هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

# Course Specifications

| | |
|---|---|
| **Course Title:** | **Calculus (1)** |
| **Course Code:** | **MAT 1101** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☑ Others ☐ |
| **b.** | Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 1 / Year 1** |
| **4.Pre-requisites for this course** (if any)**:** | **None** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

This course describes the most important ideas, theoretical results, and examples of limit, continuity, differentiation and its applications for functions with one variable. The course includes the essential fundamentals of these topics. The emphasis is on calculations, and some applications are mentioned.

**2. Course Main Objective**

Understanding basics of differentiation and integration and their applications which are essential to proceed to next courses in all programs.

**3. Course Learning Outcomes**

| | CLOs<br>Upon successful completion of this course, students will be able to: | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | Identify various types of limits of functions of one variable (graphically, numerically and algebraically) | K1, K2 |
| 1.2 | Describe different techniques of differentiation and its applications. | K1, K2 |

| CLOs<br>Upon successful completion of this course, students will be able to: | | Aligned-PLOs |
|---|---|---|
| **2** | **Skills:** | |
| 2.1 | **Use differentiation and integration to solve real world problems such as rate of change, optimization, and area problems.** | **S1, S2** |
| 2.2 | **Demonstrate the connection between area and the definite integral through Fundamental theorem of Calculus.** | **S4** |
| 2.3 | **Draw graphs of functions handily and by using CAS and online solvers.** | **S5** |
| 2.4 | **State, clearly and precisely both orally and in writing, areas and definite integrals by Riemann sums** | **S3** |
| **3** | **Values:** | |
| 3.1 | **Work individually.** | **V1, V3** |
| 3.2 | **Develop personal values and attributes such as honesty, empathy and respect for others.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Preliminaries:** Solving Linear Equations and Inequalities, Absolute value, Solving Inequalities Containing an Absolute Value, Equations of lines, Quadratic Equations and Inequalities, Special Product Formulas, Polynomials, Factoring Polynomials; Functions: Domain, Range, and graphs of functions, Common Functions, Composition of functions, Inverse function; Trigonometry: Unit Circle, Angles and their Measurements, Solving Equations Involving Sines and Cosines, Important Trigonometric Identities, Trigonometric Functions (Sine, Cosine, and Tangent Function), Inverses Trigonometric Functions, Exponential and Logarithmic Functions, Laws of Exponents and Logarithms. | 20 |
| 2 | **Limits and Continuity:** The Concept of Limit, Formal definition of limit, Limit Theorems, Limits Involving Infinity, Asymptotes, The natural number e as a limit, Continuity of functions, Operations on continuous functions, Intermediate value theorem, The Bisection Method, Formal definition of the limit. | 16 |
| 3 | **Differentiation:** Tangent Lines and Velocity, The Derivative, Computation of Derivatives: The Power Rule, Higher Order Derivatives, The Product and Quotient Rules, The Chain rule, Derivatives of Trigonometric Functions and their inverses, Derivatives of Exponential and Logarithmic Functions, Implicit Differentiation, The Rule Theorem, The Mean Value Theorem. | 18 |
| 4 | **Applications of Differentiation:** Indeterminate Forms and L'Hopital's Rule, Maxima and minima values, Monotonic functions and the first derivative test, Concavity and the second derivative test, Graphing functions. | 18 |
| **Total** | | 72 |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding** | | |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.1 | Identify various types of limits of functions of one variable (graphically, numerically and algebraically) | • 4 lecture hours\week<br>• 2 tutorial hours\week<br>• Self-study | • Regular Exams<br>• Assignments<br>• Short Quizzes |
| 1.2 | Describe different techniques of differentiation and its applications. | | |
| **2.0** | **Skills** | | |
| 2.1 | Use differentiation and integration to solve real world problems such as rate of change, optimization, and area problems. | • Self-study<br>• Real-life problems | • Participations<br>• Short Quizzes |
| 2.2 | Demonstrate the connection between area and the definite integral through Fundamental theorem of Calculus. | Self-study | Participations |
| 2.3 | Draw graphs of functions handily and by using CAS and online solvers. | Real-life problems | Short Quizzes |
| 2.4 | State, clearly and precisely both orally and in writing, areas and definite integrals by Riemann sums | Self-study | Participations |
| **3.0** | **Values** | | |
| 3.1 | Work individually. | Personal questions | Participation |
| 3.2 | Develop personal values and attributes such as honesty, empathy and respect for others. | Team work and class discussions. | Homework and Mini-projects |

**2. Assessment Tasks for Students**

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Homeworks, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**

- **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**
- **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.**

## F. Learning Resources and Facilities

**1.Learning Resources**

| | |
|---|---|
| **Required Textbooks** | ***Calculus***, 4th Edition, R. T. Smith, R. B. Minton, McGraw-Hill, 2012. **(Main Reference)** |

| | |
|---|---|
| **Essential References Materials** | 1. ***Calculus***; O. Swokowski, et al, PWS Pub. Co.; 6th Edition, 1994.<br>2. ***Calculus: Early Transcendentals***, 7th Edition; C. Henry Edwards, David E. Penney, Pearson Prentice Hall, 2008.<br>3. ***Essential Calculus with Application***; Richard A. Silverman, Dover Publications, 1989.<br>4. ***Schaum's Outline of Calculus***, 6th Edition; Frank Ayres, Elliott Mendelson, McGraw-Hill, 2013. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

## 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL** |
| **Reference No.** | **11/1444** |
| **Date** | **22/04/1444 (16/11/2022)** |

| | |
|---|---|
| **Course Title:** | **Calculus (2)** |
| **Course Code:** | **MAT 1102** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

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## A. Course Identification

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|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 2 / Year 1** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1101** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples of integration technics, infinite series, and parametric equations. The course includes the essential fundamentals of these topics. The emphasis is on calculations, and some applications are mentioned.**

**2. Course Main Objective**

- **To understand the meaning of definite integral as a limit of Riemann sum.**
- **To learn different techniques of integration.**
- **To understand the applications of definite integrals to physics and Engineering.**
- **To develop the basics of the calculus of infinite series, and their applications.**

### 3. Course Learning Outcomes

| | CLOs<br>Upon successful completion of this course, students will be able to: | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **Identify different techniques of integration and improper integrals.** | **K1, K2** |
| 1.2 | **List theorems and tests of convergence of sequences and series.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Use the concepts of definite integrals to solve problems involving area, volume, work, and other physical applications.** | **S1, S2** |
| 2.2 | **Apply the concepts of limits, convergence, and divergence to evaluate some classes of infinite series and/or improper integrals.** | **S4** |
| 2.3 | **Illustrate the revolution of a solid region using CAS and online solvers.** | **S5** |
| 2.4 | **State clearly and precisely both orally and in writing, Taylor or MacLaurin series to estimate the representation of functions as power series.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **Shows self-reliance when working independently.** | **V1, V3** |
| 3.2 | **Develop constructive and supportive relationships with classmates.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Integration:** Anti-derivatives, Indefinite Integral and its properties, Sums and Sigma Notation, Partitions and Riemann sums, Area under curves and The Definite Integral, First and Second Fundamental Theorems of Calculus. | **14** |
| 2 | **Integration Techniques:** Integration by Substitution, Integration by Parts, Integration of Rational Functions Using Partial Fractions, Trigonometric Techniques of Integration, Integrals involving logarithmic, exponential, and hyperbolic functions, Improper Integrals. | **18** |
| 3 | **Applications of Definite Integrals:** Area between curves, Volumes by slicing, Volumes using Cylindrical Shells, Arc Length and Surface Area. | **10** |
| 4 | **Infinite Series:** Sequences of Real Numbers, Convergence and Divergence of Infinite Sequences, Formal definition of a convergent sequence, Infinite Series, Basic Infinite Series (geometric series, p-series, alternating series, telescoping series), Convergence Tests for Positive Series (ratio test, root test, comparison and limit comparison test, integral test), Alternating Series, Absolute and Conditional Convergence, Power Series, Differentiation ad Integration of power series, Taylor and Maclaurin Series, Convergence of Taylor series, Applications of Taylor and Maclaurin Series. | **20** |
| 5 | **Parametric equations:** Plane Curves and Parametric Equations, Calculus and Parametric Equations, Arc Length and Surface in Parametric Equations. | **10** |
| | **Total** | **72** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | Identify different techniques of integration and improper integrals. | ●4 lecture hours\week<br>●2 tutorial hours\week<br>●Self-study | ●Regular Exams<br>●Assignments<br>●Short Quizzes |
| 1.2 | List theorems and tests of convergence of sequences and series. | | |
| 2.0 | **Skills** | | |
| 2.1 | Use the concepts of definite integrals to solve problems involving area, volume, work, and other physical applications. | ●Self-study<br>●Real-life problems | ●Participations<br>●Short Quizzes |
| 2.2 | Apply the concepts of limits, convergence, and divergence to evaluate some classes of infinite series and/or improper integrals. | Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 2.3 | Illustrate the revolution of a solid region using CAS and online solvers. | Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 2.4 | State clearly and precisely both orally and in writing, Taylor or MacLaurin series to estimate the representation of functions as power series. | Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 3.0 | **Values** | | |
| 3.1 | Shows self-reliance when working independently. | Class discussion | Participation |
| 3.2 | Develop constructive and supportive relationships with classmates. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ***Calculus***, 4th Edition; R. T. Smith, R. B. Minton, McGraw-Hill, 2012. **(Main Reference)** |
| **Essential References Materials** | 1. ***Essential Calculus with Application;*** Richard A. Silverman, Dover Publications, 1989.<br>2. ***Calculus***; O. Swokowski, et al, PWS Pub. Co.; 6th Edition, 1994.<br>3. ***Calculus: Early Transcendentals***, 7th Edition; C. Henry Edwards, David E. Penney, Pearson Prentice Hall, 2008.<br>4. ***Schaum's Outline of Calculus***, 6th Edition; Frank Ayres, Elliott Mendelson, McGraw-Hill, 2013. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Foundations of Mathematics** |
| **Course Code:** | **MAT 1151** |
| **Program:** | **Bachelor of Science in Applied Statistics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** University ☐ College ☐ Department ☑ Others ☐ | |
| **b.** Required ☑ Elective ☐ | |
| **3. Level/year at which this course is offered:** | **Level 3 / Year 1** |
| **4.Pre-requisites for this course** (if any)**:** | **None** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples of logic, set theory, methods of proof, relations, functions and basics of algebraic structures limit. The course includes the essential fundamentals of these topics. The emphasis is on step by step reasoning and mathematical thinking.**

**2. Course Main Objective**

- **To give students the rudiments of mathematical logic and set theory.**
- **To introduce the important concepts of relations, functions, and binary operations.**

