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| **Philadelphia University** | PHILADELPHIA UNIVERSITY THE WAY TO THE FUTURE | **Approval date: 20/02/2025** |
| **Faculty of Science** | | **Issue:** |
| **Department of Math** | | **Credit hours: 3** |
| **Academic year 2024/2025** | **Course Syllabus** | **Bachelor** |

## Course information

| Course# | Course title | Prerequisite |
|---|---|---|
| **0250302** | **Calculus 4** | **Calculus 3 0250202** |

| Course type | Class time | Room # |
|---|---|---|
| ☐ University Requirement ☐ Faculty Requirement<br>☒ Major Requirement ☐ Elective ☒ Compulsory | SM<br>12:40 – 13:55 | 21003 |
| **Degree / NQF Level** ☐ Diploma degree (6) ☒ Bachelor degree (7) | | |

## Instructor Information

| Name | Office No. | Phone No. | Office Hours | E-mail |
|---|---|---|---|---|
| Feras Awad | 822 | 2132 | SM 11:15 – 12:15<br>ST 12:30 – 13:30 | fawad@philadelphia.edu.jo |

## Course Delivery Method

| Course Delivery Method | | | |
|---|---|---|---|
| ☒ **Physical** ☐ **Online** ☐ **Blended** | | | |
| **Learning Model** | | | |
| **Precentage** | **Synchronous** | **Asynchronous** | **Physical** |
| | **0%** | **0%** | **100%** |

## Course Description

Calculus 4 explores advanced integration and vector fields, covering double and triple integrals, surface area, parametric surfaces, and change of variables using Jacobians. It includes vector calculus topics like line integrals, Green's Theorem, surface integrals, flux, the Divergence Theorem, and Stokes' Theorem, with real-world applications.

## Course Learning Outcomes

| Number | Outcomes | Corresponding Program outcomes * |
|---|---|---|
| **Knowledge** | | |
| **K1** | Analyze scalar and vector fields to determine if a vector field is conservative. | **$K_p1$** |
| **K2** | Compute line integrals over various paths and apply Green's and Stokes' Theorems correctly to solve related problems. | **$K_p1$** |
| **Skills** | | |
| **S1** | Use computer software like GeoGebra to do calculations and graphs. | **$S_p4$** |
| **Competencies** | | |
| **C1** | Thinking reasonably and the ability to make decisions. | **$C_p1$** |

* According to learning outcomes of the faculty of pharmacy.

## Learning Resources

| | |
|---|---|
| **Course textbook** | Anton H., Bivens I., Davis S. (2011) Calculus: Early Transcendentals (10th ed.). Wiley. |
| **Supporting References** | • Colley S. (2012) Vector Calculus (4th Edition). Pearson. |
| **Supporting websites** | ✓ GeoGebra: https://www.geogebra.org/ |
| **Teaching Environment** | ☒**Classroom** ☐ **laboratory** ☐**Learning platform** ☐**Other** |

## Meetings and Subjects Timetable

| Week | Topic | Learning Methods | Tasks | Learning Material |
|---|---|---|---|---|
| **1** | Explanation of the study plan for the course, and what is expected to be accomplished by the students.<br>**Technology Preliminaries:**<br>Moodle. Microsoft Teams. Geogebra | Lecture | | Course Syllabus<br><br>Software |
| **2** | **MULTIPLE INTEGRALS:**<br>14.1 Double Integrals | Lecture | | Chapter 14 |
| **3** | 14.2 Double Integrals over Nonrectangular Regions | Lecture | | Chapter 14 |
| **4** | 14.3 Double Integrals in Polar Coordinates | Lecture | Quiz | Chapter 14 |
| **5** | **Blessed Eid al-Fitr holiday** | | | |
| **6** | 14.4 Surface Area; Parametric Surfaces | Lecture | | Chapter 14 |
| **7** | 14.5 Triple Integrals<br>14.6 Triple Integrals in Cylindrical and Spherical Coordinates | Lecture | | Chapter 14 |
| **8** | 14.7 Change of Variables in Multiple Integrals; Jacobians | | Midterm | Chapter 14 |
| **9** | **TOPICS IN VECTOR CALCULUS:**<br>15.1 Vector Fields | Lecture | | Chapter 15 |
| **10** | 15.2 Line Integrals | Lecture | | Chapter 15 |
| **11** | 15.3 Independence of Path; Conservative Vector Fields | | | |
| **12** | 15.4 Green's Theorem | Lecture | Quiz | Chapter 15 |
| **13** | 15.5 Surface Integrals<br>15.6 Applications of Surface Integrals; Flux | Lecture | | Chapter 15 |
| **14** | 15.7 The Divergence Theorem<br>15.8 Stokes' Theorem | Lecture | Quiz | Chapter 15 |
| **15** | **Blessed Eid al-Adha holiday** | | | |
| **16** | **Final Exam** | | | |

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

## Course Contributing to Learner Skill Development

| |
|---|
| **Using Technology** |
| • Use GeoGebra to draw curves and surfaces in space. |
| **Communication Skills** |
| • Making a GeoGebra applet that do calculations of any main topic of the course and represents it to the students in class. |
| **Application of Concepts Learnt** |
| • Recognize real life quantities that are scalar fields or vector fields such as the temperature of an object in space, the force, and the velocity |

