant diagram | | Nothing is shown |

**Assignment Rubric (Mathematics)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Score**  **Category** | **5** | **4** | **3** | **2** | **1** | **0** |
| **Timeliness** | Assignment is submitted on the day it is due | Assignment is submitted  1 day late | Assignment is submitted  2 days late | Assignment is submitted  3 days late | Assignment is submitted  4 days late | Assignment is submitted  after 5 or more days |
| **Completion** | All problems are solved | Almost all (>80%) problems are solved | Most(>50%) problems are solved | Some (>20%) problems are solved | Few (>0%) problems are solved | No problems is solved |
| **Steps of Calculation** | All work is shown step by step | Some steps of work is shown | | Almost all steps are skipped | | No work and no result is shown |
| **Accuracy** | All steps of work and result are correct | All steps of work are correct but result is wrong | Most steps of the work are correct | Some steps of the work is correct | Few steps are correct | Entire work and result is wrong |

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| **Prepared by** | **Checked by** | **Approved by** |
| Sk. Reza-E-Rabbi  Lecturer (Mathematics) Department of BS&H. | Curriculum Committee  Department of CSE | Head/Dean |

**Appendix-1: Grading Policy**

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| **Numeric Grade** | **Letter Grade** | **Grade Point** |
|  |  |  |
| 80% and above | A+ | 4.00 |
| 75% to less than 80% | A | 3.75 |
| 70% to less than 75% | A- | 3.50 |
| 65% to less than 70% | B+ | 3.25 |
| 60% to less than 65% | B | 3.00 |
| 55% to less than 60% | B- | 2.75 |
| 50% to less than 55% | C+ | 2.50 |
| 45% to less than 50% | C | 2.25 |
| 40% to less than 45% | D | 2.00 |
| Less than 40% | F | 0.00 |