- **To expose students to some abstraction by presenting the group concept and studying some of its elementary properties. To learn about vector calculus.**

### 3. Course Learning Outcomes

| CLOs<br>Upon successful completion of this course, students will be able to: | | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | **Reproduce proofs of basic set-theoretic identities involving unions, intersections, and Cartesian products.** | **K1, K2** |
| 1.2 | **Recognize the concept of Logic including truth table logical statement, set theory ,method of proofs and basics of algebraic structures.** | **K1, K2** |
| **2** | **Skills** | |
| 2.1 | **Construct proofs using a variety of proof techniques including: direct proofs, proofs by contraposition and contradiction, proofs by mathematical induction to solve a given problem.** | **S1, S2** |
| 2.2 | **Formulate in logical the negation, converse, and contrapositive of a quantified implication, both linguistically and in Mathematical symbolic form.** | **S4** |
| 2.3 | **Analyze carefully abstract proofs to provide appropriate instances.** | **S5** |
| 2.4 | **Present proofs both orally and in written form using correct and concise English and mathematical grammar.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **Aspire to improve and develop, learning from mistakes;** | **V1, V3** |
| 3.2 | **Engage in group discussions and critical interactions.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Logic:** Statements, Negation, and Compound Statements, Truth Tables and Logical Equivalences, Conditional and Biconditional Statements, Open Statements and Quantifiers. | **12** |
| 2 | **Set Theory:** Sets and Subsets, Operations on Sets, Generalized Set Union and Intersection, Cartesian Product. | **9** |

| No | List of Topics | Contact Hours |
|---|---|---|
| 3 | **Methods of Proofs:** Direct proof method; Contrapositive proof method; Proof by contradiction; If and only if proof; Existence proof and counterexample method; Mathematical induction and its strong version. | **15** |
| 4 | **Relations:** Binary Relations, Reflexive, Symmetric, antisymmetric, and Transitive Relations, Equivalence Relations, Equivalence Classes, and Partitions, The Order Relations. | **15** |
| 5 | **Functions:** Functions, Onto Functions, One-to-One Functions, The bijection function, Inverse of a Function, Images and Inverse Images of Sets, Denumerable and Countable Sets, Uncountable Sets. | **9** |
| 6 | **Basics of Algebraic Structures:** Binary operations; Semigroups and Groups; Subgroups and Cyclic Groups; Rings, Integral Domains and Fields. | **12** |
| **Total** | | **72** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding** | | |
| 1.1 | **Reproduce proofs of basic set-theoretic identities involving unions, intersections, and Cartesian products.** | • 2 lecture hours\week<br>• 2 tutorial hours\week<br>• Self-study | • Regular Exams<br>• Assignments<br>• Short Quizzes |
| 1.2 | **Recognize the concept of Logic including truth table logical statement, set theory ,method of proofs and basics of algebraic structures.** | • 2 lecture hours\week<br>• 2 tutorial hours\week<br>Self-study | • Regular Exams<br>• Assignments<br>Short Quizzes |
| **2.0** | **Skills** | | |
| 2.1 | **Construct proofs using a variety of proof techniques including: direct proofs, proofs by contraposition and contradiction, proofs by mathematical induction to solve a given problem.** | • Self-study<br>• Real-life problems | • Participations<br>• Short Quizzes |
| 2.2 | **Formulate in logical the negation, converse, and contrapositive of a quantified implication, both linguistically and in Mathematical symbolic form.** | Self-study<br>Real-life problems | Participations |
| 2.3 | **Analyze carefully abstract proofs to provide appropriate instances.** | Self-study<br>Real-life problems | Short Quizzes |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 2.4 | Present proofs both orally and in written form using correct and concise English and mathematical grammar. | Self-study<br>Real-life problems | Participations |
| **3.0** | **Values** | | |
| 3.1 | Aspire to improve and develop, learning from mistakes; | Class discussion | Participation |
| 3.2 | Engage in group discussions and critical interactions. | Team work and class discussion. | Homework and Mini-projects |

**2. Assessment Tasks for Students**

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Homeworks, Quizzes, Mini-projects | During the semester | 20% |
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***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

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- **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.**

## F. Learning Resources and Facilities

**1.Learning Resources**

| | |
|---|---|
| **Required Textbooks** | 1. ***Introduction to Mathematical Proofs: A Transition***, C. Roberts; Champan & Hall/CRC 2010. **(Main Reference)**<br>2. *A Primer for Logic and Proof,* **H. P. Hirst and J. L. Hirst, webdraft, (2011-2012 Ed.), 2012.** |
| **Essential References Materials** | 1. ***Mathematical Thinking & Writing: A transition to Abstract Math***, R. Maddox, Academic Press, 2002.<br>2. **Mathematical Proofs: *A Transition to Advanced Mathematics*,** 3rd Edition, Gary Chartrand, Albert D. Polimeni, Ping Zhang, Pearson, 2014. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

## 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation** (Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ Each class room should be equipped with a whiteboard and a projector.<br>▪ Laboratories should be equipped with computers and an internet connection. |
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| **Other Resources** (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | None. |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
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| Effectiveness of teaching and assessment, Quality of learning resources. | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
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**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
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**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

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|---|---|
| **Council / Committee** | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| **Reference No.** | 11/1444 |
| **Date** | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Calculus (3)** |
| **Course Code:** | **MAT 1203** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

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| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 4 / Year 2** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1102** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**Creating a deep background of multivariable calculus and its applications which is essential to proceed to next courses.**

**2. Course Main Objective**

- **To demonstrate ability to work with different geometries in the space.**
- **To study functions of several variables and partial differentiation.**
- **To be able to set up and compute multiple integrals in rectangular, polar, cylindrical and spherical coordinates.**
- **To master the vector operations in different coordinate systems.**

### 3. Course Learning Outcomes

| CLOs | | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | **Describe parametric and polar curves in plane and recognize regions and quadric surfaces in space.** | **K1, K2** |
| 1.2 | **Express double and triple integrals in different coordinate systems. in rectangular, polar, cylindrical, and spherical.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Apply the computational and conceptual principles of vector calculus, including partial derivatives and multiple integrals, to the solutions of various problems** | **S1, S2** |
| 2.2 | **Interpret, clearly and precisely both orally and in writing, calculus operations on vector-valued functions including limits, derivatives, integrals, curvature, and the description of motion in plane and space.** | **S4** |
| 2.3 | **Illustrate figures in different coordinates using a CAS and some online solvers.** | **S5** |
| 2.4 | **Calculate arc length /surface/volume of regions in 2 and 3 dimensions, in Cartesian, polar, cylindrical, and spherical coordinate systems, directional derivatives, equations of tangent planes, and gradient vectors.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **listen to the teacher's explanation of the Mathematics reasoning and illustration of 3D figures.** | **V1, V3** |
| 3.2 | **Show attitude of support the use of computers in learning/teaching mathematics** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Vectors and Geometry of Space:** Vectors in Space, Dot Product, Cross Product, Equations of Lines and Planes in Space, Quadratic Surfaces in Space. | **14** |
| 2 | **Vector-Valued Functions:** Vector-Valued Functions, Calculus of Vector Functions, Motion in Space, Curvature, Tangent and Normal Vectors. | **14** |
| 3 | **Functions of several variables:** Functions of Several Variables, Limits and Continuity, Partial Derivatives, Differentiability, The Total Derivative, The Directional Derivatives and Gradient, Tangent Plane and Linear Approximation, Taylor's Theorem in Severable variables, Chain Rule, Maxima and Minima, Method of Lagrange Multipliers. | **22** |
| 4 | **Multiple Integrals:** Double Integrals in Cartesian Coordinates, Areas and Volumes, Polar Coordinates, Double Integrals in Polar Coordinates, Surface Area, Triple Integrals in Cartesian Coordinates, Cylindrical and Spherical Coordinates, Triple Integrals in Cylindrical and Spherical Coordinates, Change of Variables in Multiple Integrals. | **22** |
| **Total** | | **72** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding** | | |
| 1.1 | Describe parametric and polar curves in plane and recognize regions and quadric surfaces in space. | lecture hours\week<br>tutorial hours\week<br>Self-study | ●Regular Exams<br>●Assignments<br>●Short Quizzes |
| 1.2 | Express double and triple integrals in different coordinate systems. in rectangular, polar, cylindrical, and spherical. | lecture hours\week<br>tutorial hours\week<br>Self-study | ●Regular Exams<br>●Assignments<br>Short Quizzes |
| 2.0 | **Skills:** | | |
| 2.1 | Apply the computational and conceptual principles of vector calculus, including partial derivatives and multiple integrals, to the solutions of various problems. | ●Self-study<br>●Real-life problems | ●Participations<br>●Short Quizzes |
| 2.2 | Interpret, clearly and precisely both orally and in writing, calculus operations on vector-valued functions including limits, derivatives, integrals, curvature, and the description of motion in plane and space. | Self-study | Participations |
| 2.3 | Illustrate figures in different coordinates using a CAS and some online solvers. | Real-life problems | Short Quizzes |
| 2.4 | Calculate arc length /surface/volume of regions in 2 and 3 dimensions, in Cartesian, polar, cylindrical, and spherical coordinate systems, directional derivatives, equations of tangent planes, and gradient vectors. | Self-study | Participations |
| 3.0 | **Values:** | | |
| 3.1 | listen to the teacher's explanation of the Mathematics reasoning and illustration of 3D figures. | Class discussion | Participation |
| 3.2 | Show attitude of support the use of computers in learning/teaching mathematics | Problem solving, Class discussion | Homework and Mini-projects and presentation |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**
- **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.**

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ▪ ***Calculus***, 4th Edition; R. T. Smith, R. B. Minton, McGraw-Hill, 2012. **(Main Reference)** |
| **Essential References Materials** | ▪ ***Advanced Engineering Mathematics, 8th Edition, E. Kreyszig, John Wiley & Sons, INC, 1998.***<br>▪ ***Calculus, 6th Edition, O. Swokowski, et al, PWS Pub. Co., 1994.***<br>▪ ***Calculus Early Transcendentals, 7th Edition; C. Henry Edwards, David E. Penney, Prentice Hall, 2008.***<br>▪ ***Calculus, 1st Edition, F. Ayres & E. Mendelson, Schaum's Outline McGraw-Hill, 1999.*** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Linear Algebra** |
| **Course Code:** | **MAT 1223** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 4 / Year 2** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1151** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples of matrices, vector spaces, linear transformations, eigenvalues and eigenvectors. The course includes the essential fundamentals of these topics. The emphasis is on calculations.**

**2. Course Main Objective**

- **To provide students with a good understanding about matrices concept and methods of linear algebra**
- **To let students be familiar with basics of vector spaces and linear transformations.**
- **To connect linear algebra to other fields.**

