

AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)

Faculty of Science and Technology (FST)

Department of Mathematics

Undergraduate Program



**COURSE PLAN**

**SUMMER 2021-2022** SEMESTER

1. Course Core and Title

**Mat 1205: Integral Calculus and Ordinary Differential Equations**

1. Credit

**3 credit hours (3 hours of theory per week)**

1. Nature

**Core Course for CS** and Engineering

1. Prerequisite

**Differential Calculus and Coordinate Geometry.**

1. **Vision:**

Our vision is to be the preeminent Department of Mathematics through creating recognized professionals who will provide innovative solutions by leveraging contemporary research methods and development techniques of computing that is in line with the national and global context.

1. **Mission:**

The mission of the Department of Mathematics of AIUB is to educate students in a student-centric dynamic learning environment; to provide advanced facilities for conducting innovative research and development to meet the challenges of the modern era of computing, and to motivate them towards a life-long learning process.





**I - Course Description:**

* Idea about Indefinite and definite integrals.
* Comprehend numerical integrations.
* Comprehend improper integrals and application of integration.
* Define and explain multiple integrals.
* Solutions of different types of ordinary differential equations and their applications.
* Comprehend System of linear ordinary differential equations.

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**II – Course Outcomes (CO) Matrix:**

By the end of this course, students should be able to:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **COs**\* | **CO Description** | Level of Domain\*\* | | | | PO  Assessed\*\*\* |
| C | P | A | S |
| CO1 | Know different techniques of integrations and ODE. | 2 |  |  |  | 1 |
| CO2 | Use definite integrals in different applications. |  | 3 |  |  | 2 |
| CO3 | Evaluate multiple integrals and their applications. |  | 3 |  |  | 2 |
| CO4 | Formulate and solve different types of ordinary differential equations, system of linear differential equations. |  |  | 4 |  | 2 |

*C: Cognitive; P: Psychomotor; A: Affective; S: Soft-skills (CT: Critical Thinking, TS: Teamwork)*

*\* CO assessment method and rubric of COs assessment is provided in Appendix section*

*\*\* The numbers under the ‘Level of Domain’ columns represent the level of Bloom’s Taxonomy each CO corresponds to.*

*\*\*\* The numbers under the ‘PO Assessed’ column represent the PO (appendix) each CO corresponds to.*



**III – Topics to be covered in Theory class\*:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TOPICS** | **Specific Objective(s)** | **Time**  **Frame** | **Suggested**  **Activities** | **Teaching**  **Strategy(s)** | **CO mapped** |
| Introduction, Indefinite integrals | Introducing students, the |  |  |  | CO1 |
| Introduction, standard integrals, integration by substitution. | Week 1 | Lecture Discussion | Lecture notes, question- answer session. |
| Definite integrals | Riemann sum, Fundamental theorem of calculus, definite integrals and its properties, numerical integration by Trapezoidal rule and application. |  |  |  |  |
|  |  | Lecture notes, |  |
| Week 2 | Lecture | question- | CO1, CO2 |
|  | Discussion | answer session. |  |
| Application of integration | Area between two curves in Cartesian and Polar coordinates. Volume of a solid obtained by rotation, center of mass. | Week 3  & 4 | Lecture  Discussion | Lecture notes,  question-  answer session. | CO1, CO2 |
| Improper integrals | Introduction. Beta function and Gamma function. | Week 5 | Lecture Discussion | Lecture notes, question- answer session. | CO1 |
| Methods of Integration | Integration by parts, Integration of trigonometric functions, rational and irrational functions, integration by trigonometric substitution. | Week 6 | Lecture Discussion | Lecture notes, question- answer session. | CO1 |
| Midterm Week  Week 7 | | | | | |

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| --- | --- | --- | --- | --- | --- |
| Multiple integrals | Iterated integrals, Double and triple integrals. Applications of double and triple integrals (area, volume and surface area, center of mass) | Week 8 | Lecture (Definition, Need, Real-life examples) | Lecture notes, question- answer session. | CO3 |
| Ordinary Differential Equations | Definition, order, degree of DE. | Week 9 & 10 | Lecture Discussion | Lecture notes, question- answer session. | CO4 |
| Solution of first-order differential Equations | Separation of variables, Exact DE, Integrating factors, linear and Bernoulli equations, and initial value problem with its application. | Lecture Discussion | Lecture notes, question- answer session. | CO1, CO4 |
| Solution of Higher-order differential equations | Complementary function, particular integral, Inverse operator method, method of undetermined coefficients, variation of parameters and applications | Week 11 & 12 | Lecture Discussion Case studies | Lecture notes, question- answer session. | CO1, CO4 |
| System of linear first-order differential equation | Definition, homogeneous system of two linear first order equations, the general solution, solution for initial value problem, nonhomogeneous system of DE, general solution and application. | Week 13 | Lecture Discussion | Lecture notes, question- answer session. | CO1, CO4 |
| Final term Week  Week 14 | | | | | |

\* The faculty reserves the right to change, amend, add or delete any of the contents.