## Assessment Methods and Grade Distribution

| Assessment Methods | Grade Weight | Assessment Time (Week No.) | Link to Course Outcomes |
|---|---|---|---|
| **Mid Term Exam** | **30%** | **4** | **K1, K2, C1** |
| **Various Assessments *** | **30%** | **Continuous** | **S1, C1** |
| **Final Exam** | **40%** | **8** | **K1, K2, C1** |
| **Total** | **100%** | | |

* Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

## Selected Exercises from the Textbook

| Section Number | Exercises |
|---|---|
| **13.6** | 1, 5, 9, 11, 15, 19, 25, 29, 30, 33, 41, 43, 45, 53, 54, 57, 72, 75 |
| **14.1** | 4, 5, 11, 15, 24, 25, 26, 29 |
| **14.2** | 3, 5, 8, 9, 10, 11, 12, 13, 15, 16, 21, 23, 25, 29, 30, 33, 34, 35, 36, 37, 42, 47, 53, 54, 55, 56, 59 |
| **14.3** | 1, 10, 23, 26, 28, 29, 30, 39 |
| **14.4** | 1, 2, 3, 4, 5, 6. **GeoGebra:** 11, 12, 33, 34, 35, 36, 37, 38 |
| **14.5** | 1, 3, 5, 7, 15 |
| **14.7** | 1, 3, 5, 6, 7, 8, 17, 18, 19, 20, 21, 22, 23, 24, 31, 33 |
| **15.1** | 1, 2, 5, 6, 17, 19, |
| **15.2** | 7, 9, 13, 19, 20, 23, 25, 33, 34, 37 |
| **15.3** | 1, 2, 3, 6, 7, 9, 11, 15, 23, 33 |
| **15.4** | 1, 3, 4, 7, 8, 9, 21, 22, 29 |

## Alignment of Course Outcomes with Learning and Assessment Methods

| Number | Learning Outcomes | Learning Method* | Assessment Method** |
|---|---|---|---|
| **Knowledge** | | | |
| **K1** | Analyze scalar and vector fields to determine if a vector field is conservative. | Lecture | **Exam** |
| **K2** | Compute line integrals over various paths and apply Green's and Stokes' Theorems correctly to solve related problems. | Lecture | **Exam** |
| **Skills** | | | |
| **S1** | Use computer software like GeoGebra to do calculations and graphs. | Case study | **Computer project** |
| **Competencies** | | | |
| **C1** | Thinking reasonably and the ability to make decisions. | Discussion | **Quiz** |

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

** Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

## Course Polices

| Policy | Policy Requirements |
|---|---|
| **Passing Grade** | The minimum passing grade for the course is (50%) and the minimum final mark recorded on transcript is (35%). |

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|---|---|
| **Missing Exams** | • Missing an exam without a valid excuse will result in a zero grade to be assigned to the exam or assessment.<br>• A Student who misses an exam or scheduled assessment, for a legitimate reason, must submit an official written excuse within a week from an exam or assessment due date.<br>• A student who has an excuse for missing a final exam should submit the excuse to the dean within three days of the missed exam date. |
| **Attendance** | The student is not allowed to be absent more than (15%) of the total hours prescribed for the course, which equates to six lectures days (M, W) and seven lectures (S, T, T). If the student misses more than (15%) of the total hours prescribed for the course without a satisfactory excuse accepted by the dean of the faculty, s/he will be prohibited from taking the final exam and the grade in that course is considered (zero), but if the absence is due to illness or a compulsive excuse accepted by the dean of the college, then withdrawal grade will be recorded. |
| **Academic Honesty** | Philadelphia University pays special attention to the issue of academic integrity, and the penalties stipulated in the university's instructions are applied to those who are proven to have committed an act that violates academic integrity, such as: cheating, plagiarism (academic theft), collusion, and violating intellectual property rights. |

## Program Learning Outcomes to be Assessed in this Course

| Number | Learning Outcome | Course Title | Assessment Method | Target Performance level |
|---|---|---|---|---|
| **$K_p1$** | The student has completed knowledge of the basic concepts, facts and theories in mathematics. | Calculus 4 | Quiz | 100% of the students get 60% or more on the rubric. |

## Description of Program Learning Outcome Assessment Method

| Number | Detailed Description of Assessment |
|---|---|
| **$K_p1$** | The student will be given a vector field **F** and he/she will (a) Show that **F** is a conservative vector field. (b) Find a potential function for **F**. (c) Find the work performed by the force field on a particle that moves along a curve represented by parametric equations. |

## Assessment Rubric of the Program Learning Outcome

| | **Weak (**1 pt.**)** | **Not Bad (**2 pts**)** | **Good (**3 pts**)** | **Excellent (**4 pts**)** |
|---|---|---|---|---|
| **Conservative Field**<br>Student should proof that F is conservative. | Calculations are totally wrong. | Calculations were done with major errors. | Calculations were done with minor errors. | Calculations are complete and correct. |
| **Potential Function**<br>Student should find the potential function for F. | Calculations are totally wrong. | Calculations were done with major errors. | Calculations were done with minor errors. | Calculations are complete and correct. |
| **The Work**<br>Student should calculate the work performed by the force field on a particle that moves along curve. | Calculations are totally wrong. | Calculations were done with major errors. | Calculations were done with minor errors. | Calculations are complete and correct. |