### 3. Course Learning Outcomes

| CLOs<br>Upon successful completion of this course, students will be able to: | | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | Recognize concept of concepts of linear algebra matrix and determinant and eigenvalues. | K1, K2 |
| 1.2 | Identify structure and features of vector space and linear dependence and linear independence. | K1, K2 |
| 2 | **Skills:** | |
| 2.1 | Find inverse of a square matrix by using its determinant and extension matrix to solve some world-real problems. | S1, S2 |
| 2.2 | State, clearly and precisely both orally and in writing, the general solution of at most a 4×4 linear system using appropriate method of linear algebra matrix including Gaussian elimination and matrix inversion. | S4 |
| 2.3 | Use CAS and online solver to manipulate matrices. | S5 |
| 2.4 | Compute eigenvalues and eigenvectors of square matrix to produce the diagonalization of the matrix. | S3 |
| 3 | **Values:** | |
| 3.1 | Work individually and in group | V1, V3 |
| 3.2 | Show attitude of support the use of computers in Matrix manipulation. | V1, V2 |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Matrices and Gauss Elimination:** Linear Systems and Matrices (Gauss Eliminations, Echelon & Reduced Echelon Forms, Matrix Operations, Matrix Inverses), Determinants (Minor & Cofactors, Evaluating Determinants, Cramer's Rule, Adjoints & Matrix Inverses). | 20 |
| 2 | **Vector Spaces:** Spaces $\mathbb{R}2$ & $\mathbb{R}3$ and their Geometry, Vector Spaces and Subspaces, Euclidean Vector Spaces $\mathbb{R}n$, Linear Dependence & Independence, Basis and Dimensions of Vector Space, Change of a Basis- Inner Products (Norms, Angle and Orthogonality). | 20 |
| 3 | **Linear Transformations:** Definition and Basics, The Kernel and the Image, Linear Transformation Matrix, Nonsingular Transformations and their Inverses, The Direct Sum, The Dimension Theorem. | 18 |
| 4 | **Eigenvalues and Eigenvectors:** Characteristic Polynomial, Eigenvalues, Eigenvectors, Diagonalization, Triangulation, Matrix Powers. | 14 |
| **Total** | | 72 |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding** | | |
| 1.1 | Recognize concept of concepts of linear algebra matrix and determinant and eigenvalues. | • 4 lecture hours\week<br>• 2 tutorial hours\week | • Regular Exams<br>• Assignments<br>• Short Quizzes |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| | | ●Self-study | |
| 1.2 | Identify structure and features of vector space and linear dependence and linear independence. | ●4 lecture hours\week<br>●2 tutorial hours\week<br>Self-study | ●Regular Exams<br>●Assignments<br>Short Quizzes |
| 2.0 | Skills: | | |
| 2.1 | Find inverse of a square matrix by using its determinant and extension matrix to solve some world-real problems. | ●Self-study<br>●Real-life problems | ●Participations<br>●Short Quizzes |
| 2.2 | State, clearly and precisely both orally and in writing, the general solution of at most a 4×4 linear system using appropriate method of linear algebra matrix including Gaussian elimination and matrix inversion. | Regular Exams | Participations |
| 2.3 | Use CAS and online solver to manipulate matrices. | Assignments | Short Quizzes |
| 2.4 | Compute eigenvalues and eigenvectors of square matrix to produce the diagonalization of the matrix. | Short Quizzes | Participations |
| 3.0 | Values: | | |
| 3.1 | Work individually and in group | Class activities | Individual and group coursework |
| 3.2 | Show attitude of support the use of computers in Matrix manipulation. | Class discussion | participation |

## 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

# E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ▪ *Elementary Linear Algebra;* **11th Edition; H. Anton, C. Rorres, Wiley, 2014. (Main Reference)** |
| **Essential References Materials** | ▪ *Linear Algebra with Application,* **5th Edition; W. K. Nicholson, McGraw- Hill, 2006.**<br>▪ *Linear Algebra with Application,* **4th Edition; O. Bretscher; Pearson Ed. Int., 2009.**<br>▪ *Linear Algebra, Schaum's Outline,* **S. Lipschutz, M. Lipson, McGraw-Hill 3rd Edition, 2000** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Introduction to Number Theory** |
| **Course Code:** | **MAT 1225** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type**<br>**a.** University ☐ College ☐ Department ☒ Others ☐<br>**b.** Required ☒ Elective ☐ | |
| **3. Level/year at which this course is offered:** | **Level 6 / Year 2** |
| **4.Pre-requisites for this course** (if any)**:** | **None** |
| **5. Co-requisites for this course** (if any)**:**<br>**None** | |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples of divisibility, factorizations and congruences. The course includes the essential fundamentals of these topics. The emphasis is on calculations, and some applications are mentioned.**

**2. Course Main Objective**

- **To expose students to the fascinating subject of number theory.**
- **To let students, gain basic knowledge in number theory; this is essential for subsequent courses in mathematics and computer science.**
- **To prepare student for abstract mathematics courses like "Modern Algebra".**

### 3. Course Learning Outcomes

| CLOs | | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **Recognize the concepts of divisibility, prime number, congruence and number theorems.** | **K1, K2** |
| 1.2 | **Duplicate Euclid's algorithm, Fermat Theorem, Euler Theorem and Wilson's Theorem.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Solve some Diophantine equations and problems on selected applications of Number theory using Euclid's algorithm, Fermat Theorem, Euler Theorem and Wilson's Theorem.** | **S1, S2** |
| 2.2 | **Apply rigorously the quadratic reciprocity law in computing and proving some statements in number theory including questions about divisibility and primes.** | **S4** |
| 2.3 | **Use online solvers related to number theory applications.** | **S5** |
| 2.4 | **Compute the order of integers and primitive roots modulo primes.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **Defend the ideas and axioms underpinning the mathematics** | **V1, V3** |
| 3.2 | **Engage in group discussions and critical interactions.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Divisibility and factorizations**: Divisibility properties, the division algorithm, representation of a number relative to arbitrary base, the binary digit system, Fundamental theorem of arithmetic, infinitude of prime numbers, greatest common divisors and least common multiple, Euclidean algorithm and Bezout's identity. | **16** |
| 2 | **Congruences**: Congruence and modular arithmetic, Diophantine linear equation, Chinese Remainder Theorem and system of linear Diophantine equations. Wilson's Theorem, Little Fermat's Theorem, Euler phi function and Euler Theorem. | **16** |
| 3 | **Applications**: divisibility tests, round-robin tournaments, pseudo primes, pseudorandom numbers, linear codes, Pythagorean triples and sum of two squares. | **12** |
| 5 | **Divisibility and factorizations**: Divisibility properties, the division algorithm, representation of a number relative to arbitrary base, the binary digit system, Fundamental theorem of arithmetic, infinitude of prime numbers, greatest common divisors and least common multiple, Euclidean algorithm and Bezout's identity. | **16** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | Recognize the concepts of divisibility, prime number, congruence and number theorems. | •3 lecture hours\week<br>•2 tutorial hours\week<br>•Self-study | •Regular Exams<br>•Assignments<br>•Short Quizzes |
| 1.2 | Duplicate Euclid's algorithm, Fermat Theorem, Euler Theorem and Wilson's Theorem. | | |
| 2.0 | **Skills:** | | |
| 2.1 | Solve some Diophantine equations and problems on selected applications of Number theory using Euclid's algorithm, Fermat Theorem, Euler Theorem and Wilson's Theorem | Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 2.2 | Apply rigorously the quadratic reciprocity law in computing and proving some statements in number theory including questions about divisibility and primes. | Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 2.3 | Use online solvers related to number theory applications. | Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 2.4 | Compute the order of integers and primitive roots modulo primes. | Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 3.0 | **Values** | | |
| 3.1 | Defend the ideas and axioms underpinning the mathematics | Class discussion. | Participation |
| 3.2 | Engage in group discussions and critical interactions. | Team work | Group classwork |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ▪ *Elementary Number Theory,* **7th Edition, David M. Burton, McGraw Hill, 2011. (Main Reference).** |
| **Essential References Materials** | ▪ *Elementary Number Theory*, **5th edition, K. Rosen, Addison-Wesley, 2004.**<br>▪ *An Introduction to Mathematical Reasoning: Numbers, Sets and Functions*, **P. Eccles, Academic Express, 1997.**<br>▪ *Elementary Theory of Numbers*, **W. Le Veque, Dover Publications, 1990.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Introduction to Differential Equations** |
| **Course Code:** | **MAT 1231** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 6 / Year 2** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1102, MAT 1223** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples of first order differential equations, second and higher order linear differential equations, Laplace transform and linear systems of linear differential equations. The course includes the essential fundamentals of these topics. The emphasis is on calculations, and some applications are mentioned. The use of Symbolic MATLAB software to solve differential equations is essential.**

**2. Course Main Objective**

- **Classify differential equations by order, linearity, and homogeneity.**
- **Be familiar with techniques for solving first, second and higher order differential equations.**
- **Solve systems of linear differential equations solving linear system of differential equations using matrix techniques and eigenvalues and notion of the exponential of matrices.**
- **Use Laplace transforms to solve differential equations and systems of differential equations.**