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**IV- Course Requirements**

At least 80% class attendance is mandatory to pass the course. All students are expected to attend all scheduled classes as well as counseling, and to read all assigned chapters/materials before coming to class. If there is any assignment given to the students, they have to submit it before the deadline decided by the course teacher.



**V – Evaluation & Grading System**

Marking system for theory classes (Midterm and Final term)

1. Quizzes --------------------------------------------------------40

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1. Attendance & Performance ---------------------------------10
2. Midterm/Final term assessment ------- 20
3. Viva-------------------------------------------------------------20
4. Assignment----------------------------------------------------10

## Total 100

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**Grand Total 40% of Midterm + 60% of Final Term**



|  |  |  |
| --- | --- | --- |
| **Letter** | **Grade Point** | **Numerical %** |
| A+ | 4.00 | 90-100 |
| A | 3.75 | 85-<90 |
| B+ | 3.50 | 80-<85 |
| B | 3.25 | 75-<80 |
| C+ | 3.00 | 70-<75 |
| C | 2.75 | 65-<70 |
| D+ | 2.50 | 60-<65 |
| D | 2.25 | 50-<60 |
| F | 0.00 | <50(Failed) |
| I | Incomplete | |
| W | Withdrawal | |
| UW | Unofficially Withdrawal | |
|  |  |  |

The evaluation system will be strictly followed as par the AIUB grading policy.



**VI- Teaching Methods**

Most of the topics will be covered from the textbook. For the rest of the topics, reference books will be followed. Class lectures will be uploaded on the web on a regular basis. White board will be used for most of the time. Multimedia projector will be used for the convenience of the students. Students must study up to the last lecture before coming to the class and it is suggested that they should go through the relevant topics before coming to the class. Just being present in the class is not enough- students must participate in classroom discussion and classwork actively.

1. Calculus– J. Stewart, - 8th edition, Cengage Learning, Inc.



**VII – Textbook/ References**

2. Differential Equations – P. Blanchard, R. L. Devaney, G. R. Hall.

3. Calculus–H. Anton, I.C. Bivens and S. Davis.-10th edition, John Wiley & Sons Inc.

4. Differential Equations – S.L. Ross.- 3rd edition, John Wiley & Sons Inc.

5. Calculus with Analytical Geometry –G.B. Thomas and R.L. Finny.- 9th edition, Addison-Wesley Publishing Company

6. Differentials and Integral Calculus – F. Ayres (Schaum’s Outline Series).-2nd edition, McGraw Hill.



**VII- List of Faculties Teaching the Course**



**VIII – Verification:**

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| --- | --- | --- |
| **Prepared by :**  **Dr. M. Mostafizur Rahman**  Date:......................................... | **Moderated by :**  **Ayesha Siddiqua**  Date:......................................... | **Moderated by :**  **Md. Mahfuzur Rhaman**  Date:......................................... |
| **Checked by:** | **Certified by:** | **Approved by:** |
| .................................................... | ......................................................... | ......................................................... |
| **Dr. Mohammed Jashim Uddin**  *Head*,  *Department of Mathematics* | **Dr. Dip Nandi**  *Director*,  *Faculty of Science & Technology* | **Mr. Mashiour Rahman**  *Associate Dean*,  *Faculty of Science & Technology* |
| Date:.......................................... | Date:............................................... | Date:............................................... |

**APPENDIX**

**Program Outcomes (POs)**



|  |  |
| --- | --- |
| **PO1** | **Engineering Knowledge** |
| **1** | Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems. |
| **PO2** | **Problem Analysis** |
| **2** | Identify, formulate, research and analyze complex engineering problems and reach substantiated conclusions using the principle of mathematics, the natural sciences and the engineering sciences |

## Mapping of CO Assessment Method and Rubric

The mapping between Course Outcome(s) (COs) and The Selected Assessment method(s) and the mapping between Assessment method(s) and Evaluation Rubric(s) is shown below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CO** | **Description** | **Learning Domain** | **Assessment Method** | **Assessment Rubric** |
| CO1 | Understand indefinite and definite integrals. | Cognitive | Quiz/ Term Question, Assignment | Rubric for Quiz/ Term Question, Assignment |
| CO2 | Application of definite integrals. | Psychomotor | Quiz/ Term Question, Assignment | Rubric for Quiz/ Term Question, Assignment |
| CO3 | To evaluate multiple integrals and their applications. | Psychomotor | Quiz/ Term Question, Assignment | Rubric for Quiz/ Term Question, Assignment |
| CO4 | To solve and analyze different types of ordinary differential equations, system of linear ordinary differential equations. | Psychomotor | Quiz/ Term Question, Assignment | Rubric for Quiz/ Term Question, Assignment |