### 3. Course Learning Outcomes

| | CLOs<br>Upon successful completion of this course, students will be able to: | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **Summarize the concept of ordinary differential equations, the meaning of the meaning of their solutions, and the methods to find them.** | **K1, K2** |
| 1.2 | **Classify differential equations with respect to their order and linearity to match the corresponding methods to solve them.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Solve real-world problems involving Cauchy-Euler equations Bernoulli, Ricatti differential equations and other initial value problems in fields of such as economics, engineering, and the sciences.** | **S1, S2** |
| 2.2 | **Formulate, clearly and precisely, differential equations to solve various applied problems.,** | **S4** |
| 2.3 | **Using Symbolic MATLAB software and online CAS to find and visualize solutions of differentia equations.** | **S5** |
| 2.4 | **Solve first-order and second-order and high-order ordinary differential equations using the appropriates methods including integration, the method of undetermined coefficients, the method of variations of parameters, Laplace transform.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **Engage in group discussions and critical interactions** | **V1, V3** |
| 3.2 | **differentiate between valid and fallacious Mathematical arguments to model real problem involving differential equations.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **First order differential equations:** Separable equations, First order linear equations, Exact differential equations, Homogeneous differential equations, Bernoulli equations, Riccati equations. | **14** |
| 2 | **Second order linear differential equations:** General solution of the homogeneous linear equation with constant coefficients, Particular solution of the non-homogeneous equation, Method of Undetermined Coefficients, Variation of Parameters Method. | **14** |
| 3 | **Higher order linear differential equations:** General theory of linear differential equations, Homogeneous linear equations with constant coefficients, Undetermined Coefficients Method, Variation of Parameters Method. | **10** |
| 4 | **Laplace Transforms:** Basic definitions and properties, First shifting theorem, Partial fractions, Differentiation and integration of Laplace transforms, Laplace transform of some particular discontinuous functions, the unit step function, Dirac function, shifting on the t- axes and second shifting theorem, Inverse of Laplace transform, Convolution, Solving Initial Value Problems Using Laplace Transforms. | **16** |
| 5 | **Linear systems of differential equations:** Superposition principle, Independence, Matrix exponential, Basic theory of systems of first order linear equations, Homogeneous linear systems with constant coefficients, non-homogeneous linear systems of differential equations. | **12** |

| | | |
|---|---|---|
| 6 | **Using Symbolic MATLAB software to solve differential equations.** Brief introduction to symbolic MATLAB software, solving some generic ODE with examples. | **6** |
| **Total** | | **72** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding:** | | |
| 1.1 | **Summarize the concept of ordinary differential equations, the meaning of the meaning of their solutions, and the methods to find them.** | **●4 lecture hours\week<br>●2 tutorial hours\week<br>●Self-study** | **●Regular Exams<br>●Assignments<br>●Short Quizzes** |
| 1.2 | **Classify differential equations with respect to their order and linearity to match the corresponding methods to solve them.** | **●4 lecture hours\week<br>●2 tutorial hours\week<br>Self-study** | **●Regular Exams<br>●Assignments<br>Short Quizzes** |
| **2.0** | **Skills:** | | |
| 2.1 | **Solve real-world problems involving Cauchy-Euler equations Bernoulli, Ricatti differential equations and other initial value problems in fields of such as economics, engineering, and the sciences.** | **Self-study Real-life problems** | **Participations<br>Short Quizzes** |
| 2.2 | **Formulate, clearly and precisely, differential equations to solve various applied problems.,** | **Self-study Real-life problems** | **Participations<br>Short Quizzes** |
| 2.3 | **Using Symbolic MATLAB software and online CAS to find and visualize solutions of differentia equations.** | **Self-study Real-life problems** | **Participations<br>Short Quizzes** |
| 2.4 | **Solve first-order and second-order and high-order ordinary differential equations using the appropriates methods including integration, the method of undetermined coefficients, the method of variations of parameters, Laplace transform.** | **Self-study Real-life problems** | **Participations<br>Short Quizzes** |
| **3.0** | **Values:** | | |
| 3.1 | **Engage in group discussions and critical interactions** | **Class discussion and team work** | **Participation and homework report.** |
| 3.2 | **differentiate between valid and fallacious Mathematical arguments to model real problem involving differential equations.** | **Class discussion** | **Participation, mini-project and homework.** |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | **Home works, Quizzes, Mini-projects** | **During the term** | **20%** |
| 2 | **First Midterm** | **Week 4-5** | **20%** |

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**
- **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.**

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ▪ ***Elementary Differential Equations and Boundary Value Problems,*** W. Boyce and R. DiPrima, 9th Edition, New York: John Wiley & Sons, 2010. (Main Reference) |
| **Essential References Materials** | ▪ ***Advanced Engineering Mathematics,*** E. Kreyszig, John Wiley & Sons, INC 10th Edition, 2010.<br>▪ ***Fundamentals of Differential Equations,*** R. Nagle, E. Saff and A. Snider, Addison-Wisley, 6th Edition, 2011.<br>▪ ***A first course in differential equations with applications,*** Dennis G. Zill, 5th Edition, PWS Kent Publishing Company, 2000. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation** (Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources** (AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources** (Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Math Software** |
| **Course Code:** | **MAT 1241** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **3 (2 Lectures, 2 Lab, 0 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 4 / Year 2** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1102** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 48 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 24 |
| 2 | Laboratory/Studio | 24 |
| 3 | Tutorial | 0 |
| 4 | Others (specify) | 0 |
| | Total | 48 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples for an introduction in MATLAB programming. The emphasis is on calculations, and programming.**

**2. Course Main Objective**

- **To provide an introduction to the use of some of the high-level mathematical programming language such MATLAB, Maple and Mathematica, as a practical aid in doing mathematics.**
- **To provide the student with some basic skills in the use of this software without attempting deep coverage.**

### 3. Course Learning Outcomes

| CLOs | | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **Recognize the environment of software "Matlab".** | **K1, K2** |
| 1.2 | **Reproduce a range of syntaxes using Matlab.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Create code to provide a solution to a range of Mathematical problems ranging from simple to complex.** | **S1, S2** |
| 2.2 | **Design and implement, clearly and precisely, simple programs.** | **S4** |
| 2.3 | **Convert Matlab code into a given to online solver.** | **S5** |
| 2.4 | **Construct algorithms, M-file script and calculus operation design to solve mathematical problems via Matlab.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **Work individually and in groups.** | **V1, V3** |
| 3.2 | **Show attitude of support the use of mathematical software in solving real life problems.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Starting with MATLAB:** Introduction to the software and computer, MATLAB windows, ***help*** and ***look for*** commands, arithmetic operations, Display Formats, Built-in functions, Variables assignment, Elementary built-in functions, Command line editing. | **4** |
| 2 | **Arrays:** Creating arrays (vectors, matrices), *Lin space* command, some major matrices, operators, Matrix operations in MATLAB, Array addressing, Adding and deleting elements, Strings. | **7** |
| 3 | **Other Operators:** Operator Precedence, Relational operations, Logical operations, ***all*** and ***any*** commands, ***find*** command, ***sort*** command, ***max*** and ***min*** command. | **6** |
| 4 | **2D and 3D graphs:** ***Plot*** and ***ezplot*** command, ***fplot*** command, multigraphs plots, others plot commands, axis and graphic handling, layout a figure, 3D line plot, Mesh and Surface plots, view command. | **6** |
| 5 | **Script files:** Creating and saving a file, ***disp*** and ***fprintf*** commands, loading a file, search path, defining functions, structure of a function file, ***inline*** function, ***feval*** command, local and global variables, … | **6** |
| 6 | **Starting with MATLAB:** Introduction to the software, Command window, help and look for commands, arithmetic operations, Display Formats, Built-in functions, Variables assignment, Command line editing. | **7** |
| 7 | **Programming**: If-else structure, for and while loops, Break and continue commands, Switch-case statement. | **6** |
| 8 | **Symbolic toolbox:** Symbolic object and expressions, algebraic expression manipulation, factorization, simplification, solving equations. | **6** |
| **Total** | | **48** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | Recognize the environment of software "Matlab". | ●2 lecture hours\week<br>●2 tutorial hours\week<br>●Self-study | ●Regular Exams<br>●Assignments<br>●Short Quizzes |
| 1.2 | Reproduce a range of syntaxes using Matlab. | | |
| 2.0 | **Skills:** | | |
| 2.1 | Create code to provide a solution to a range of Mathematical problems ranging from simple to complex. | ●Self-study<br>●Real-life problems | Participations, Short Quizzes |
| 2.2 | Design and implement, clearly and precisely, simple programs. | Self-study.<br>Real-life problems | Participations, Short Quizzes |
| 2.3 | Convert Matlab code into a given to online solver. | Self-study<br>Real-life problems | Participations, Short Quizzes |
| 2.4 | Construct algorithms, M-file script and calculus operation design to solve mathematical problems via Matlab. | Self-study<br>Real-life problems | Participations, Short Quizzes |
| 3.0 | **Values:** | | |
| 3.1 | Work individually and in groups. | Personal questions | Participation |
| 3.2 | Show attitude of support the use of mathematical software in solving real life problems. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ▪ ***Introduction to MATLAB***, Delores Etter, Pearson Education Inc, 4th Edition, 2018. **ISBN: 978-0-13-461528-8 (Main Reference)** |
| **Essential References Materials** | ▪ ***MATLAB: An Introduction with Applications,*** 3rd Edition; Amos Gilat, The Ohio State Univ. 2008.<br>▪ ***MATLAB Primer,*** K. Sigmon and T. Davis, Champan& Hall, 6th Edition, 2002.<br>▪ ***Maple V: learning Guide,*** K. Heal & K. Rickard, Springer Verlag, 1996.<br>▪ ***Mathematica by example,*** M. Abell& J. Braselton, Academic Express, 1997. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Introduction to Operations Research** |
| **Course Code:** | **MAT 1253** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 6 / Year 2** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1151** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples of an introduction to operations research. The course includes the essential fundamentals of linear and integer programming. The emphasis is on calculations, and some applications are mentioned.**

**2. Course Main Objective**

**After finishing this course, the student should be able to formulate a real problem with a linear program (if possible) and to solve it with the appropriate method (Simplex algorithm, special algorithms for transportation or assignment problems, or algorithms for integer programming) by hand (if possible) or by using TORA software.**

### 3. Course Learning Outcomes

| CLOs<br>Upon successful completion of this course, students will be able to | | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **Identify a Linear Programming Problem and its formulation.** | **K1, K2** |
| 1.2 | **Summarize techniques of operations research including Linear Programming, Assignment Problem. Integer programming, simplex, duality and sensitive analysis.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Solve proposed real-life problems by applying the methodology and tools of Operations Research including Linear Programming, Assignment Problem. Integer programming, simplex, duality and sensitive analysis.** | **S1, S2** |
| 2.2 | **Model in mathematical language understandable operational research problems from the verbal description of the real system.** | **S4** |
| 2.3 | **Use of TORA software to solve and online solver to solve some to solve the proposed models..** | **S5** |
| 2.4 | **Employ clearly, the best strategy Solve linear programming problems using appropriate techniques and optimization solvers.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **work individually.** | **V1, V3** |
| 3.2 | **Relate well to others and maintain good relationships;** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Introduction to Linear programming:** Overview, Linear programming formulations, Graphical Linear Programming Solution, Graphical Sensitivity analysis. | **8** |
| 2 | **The Simplex Method:** Standard Linear Programming, Determination of Basic Feasible Solutions; The Simplex Algorithm. | **8** |
| 3 | **Special Cases of the Simplex:** Degeneracy, Alternative optimum, Unbounded solution, Infeasibility. | **6** |
| 4 | **Duality and Sensitivity Analysis:** Formulation of the Dual Problem, Relationship between Optimal Primal and Optimal Dual Solutions, Economic interpretation of Duality, Dual Simplex and Sensitivity Analysis. | **10** |
| 5 | **Special linear programming models:** The transportation model, The assignment model. | **8** |
| 6 | **Introduction to Integer Linear Programming:** Illustrative applications, Branch and Bound algorithm, Application to the Traveling Salesman Problem. | **10** |
| 7 | **Tora Software:** Use of TORA software to solve exercises and problems from all course chapters. | **10** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | Identify a Linear Programming Problem and its formulation. | ●3 lecture hours\week<br>●2 tutorial hours\week<br>Self-study | ●Regular Exams<br>●Assignments<br>●Short Quizzes |
| 1.2 | Summarize techniques of operations research including Linear Programming, Assignment Problem. Integer programming, simplex, duality and sensitive analysis. | ●3 lecture hours\week<br>●2 tutorial hours\week<br>Self-study | ●Regular Exams<br>●Assignments<br>Short Quizzes |
| 2.0 | **Skills:** | | |
| 2.1 | Solve proposed real-life problems by applying the methodology and tools of Operations Research including Linear Programming, Assignment Problem. Integer programming, simplex, duality and sensitive analysis. | ●Self-study<br>●Real-life problems | ●Participations<br>●Short Quizzes |
| 2.2 | Model in mathematical language understandable operational research problems from the verbal description of the real system. | ●Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 2.3 | Use of TORA software to solve and online solver to solve some to solve the proposed models.. | ●Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 2.4 | Employ clearly, the best strategy Solve linear programming problems using appropriate techniques and optimization solvers. | ●Self-study<br>Real-life problems | Participations<br>Short Quizzes |
| 3.0 | **Values** | | |
| 3.1 | work individually. | Class discussion | Participation |
| 3.2 | Relate well to others and maintain good relationships; | Class discussion Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

| |
|---|
| **Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**<br>• **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**<br>• **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.** |

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ▪ ***Operations Research: An Introduction*****,** H. Taha, Prentice Hall, 8th Edition, 2006. **(Main Reference)** |
| **Essential References Materials** | ▪ ***Introduction to Operations Research*****,** F. Hillier and G. Lieberman, 7th Edition, McGraw Hill, 2001. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course** |

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| | | **report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Real Analysis** |
| **Course Code:** | **MAT 1311** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 7 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1203** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course gives students the theoretical foundations underlying the topics taught in typical Calculus courses. It will cover the fundamentals of mathematical analysis, algebraic and order properties of the real numbers, the least upper bound axiom, limits, continuity, differentiation, the Riemann integral, sequences and series of functions and uniform continuity. An understanding and construction of proofs will be stressed throughout the course.**

**2. Course Main Objective**

- **To give a careful and rigorous treatment of the main ideas of differential calculus which was taught to students in Calculus I and Calculus II.**
- **To let students, gain experience in dealing with axiomatic thinking and concise proofs of calculus.**
- **To expose students to the rudiments of metric and topological spaces.**

### 3. Course Learning Outcomes

| | CLOs<br>Upon successful completion of this course, students will be able to: | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | Summarize the fundamental concepts real sequences and real functions of a single variable: continuity, limits, differentiation, integration, and convergence types.. | K1, K2 |
| 1.2 | Describe the real line as a complete, ordered field, and basic differences between the rational and the real numbers, as well as, the difference between pointwise and uniform convergence of a sequence of functions. | K1, K2 |
| 2 | **Skills:** | |
| 2.1 | Construct appropriate logical structure of proofs based on Stone-Weierstrass' theorem, Cauchy criterion, the contraction theorem, the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis. | S1, S2 |
| 2.2 | Communicate mathematical ideas in written form. | S4 |
| 2.3 | Appraise how to search the internet and using software programs to deal with problem. | S5 |
| 2.4 | Compute, in rigorous mathematical way, the real analysis tools, such as the limit of sequences/sum of series/ sequence of functions and Riemann integrals. | S3 |
| 3 | **Values:** | |
| 3.1 | Independently, create approaches to unfamiliar mathematical problems. | V1, V3 |
| 3.2 | To work in groups. | V1, V2 |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Fundamentals:** The field of real numbers; The least upper bound property; Completeness property; Archimedean property; Density of Rationales in the set of real numbers, Nested Intervals property. | 15 |
| 2 | **Real sequences:** Formal definition of the limit; Limit theorems; monotonicity; Boundedness; Subsequences and Bolzano-Weierstass Theorem; Cauchy criterion. | 15 |
| 3 | **Limits and Continuity:** Formal definition of the limit; right and left limits; continuity; Continuous Functions on Intervals; uniform continuity. | 14 |
| 4 | **Differentiation:** Derivative of a function; The Mean Value Theorem; main applications to calculus. | 8 |
| 5 | **Riemann's Integral:** Riemann Sums, Riemann Integral, Properties of Riemann Integral, Case of Monotonic Functions, Case of Continuous Functions, The Fundamental Theorem of Calculus. | 10 |
| 6 | **Sequences of functions:** Pointwise convergence, uniform convergence, applications on uniform convergence. | 10 |
| | **Total** | 72 |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | Summarize the fundamental concepts real sequences and real functions of a single variable: continuity, limits, differentiation, integration, and convergence types.. | ●4 lecture hours\week<br>●2 tutorial hours\week<br>●Self-study | ●Regular Exams<br>●Assignments<br>●Short Quizzes |
| 1.2 | Describe the real line as a complete, ordered field, and basic differences between the rational and the real numbers, as well as, the difference between pointwise and uniform convergence of a sequence of functions. | ●4 lecture hours\week<br>●2 tutorial hours\week<br>Self-study | ●Regular Exams<br>●Assignments<br>Short Quizzes |
| 2.0 | **Skills:** | | |
| 2.1 | Construct appropriate logical structure of proofs based on Stone-Weierstrass' theorem, Cauchy criterion, the contraction theorem, the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis. | ●Self-study<br>●Real-life problems | ●Participations<br>●Short Quizzes |
| 2.2 | Communicate mathematical ideas in written form. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 2.3 | Appraise how to search the internet and using software programs to deal with problem. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 2.4 | Compute, in rigorous mathematical way, the limit of sequences/sum of series/ sequence of functions and Riemann integrals. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 3.0 | **Values:** | | |
| 3.1 | Independently, create approaches to unfamiliar mathematical problems. | Class discussion. | Participation |
| 3.2 | To work in groups. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

| |
|---|
| **Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**<br>• **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**<br>• **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.** |

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| ***Required Textbooks*** | ▪ ***Introduction to Real Analysis, 4th Edition; R. Bartle, D. Sherbert, Wiley,2011. (Main Reference)*** |
| **Essential References Materials** | ▪ ***Introduction to Real Analysis*****, William F. Trench, (Pearson Education)**<br>▪ ***Real and Complex Analysis*****, W. Rudin, 3rd edition, McGraw-Hills, 1987.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Modern Algebra** |
| **Course Code:** | **MAT 1321** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 8 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1223, MAT 1225** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course is an introduction to the principles and concepts of modern algebra. Topics will include the theory of groups with their structures. It discusses also the theory of rings and their ideals, emphasizing Euclidean domains.**

**2. Course Main Objective**

- **Understand elementary concepts of group theory as Definition of Group, Subgroups, Cyclic Groups, Euler's theorem, Cosets, Lagrange's theorem, Normal Subgroups, quotient Groups.**
- **Understand Structures of groups.**
- **Understand Rings, polynomial rings.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **Identify fundamental structures of abstract algebra including groups, rings, fields, and integral domains by definitions and examples and non-examples** | **K1, K2** |
| 1.2 | **Discuss the fundamental theorem of finite Abelian groups, integral domains and fields, principal ideal domains, and polynomial rings.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Apply fundamental theorems of modern algebra such as Syllow Theorem and isomorphism theorems, and Irreducibility criteria to solve problems in applied settings.** | **S1, S2** |
| 2.2 | **Write to communicate the topics of modern algebra using rigorous proof writing conventions, explanations, and correct mathematical notation.** | **S4** |
| 2.3 | **Use information technology to algebraic structures in the context of modern algebra topics through consideration of examples.** | **S5** |
| 2.4 | **Analyze similarities and differences between algebraic structures including groups, rings, fields, and integral domains.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **Demonstrate a sense of self-worth** | **V1, V3** |
| 3.2 | **Relate well to others and maintain good relationships;** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Group Theory:** Review, Definition of Group, Subgroups, Cyclic Groups, Euler's theorem, Cosets, Lagrange's theorem, Normal Subgroups, quotient Groups. | **20** |
| 2 | **Structures of groups:** Isomorphism Theorems, Conjugacy, Group acting on Sets, Finite Abelian Groups, Sylow Theorems, Examples of Simple Groups. | **14** |
| 3 | **Rings:** Basic definitions and examples, Ring Homomorphisms, Ideals. Quotient Ring, Principal Ideal Domains, Euclidean Domains, Fields. | **20** |
| 4 | **Polynomial rings:** Definitions and basic property, Polynomial Rings over fields. Irreducibility criteria. | **18** |
| **Total** | | **72** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | Identify fundamental structures of abstract algebra including groups, rings, fields, and integral domains by definitions and examples and non-examples | ●4 lecture hours\week<br>●2 tutorial hours\week<br>●Self-study | ●Regular Exams<br>●Assignments<br>●Short Quizzes |
| 1.2 | Discuss the fundamental theorem of finite Abelian groups, integral domains and fields, principal ideal domains, and polynomial rings. | ●4 lecture hours\week<br>●2 tutorial hours\week<br>Self-study | ●Regular Exams<br>●Assignments<br>Short Quizzes |
| 2.0 | **Skills:** | | |
| 2.1 | Apply fundamental theorems of modern algebra such as Syllow Theorem and isomorphism theorems, and Irreducibility criteria to solve problems in applied settings. | ●Self-study<br>●Real-life problems | ●Participations<br>●Short Quizzes |
| 2.2 | Write to communicate the topics of modern algebra using rigorous proof writing conventions, explanations, and correct mathematical notation. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 2.3 | Use information technology to algebraic structures in the context of modern algebra topics through consideration of examples. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 2.4 | Analyze similarities and differences between algebraic structures including groups, rings, fields, and integral domains. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 3.0 | **Values** | | |
| 3.1 | Demonstrate a sense of self-worth | Class discussion | Individual classwork |
| 3.2 | Relate well to others and maintain good relationships; | Class discussion and Team work | Group classwork |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**
- **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.**

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | *A First Course in Abstract Algebra*, **J. Farleigh, Pearson Education, 1st Indian edition, 2003. (Main Reference).** |
| **Essential References Materials** | *Abstract Algebra*, **D. Dummit, R. Foote, John Wiley, 3rd Edition, 2004.**<br>*Contemporary Abstract Algebra*, **J. Gallian, Houghton Mifflin Company; 5th Edition, 2001.**<br>*Abstract Algebra: An Introduction*, **T. Hungerford, Brooks Cole; 2nd Edition, 1996.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Mathematical Methods** |
| **Course Code:** | **MAT 1332** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 7 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1203, MAT 1231** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course covers a broad spectrum of mathematical techniques essential to the solution of advanced problems. Topics include Series Solutions of ODES, Vector Calculus, Fourier series and Fourier transform. Each topic is given a formal treatment and illustrated by examples of varying degrees of difficulty.**