## Rubric for Quiz/ Term Question, Assignment (CO1)A picture containing diagram Description automatically generated:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Marking Criteria** | **Marks Distribution (Maximum 5X3=15)** | | | | **Acquired Marks** |
| **Inadequate**  **(1-2)** | **Satisfactory**  **(3)** | **Good**  **(4)** | **Excellent**  **(5)** |
| **Definition** | * Student does not answer or vaguely define the terms or concept | * Definition provided with partial relevance to the subject matter. | * Correctly define the terms. May miss minor detail. | * Correctly and comprehensively define the term with examples. |  |
| **Fundamental concepts of integration** | * No usage of laws or incorrect usage of laws. | * Usage of laws without mentioning the name of laws. | * Usage of laws with mentioning the name of laws but with minor mistakes. | * Proper usage of laws mentioning their names correctly and without any mistake. |  |
| **Correctness of answer** | * Arrived at incorrect answer. | * Arrived at correct answer but with some logical errors. | * Arrived at correct answer with minor errors. | * Arrived at correct answer with no error. |  |
| **Acquired Marks:** | | | | |  |
| **CO Pass / Fail:** | | | | |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Marking Criteria** | **Marks Distribution (Maximum 5X3=15)** | | | | **Acquired Marks** |
| **Inadequate (1-2)** | **Satisfactory (3)** | **Good (4)** | **Excellent (5)** |
| **Definition** | * Student does not define or vaguely define the terms or concept | * Definition provided with partial relevance to the subject matter. | * Correctly define the terms. May miss minor detail. | * Correctly and comprehensively define the terms. |  |
| **Application of definite integrals in finding area and volume** | * Student does not provide correct method to solve   problems. | * Provided answer with partial relevance to the subject matter. | * provided answer with minor mistakes. | * Correct answer provided with no mistake. |  |
| **Correctness of answer** | * Arrived at incorrect answer. | * Arrived at correct answer but with some missing steps. | * A picture containing diagram    Description automatically generatedArrived at a correct answer with minor errors. | * Arrived at correct answer showing all the relevant steps and with no error. |  |
| **Acquired Marks:** | | | | |  |
| **CO Pass / Fail:** | | | | |  |

Rubric for Quiz/ Term Question, Assignment (CO2):

Rubric for Quiz/ Term Question, Assignment (CO3):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Marking Criteria** | **Marks Distribution (Maximum 5X3=15)** | | | | **Acquired Marks** |
| **Inadequate (1-2)** | **Satisfactory (3)** | **Good (4)** | **Excellent (5)** |
| **Definition** | * Student does not define or vaguely define the terms or concept | * Definition provided with partial relevance to the subject matter. | * Correctly define the terms. May miss minor detail. | * Correctly and comprehensively define the terms. |  |
| **Evaluate multiple integrals and their applications for finding area, volume, center of mass** | * Student does not provide correct method to solve problems. | * Provided answer with partial relevance to the subject matter. | * Provided answer with minor mistakes. | * Correct answer provided with no mistake. |  |
| **Correctness of answer** | * Arrived at incorrect answer. | * Arrived at correct answer but with some missing steps. | * A picture containing diagram    Description automatically generatedArrived at a correct answer with minor errors. | * Arrived at correct answer showing all the relevant steps and with no error. |  |
| **Acquired Marks:** | | | | |  |
| **CO Pass / Fail:** | | | | |  |

Rubric for Quiz/ Term Question, Assignment (CO4):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Marking Criteria** | **Marks Distribution (Maximum 5X3=15)** | | | | **Acquired Marks** |
| **Inadequate (1-2)** | **Satisfactory (3)** | **Good (4)** | **Excellent (5)** |
| **Definition** | * Student does not define or vaguely define the terms or concept | * Definition provided with partial relevance to the subject matter. | * Correctly define the terms. May miss minor detail. | * Correctly and comprehensively define the terms. |  |
| **Solving different types of ordinary differential equations and applying for different physical problems, system of linear ordinary differential equations.** | * Student does not provide correct method to solve problems. | * Provided answer with partial relevance to the subject matter. | * Provided answer with minor mistakes. | * Correct answer provided with no mistake. |  |
| **Correctness of answer** | * Arrived at incorrect answer. | * Arrived at correct answer but with some missing steps. | * A picture containing diagram    Description automatically generatedArrived at a correct answer with minor errors. | * Arrived at correct answer showing all the relevant steps and with no error. |  |
| **Acquired Marks:** | | | | |  |
| **CO Pass / Fail:** | | | | |  |