**2. Course Main Objective**

- **This course is designed to enable students to know some classical methods used for solving differential equations.**
- **The course covers series solutions to ODEs as well as the description of Fourier methods together with applications to ODEs solvability.**

### 3. Course Learning Outcomes

| | CLOs<br>On successful completion of the course, students will be able to: | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | Identify various techniques, including Power series method, Special functions, and Fourier series/transform, to solve differential equations. | K1, K2 |
| 1.2 | Distinguish advanced differential and integral calculus theory. | K1, K2 |
| **2** | **Skills:** | |
| 2.1 | Apply appropriately Fourier transform and their inverse real-life problems involving differential equations in the context of mathematical method | S1, S2 |
| 2.2 | Communicate mathematics clearly and precisely both orally and in writing. | S4 |
| 2.3 | Use mathematical software and online solvers to solve differential equation in context of the course. | S5 |
| 2.4 | Develop competency in mathematical presentation, written and verbal skills. | S3 |
| **3** | **Values:** | |
| 3.1 | Demonstrate confidence in solving given mathematical problems. | V1, V3 |
| 3.2 | Operate meaningfully and productively with others. | V1, V2 |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Series solutions of differential equations:** Power series solution of differential equations around ordinary points, Euler-Cauchy equations, Frobenius method for solving second order linear differential equations around regular singular points, Bessel's equations and Bessel's functions, Legendre's Equations. Special functions (Gamma and Beta functions). | 18 |
| | **Vector Calculus:** Vector-Valued Functions of one variable, Del operator: divergence, gradient, curl, and Laplacian, Line and Surface Integrals, conservative fields, Green's Theorem, Divergence Theorem, Stokes' Theorem, Vector operators in curvilinear coordinate systems , Some Physical Applications of Vector Calculus. | 24 |
| 2 | **Fourier Transforms:** Review of Fourier Series, Convergence of Fourier Series, Fourier Integrals and their convergence, Complex Fourier series and Integrals. Fourier Transform, Inverse Fourier Transform, Time and frequency shifting. Properties and Applications of the Fourier transforms. Fourier Cosine and Sine transforms. | 15 |
| 3 | **Fourier transform:** The Fourier Integral, Fourier Cosine Integral and Sine Integral, The Complex Fourier Integral, Fourier transforms, Properties and Applications of the Fourier transforms, Fourier Cosine and Sine Transforms, The Discrete Fourier Transform, The Fast Fourier transform. | 15 |
| **Total** | | 72 |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | Identify various techniques, including Power series method, Special functions, and Fourier series/transform, to solve differential equations. | • 4 lecture hours\week<br>• 2 tutorial hours\week<br>• Self-study | • Regular Exams<br>• Assignments<br>• Short Quizzes |
| 1.2 | Distinguish advance differential and integral calculus theory. | • 4 lecture hours\week<br>• 2 tutorial hours\week<br>Self-study | • Regular Exams<br>• Assignments<br>Short Quizzes |
| 2.0 | **Skills:** | | |
| 2.1 | Apply appropriately Fourier transform and their inverse real-life problems involving differential equations in the context of mathematical method | • Self-study<br>• Real-life problems | • Participations<br>• Short Quizzes |
| 2.2 | Communicate mathematics clearly and precisely both orally and in writing. | • Self-study<br>Real-life problems | • Participations<br>Short Quizzes |
| 2.3 | Use mathematical software and online solvers to solve differential equation in context of the course. | • Self-study<br>Real-life problems | • Participations<br>Short Quizzes |
| 2.4 | Develop competency in mathematical presentation, written and verbal skills. | • Self-study<br>Real-life problems | • Participations<br>Short Quizzes |
| 3.0 | **Values:** | | |
| 3.1 | Demonstrate confidence in solving given mathematical problems. | Class discussion | Individual classwork |
| 3.2 | Operate meaningfully and productively with others. | Team work | Group classwork |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ▪ **Elementary Differential Equations and Boundary Value Problems, W. Boyce and R. Di Prima, 9th edition, New York: John Wiley & Sons, (2010).** |
| **Essential References Materials** | ▪ **Advanced Engineering Mathematics, E. Kreyszig, John Wiley & Sons, INC 10th ed. (2010).**<br>▪ **Mathematical methods in the physical sciences, Boas, Mary L.: John Wiley & Sons, INC., (2005).**<br>▪ **Calculus, Robert T. Smith and Roland B. Minton, 4th Edition; McGraw-Hill, 2012.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Introduction to Partial Differential Equations** |
| **Course Code:** | **MAT 1334** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☑ Others ☐ |
| **b.** | Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 9 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1331** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course introduces students to the theory of boundary value and initial value problems for partial differential equations (Dirichlet, Neumann, and Mixed BVP). It emphasizes classification, characteristics, linear, elliptic, hyperbolic, and parabolic for first-order equations and second order equations. Topics covered include Laplace's equation, heat equation, wave equation and separation of variables method, Fourier series, Fourier and Laplace transforms for Solving PDEs.**

**2. Course Main Objective**

- **To provide the student with the necessary mathematical tools of applied mathematics in order to understand a wide variety of model problems that arises in physics and engineering using partial differential equations with boundary conditions.**
- **To emphasize techniques and broad understanding rather than proofs.**
- **To introduce the students to the theory and applications of partial differential equations (PDEs), and to explore various methods of solving PDEs.**
- **Once successful completion of this course, students should be able to classify PDEs and solve them by using appropriate methods.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To recognize BVPs and IVPs for classical second-order PDEs describing physical processes such as heat and wave diffusions.** | **K1, K2** |
| 1.2 | **To solve analytically PDEs via methods of separation of variables, of characteristics, and Fourier and Laplace transforms.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop techniques of first and second-order PDEs.** | **S1, S2** |
| 2.2 | **To present basic PDE's methods clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for different kinds of PDEs** | **S5** |
| 2.4 | **To demonstrate some proofs of PDEs solving methods.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To defend the formulated conclusions individually.** | **V1, V3** |
| 3.2 | **To operate meaningfully and productively with others.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Introduction to PDEs:** Definition of a PDE; Degree, linearity; homogeneous and inhomogeneous equations; First order partial differential equations; The method of characteristics. | **18** |
| 2 | **Second-order equation:** Classification as Parabolic, Hyperbolic, and Elliptic equations. | **6** |
| 3 | **Classical PDEs of mathematical physics and Boundary-Value Problems:** Wave equation, Heat equation, Laplace equation; Boundary Conditions; Definition of a Boundary-Value Problem. Dirichlet, Neumann, and Mixed BVP. | **24** |
| 4 | **Analytic methods for solving PDEs:** Separation of variables method; Solution of PDEs by Fourier series; Fourier and Laplace transforms; Solving PDEs using Fourier and Laplace transforms. | **24** |
| **Total** | | **72** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To recognize BVPs and IVPs for classical second-order PDEs describing physical processes such as heat and wave diffusions. | ●4 lecture hours\week | ●Regular Exams |
| 1.2 | To solve analytically PDEs via methods of separation of variables, of characteristics, and Fourier and Laplace transforms. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of first and second-order PDEs. | Real-life problems | Short Quizzes |
| 2.2 | To present basic PDE's methods clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for different kinds of PDEs | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate some proofs of PDEs solving methods. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | To defend the formulated conclusions individually. | Personal questions | Participation |
| 3.2 | To operate meaningfully and productively with others. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ***Introduction to Partial Differential Equations;*** Undergraduate Texts in Mathematics, P. Olver, Springer, 2013. **(Main Reference).** |
| **Essential References Materials** | • *Partial Differential Equations of Mathematical Physics,* **R.B. Guenther & J.W. Lee, Prentice Hall/Dover publication, Mineola, 1996. (Main Reference).**<br>• *Partial Differential Equations Methods and Applications (2nd Edition),* **R. McOwen, Prentice Hall/Pearson Education, 2002.**<br>• *Lectures on Partial Differential Equations,* **V. I. Arnold, Springer-Verlag, Berlin, 2004.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation** (Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources** (AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources** (Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Numerical Analysis (1)** |
| **Course Code:** | **MAT 1341** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (3 Lectures, 2 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 8 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1231, CS 1249** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 84 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 24 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 84 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course is an introduction to the numerical analysis. It presents the fundamental concepts and methods, and basic numerical analysis tools in the field. This course emphasizes not only numerical methods, but also the analysis of their convergence and convergence rates. It develops as well the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems on the computer.**

**2. Course Main Objective**

- **To provide an introduction of computational techniques for finding approximate solutions to difficult mathematical problems.**
- **To estimate the error sources and the convergence of the algorithms with respect to the various techniques used.**
- **To introduce students to the basics of numerical analysis.**
- **To learn how to use computers to solve mathematical problems using MATLAB in Lab.**

### 3. Course Learning Outcomes

| | CLOs<br>Upon successful completion of this course, students will be able to: | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | Recognize theories and concepts used in Numerical Analysis. | K1, K2 |
| 1.2 | Identify the concept of finite difference, approximation by iteration, numerical differentiation and integration, error analysis. | K1, K2 |
| 2 | **Skills:** | |
| 2.1 | Apply elementary numerical techniques and rules, including Floating Point Representation, interpolation, Trapezoidal and Simpson Rules, Gaussian Quadrature, Newton Divided Difference, Euler method, Runge-Kutta methods, and matrix algebra tools to solve given real-life problems. | S1, S2 |
| 2.2 | Write efficient, well-documented Matlab code and present numerical results in an informative way. | S4 |
| 2.3 | Implement some numerical methods using Matlab software and CAS. | S5 |
| 2.4 | Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. | S3 |
| 3 | **Values:** | |
| 3.1 | work individually and in group | V1, V3 |
| 3.2 | formulate a variety of alternative numerical methods to estimate the solutions of ODEs according to their setting. | V1, V2 |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Introduction to data representation:** Numerical Errors; Floating Point Representation; Round-off; Significant Digit; Error Propagation. | 12 |
| 2 | **Root Finding:** Bisection Method, Newton's Method, Secant Method, Fixed Point Iterations. | 12 |
| 3 | **Interpolation and Approximation:** Taylor polynomials, Approximation of order n, Polynomial Error, Linear and Quadratic Interpolation, Lagrange Interpolation, Newton Divided Difference Method, Error Evaluation. | 14 |
| 4 | **Numerical Integration and Differentiation:** The Trapezoidal and Simpson Rules, Gaussian Quadrature, Numerical Differentiation. | 14 |
| 5 | **Numerical Solution of Linear Systems:** Gauss Elimination, LU and Cholesky Decompositions, Iterative Methods: Jacobi and Gauss-Siedel Methods, Error Analysis. | 18 |
| 6 | **Numerical solution of differential equations:** Euler method, Runge-Kutta methods. Error and convergence analysis. | 14 |
| | **Total** | 84 |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | Recognize theories and concepts used in Numerical Analysis. | ●3 lecture hours\week<br>●2 lab hour\week<br>●2 tutorial hours\week<br>●Self-study | ●Regular Exams<br>●Assignments<br>●Short Quizzes |
| 1.2 | Identify the concept of finite difference, approximation by iteration, numerical differentiation and integration, error analysis. | ●3 lecture hours\week<br>●2 lab hour\week<br>●2 tutorial hours\week<br>Self-study | ●Regular Exams<br>●Assignments<br>Short Quizzes |
| 2.0 | Identify the concept of finite difference, approximation by iteration, numerical differentiation and integration, error analysis. | | |
| 2.1 | **Skills:** | ●Self-study<br>●Real-life problems | ●Participations<br>●Short Quizzes |
| 2.2 | Apply elementary numerical techniques and rules, including Floating Point Representation, interpolation, Trapezoidal and Simpson Rules, Gaussian Quadrature, Newton Divided Difference, Euler method, Runge-Kutta methods, and matrix algebra tools to solve given real-life problems. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 2.3 | Write efficient, well-documented Matlab code and present numerical results in an informative way. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 2.4 | Implement some numerical methods using Matlab software and CAS. | ●Self-study<br>Real-life problems | ●Participations<br>Short Quizzes |
| 3.0 | **Values** | | |
| 3.1 | work individually and in group | Class discussion and team work | Participation |
| 3.2 | formulate a variety of alternative numerical methods to estimate the solutions of ODEs according to their setting. | Class discussion and problem solving. | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

| |
|---|
| **Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**<br>• **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**<br>• **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.** |

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ▪ *Elementary Numerical Analysis*, **3rdEdition, Kendall Atkinson; Weimin Han, 2004. (Main Reference)** |
| **Essential References Materials** | ▪ *An Introduction to Numerical methods and Analysis*, **James F. Epperson, Wiley, 2002.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying** |

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| | | changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Combinatorics and Graphs** |
| **Course Code:** | **MAT 1353** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☑ Others ☐ |
| **b.** | Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 9 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1102, MAT 1223** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course serves to introduce the basic combinatorial techniques such as counting, recursion and linear recurrence equations with emphasis on pigeonhole principle, binomial coefficients, recursive functions, generating functions and homogeneous and non-homogeneous linear recurrences with constant coefficients. It will introduce also the students to graph theory, with emphasis on simple graphs, Euler and Hamiltonian graphs, trees, networks, paths and cycles, graph colorings, and planar graphs and graphs isomorphism.**

**2. Course Main Objective**

- **To introduce student to Combinatorics and Graph theory.**
- **To learn basics of counting, recursion and recurrence relations.**
- **To introduce students to graph theory, especially Euler and Hamiltonian graphs, planar graphs, coloring graphs, shortest paths, isomorphism of graphs, spanning trees and network flows.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To recognize planar graphs, trees, shortest path problems, and Euler, Hamilton circuits.** | **K1, K2** |
| 1.2 | **To use efficient methods of combinatorics.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop techniques of enumeration problems.** | **S1, S2** |
| 2.2 | **To present basic theorems of graph theory clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for Hamiltonian problem algorithms** | **S5** |
| 2.4 | **To demonstrate some proofs of enumeration and graphs related problems.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To employ ethical concepts and rules to determine viable alternatives in any given situation.** | **V1, V3** |
| 3.2 | **To show findings and discuss the results with others.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Counting:** Product rule, Sum rule, Inclusion-Exclusion principle, Tree diagrams; Pigeonhole principle, Binomial coefficients. | **9** |
| 2 | **Recursion:** Recurrence definitions, Set defined recursively, Recursive functions. Recurrence relations, generating functions, multiplication of generating functions; generalized binomial theorem. | **9** |
| 3 | **Linear recurrence equations:** Homogeneous and non-homogeneous linear recurrences with constant coefficients. | **8** |
| 4 | **Introduction to Graph Theory:** Graph terminology, degree of a vertex, simple graphs, paths, cycles, subgraphs, isomorphism of graphs, adjacency matrix, incidence matrix. | **7** |
| 5 | **Euler & Hamiltonian graphs:** Euler cycle, characterization of Euler graphs. Hamiltonian cycle, properties, Traveling Salesman Problem. | **3** |
| 6 | **Planar graphs:** Euler's Formula, Kuratowski's theorem. Genus of a graph. Ringel-Youngs theorem. | **3** |
| 7 | **Graph colorings:** Vertex colorings. Greedy algorithm. | **3** |
| 8 | **Shortest path:** shortest path problems; Optimality principle, Djkstra's algorithm. | **8** |
| 9 | **Isomorphism of graphs:** Homomorphisms, embedding, and isomorphism of graphs, invariant properties. | **3** |
| 10 | **Trees:** Spanning trees, minimum spanning trees, Kruskal's algorithm, Prim's algorithm, Greedy algorithm. | **4** |
| 11 | **Networks flow:** Definitions, flow augmenting paths, cut sets, maximum flow, Ford-Fulkerson algorithm, Minimum cost capacities flow problem. | **3** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To recognize planar graphs, trees, shortest path problems, and Euler, Hamilton circuits. | ●3 lecture hours\week | ●Regular Exams |
| 1.2 | To use efficient methods of combinatorics. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of enumeration problems. | Real-life problems | Short Quizzes |
| 2.2 | To present basic theorems of graph theory clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for Hamiltonian problem algorithms | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate some proofs of enumeration and graphs related problems. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | To employ ethical concepts and rules to determine viable alternatives in any given situation. | Personal questions | Participation |
| 3.2 | To show findings and discuss the results with others. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | *Discrete Mathematics and its Applications*, **K. Rosen, McGraw-Hill, 6th Edition, 2006. (Main Reference)** |
| **Essential References Materials** | |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation** (Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources** (AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources** (Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL** |
| **Reference No.** | **11/1444** |
| **Date** | **22/04/1444 (16/11/2022)** |

| | |
|---|---|
| **Course Title:** | **Financial Mathematics (1)** |
| **Course Code:** | **MAT 1371** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 8 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1102** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course is designed to introduce students to Financial Mathematics. They will learn about the different types of interest (simple interest, compound interest) and annuities. The topics expose as well the fundamental concepts such as cash flows, present value, and yield that form the basis for further advanced learning. More topics will also be covered.**

**2. Course Main Objective**

**On completion of this module, students should be able**

- **to understand and to perform calculations relating to present value, current value, and accumulated value,**
- **to calculate present value, current value, and accumulated value for sequences of non-contingent payments,**
- **to understand key concepts concerning loans and how to perform related calculations,**
- **to understand key concepts concerning bonds, and how to perform related calculations,**
- **to understand key concepts concerning yield curves, rates of return, and measures of duration and convexity, and how to perform related calculations.**

### 3. Course Learning Outcomes

| CLOs<br>Upon successful completion of this course, students will be able to: | | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **Recognize the interest rate, annuities, problem of interest, accumulation function, future value, current value, present value, discount factor, convertible *m*-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value.** | **K1, K2** |
| 1.2 | **Describe the price, book value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon.** | **K1, K2** |
| 1.3 | | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Solve real-life financial problems involving compound interest, present and future values, and annuities.** | **S1, S2** |
| 2.2 | **Apply logical thinking to problem solving in context to communicate results clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **Use appropriate technology to aid problem solving.** | **S5** |
| 2.4 | **calculate appropriately the value(s) of money. the annual effective rate of interest, the loan amount or outstanding loan balance, the value of a stock.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **work individually and in group.** | **V1, V3** |
| 3.2 | **Show the scientific attitude by mentioning and testing a hypothesis before accepting it.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **The measurement of interest:** Introduction. The accumulation and amount functions. The effective rate of interest. Simple interest. Compound interest. Present value. The effective rate of discount. Nominal rates of interest and discount. Forces of interest and discount. Varying interest. | **10** |
| 2 | **Solution of problems in interest:** Introduction. The basic problem. Equations of value. Unknown time. Unknown rate of interest. Determining time periods. Practical examples. | **8** |
| 3 | **Basic annuities:** Introduction. Annuity-immediate. Annuity-due. Annuity values on any date. Perpetuities. Unknown time. Unknown rate of interest. Varying interest. | **8** |
| 4 | **More general annuities:** Introduction. Differing payment and interest conversion periods. Annuities payable less frequently than interest is convertible. Annuities payable more frequently than interest is convertible. Continuous annuities. Payments varying in arithmetic progression. Payments varying in geometric progression. More general varying annuities. Continuous varying annuities. | **7** |
| 5 | **Amortization schedules and sinking funds**: Introduction. Finding the outstanding loan balance. Amortization schedules. Sinking funds. Differing payment periods and interest conversion periods. Varying series of payments. | **8** |
| 6 | **Bonds and other securities**: Introduction. Types of securities. Price of a bond. Premium and discount. Valuation between coupon payment dates. Determination of yield rates. Callable and puttable bonds. Other securities, | **8** |

| | | |
|---|---|---|
| 7 | **Yield rates**: Introduction. Discounted cash flow analysis. Uniqueness of the yield rate. Reinvestment rates. Interest measurement of a fund. Time-weighted rates of interest. Portfolio methods and investment year methods. | **7** |
| 8 | **Practical applications**: Introduction. Truth in lending. Automobile financing. Real estate mortgages. Approximate methods. Depreciation methods. Capitalized cost. Modern financial instruments. | **4** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding:** | | |
| 1.1 | **Recognize the interest rate, annuities, problem of interest, accumulation function, future value, current value, present value, discount factor, convertible *m*-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value.** | **●3 lecture hours\week<br>●2 tutorial hours\week<br>Self-study** | **●Regular Exams<br>●Assignments<br>Short Quizzes** |
| 1.2 | **Describe the price, book value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon.** | **●3 lecture hours\week<br>●2 tutorial hours\week<br>Self-study** | **●Regular Exams<br>●Assignments<br>Short Quizzes** |
| **2.0** | **Skills:** | | |
| 2.1 | **Solve real-life financial problems involving compound interest, present and future values, and annuities.** | **●Self-study<br>●Real-life problems** | **●Participations<br>●Short Quizzes** |
| 2.2 | **Apply logical thinking to problem solving in context to communicate results clearly and precisely both orally and in writing.** | **Self-study<br>Real-life problems** | **Participations<br>Short Quizzes** |
| 2.3 | **Use appropriate technology to aid problem solving.** | **Self-study<br>Real-life problems** | **Participations<br>Short Quizzes** |
| 2.4 | **calculate appropriately the value(s) of money. the annual effective rate of interest, the loan amount or outstanding loan balance, the value of a stock.** | **Self-study<br>Real-life problems** | **Participations<br>Short Quizzes** |
| **3.0** | **Values:** | | |
| 3.1 | **work individually and in group.** | **Personal questions and team work.** | **Participation, Homework and Mini-projects** |
| 3.2 | **Show the scientific attitude by mentioning and testing a hypothesis before accepting it.** | **Class discussion** | **participation** |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**
- **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.**

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ***Theory of Interest,*** 3rd Edition, Stephen Kellison, McGraw-Hill Education, 2009. |
| **Essential References Materials** | ***Schaum's Outline of Mathematics of Finance****, Revised Edition*, 2nd Edition, McGraw-Hill Education, 2011.<br>***Introduction to mathematical finance***, D. Heath and G. Swindle (Eds), American Mathematical Society, 1999. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Advanced Euclidean Geometry** |
| **Course Code:** | **MAT 1382** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☑ Others ☐ |
| **b.** | Required ☐ Elective ☑ |
| **3. Level/year at which this course is offered:** | **Level 10 or 11 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1223** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**Advanced Euclidean Geometry is an elective course. This is a senior level class which is a comprehensive study of geometry. It includes the historical development of geometry, abstract and concrete treatments of the subject, examples of various geometries, proving fundamental geometric theorems as of: Ceva, Stewart, Ptolemy and of Miquel.**

**2. Course Main Objective**

**This course will be devoted to the Euclidean and Non-Euclidean geometry, and will begin where the high school geometry course leaves off. It will fill by providing a thorough review of the essentials of the high school geometry course and then expanding those concepts to advanced Euclidean geometry. This course will aim for a high level of competence in the fundamentals, a broad appreciation of the structure of the subject, and a robust ability to solve problems, write proofs and explanations, and explain mathematics verbally and in writing.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To outline a core set of geometric facts and relationships about triangles, quadrilaterals, circles, congruence, and similarity.** | **K1, K2** |
| 1.2 | **To recognize the basics concepts and results related to Euclidean Geometry.** | **K1, K2** |
| 1.3 | **To memorize the principal theorems of this course as: Ceva's theorem, Menelaus's theorem, Ptolemy's theorem, and Stewart's theorem.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop techniques of Euclidean geometry problems.** | **S1, S2** |
| 2.2 | **To present main Euclidean geometry theorems clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for up-to-date results in Euclidean geometry.** | **S5** |
| 2.4 | **To demonstrate some proofs in advanced Euclidean geometry.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To work individually.** | **V1, V3** |
| 3.2 | **To show findings and discuss the results with others.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Review:** basics and stating basic facts concepts and facts of the triangle geometry. | **9** |
| 2 | **Ceva's theorem:** Ceva's Theorem and its dual Menelaus's theorem and their applications. Simon's Line, The Butterfly, Theorem Pappus's Theorem. | **15** |
| 3 | **Stewart's theorem and its applications:** Equiangular point, Property of Equilateral triangles, and a Minimum Distance Point. | **12** |
| 4 | **Centers of Quadrilaterals:** Cyclic Quadrilaterals, and Ptolemy's Theorem and its applications. | **9** |
| 5 | **Miquel's Theorem:** Euler distance formula. The nine points circle Theorem and its proof. | **6** |
| 6 | **Axiomatic Systems and Finite Geometries**: Glimpse on hyperbolic geometry, elliptic geometry. | **9** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To outline a core set of geometric facts and relationships about triangles, quadrilaterals, circles, congruence, and similarity. | 3 lecture hours\week | Regular Exams |
| 1.2 | To recognize the basics concepts and results related to Euclidean Geometry. | 2 tutorial hours\week | Assignments |
| 1.3 | To memorize the principal theorems of this course as: Ceva's theorem, Menelaus's theorem, Ptolemy's theorem, and Stewart's theorem. | Self-study | Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of Euclidean geometry problems. | Real-life problems | Short Quizzes |
| 2.2 | To present main Euclidean geometry theorems clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for up-to-date results in Euclidean geometry. | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate some proofs in advanced Euclidean geometry. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | To work individually. | Personal questions | Participation |
| 3.2 | To show findings and discuss the results with others. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | • Advanced Euclidean Geometry, **A. Posamentier, Wiley 2008.**<br>• Advanced Euclidean Geometry, **R. Johnson, Dover 2007.** |
| **Essential References Materials** | • Geometry for College Students, I. Isaacs, Thomson Learning 2001. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL** |
| **Reference No.** | **11/1444** |
| **Date** | **22/04/1444 (16/11/2022)** |

| | |
|---|---|
| **Course Title:** | **Complex Variable** |
| **Course Code:** | **MAT 1412** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☑ Others ☐ |
| **b.** | Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 10 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1311** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course is an introduction to the theory of functions of a complex variable. Topics include complex numbers and their properties, Cauchy-Riemann equations and analytic functions, harmonic functions, Cauchy's theorem, integral representation formulae, power series of analytic functions, zeros, isolated singularities, Laurent series, poles, residues, use of residue calculus to evaluate real integrals, and conformal mapping.**

**2. Course Main Objective**

**The main purpose of Complex Analysis is to study the development of functions of one complex variable and perform a thorough investigation of the major theorems of complex analysis – the Cauchy-Riemann Equations, Cauchy's Theorem, Cauchy's Integral Formula, the Maximum Modulus Principle, Liouville's Theorem, the Residue Theorem, Rouche's Theorem, the Riemann Mapping Theorem – including their proofs. Also apply these ideas to a wide range of problems that include the evaluation of both complex line integrals and real integrals.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To recognize complex functions and their properties: continuity, differentiation, Cauchy-Riemann equations, and analyticity.** | **K1, K2** |
| 1.2 | **To outline line integrals, complex contour integrals, series, and residues.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop techniques of integration by using residues.** | **S1, S2** |
| 2.2 | **To present Complex integral and its applications clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for complex sequences and series** | **S5** |
| 2.4 | **To demonstrate some proofs of ODE solutions by using complex series.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To work individually.** | **V1, V3** |
| 3.2 | **Develop personal values and attributes such as honesty, empathy and respect for others.** | **V1, V2** |

## C. Course Content

| | | |
|---|---|---|
| 1 | **Basics:** Euler formula and exponential form of a complex number, Basic topological properties, Functions of complex variable, Elementary functions, Limits, continuity and uniform continuity. | **10** |
| 2 | **Continuity and differentiability:** Limits, Continuity and uniform continuity, Derivative of a complex function at a point, Cauchy-Riemann equations and differentiability of complex functions, Derivatives of elementary functions, Analytic function at a point, Singular points, Analytic function and harmonic functions, Hopital's rule. | **18** |
| 3 | **Complex integral:** Line integral and complex integral, Complex form of Green's theorem, Cauchy's and Cauchy-Goursat theorems, Complex indefinite integral, Cauchy's integral formula, Argument, Rouche's, Liouville's, and modulus theorems. | **17** |
| 4 | **Complex sequences and series:** Basic definitions, tests of series absolute convergence, power series and uniform convergence, circle of convergence, differentiation and integration of power series, Taylor's series and Laurent's series. Type of singular points, Picard's theorem. | **17** |
| 5 | **Residues:** Residues and the residue theorem with applications. | **5** |
| 6 | **Basic concepts of conformal mapping.** | **5** |
| | **Total** | **72** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To recognize complex functions and their properties: continuity, differentiation, Cauchy-Riemann equations, and analyticity. | ●4 lecture hours\week | ●Regular Exams |
| 1.2 | To outline line integrals, complex contour integrals, series, and residues. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of integration by using residues. | Real-life problems | Short Quizzes |
| 2.2 | To present Complex integral and its applications clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for complex sequences and series | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate some proofs of ODE solutions by using complex series. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | To work individually. | Personal questions | Participation |
| 3.2 | Develop personal values and attributes such as honesty, empathy and respect for others. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | *Complex Variables: Introduction and Applications*, **M. Ablowitz et al, 2nd Edition, 2003. (Main Reference)** |
| **Essential References Materials** | *Complex Variables and applications*, **R.V. Churchill and J.W. Brown, McGraw-Hill 5th Edition, 1989.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation** (Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources** (AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources** (Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL** |
| **Reference No.** | **11/1444** |
| **Date** | **22/04/1444 (16/11/2022)** |

| | |
|---|---|
| **Course Title:** | **Introduction to Topology** |
| **Course Code:** | **MAT 1415** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **5 (4 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☑ Others ☐ |
| **b.** | Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 11 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1311** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 72 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 48 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 72 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**The course starts with the topology of the real line and the topology of the plane. It then deals with metric spaces and all their properties. In particular continuity and uniform continuity of mappings between metric spaces are discussed in terms of sequences. The course also covers topological spaces, subspaces, and product of spaces together with the main properties. Homeomorphisms are also introduced in the general setting of topological spaces. However, the concepts of compact set and connected set are only introduced for the real line.**

**2. Course Main Objective**

**This course introduces the fundamentals of Topology.**
**It emphasizes techniques of proofs in the setting of topological spaces.**
**It introduces the students to the concepts of metric and topological spaces. Once successful completion of this course, students should be able to distinguish between them and to know their properties.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To outline the fundamental concepts of metric and topological spaces.** | **K1, K2** |
| 1.2 | **To define connected and compact spaces on the real line.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop techniques of problem solving in the topology of the line.** | **S1, S2** |
| 2.2 | **To present basic theorems of topology for the real line clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for topological spaces.** | **S5** |
| 2.4 | **To demonstrate some proofs of theorems related to the topology of the real line.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To work individually.** | **V1, V3** |
| 3.2 | **Develop personal values and attributes such as honesty, empathy and respect for others.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Topology of the line:** Open and closed sets, neighborhoods, interior points, limit points. Boundary points; closure of a set, dense sets, isolated points, cluster points. Nested intervals, Cantor's Nested Intervals Theorem, open cover of a set. Compact sets, the Heine-Borel Theorem, Bolzano-Weierstrass Theorem. Connected sets. Topology of the plane: Metrics, balls, open and closed sets in R^2, examples of other metric spaces. | **24** |
| 2 | **Metric space:** Open and closed sets, neighborhoods, isolated, boundary, adherent and limit points, interior and closure of a set, dense sets, and separable spaces. Distance between a point and a set and between sets, diameter of a set. Sequences and limit of a sequence. Cauchy sequences and complete metric spaces. Continuous functions on metric spaces and their properties. Uniform continuity, isometric and homeomorphic spaces, equivalent metrics. | **24** |
| 3 | **Topological space:** Open and closed sets, neighborhoods, interior points, adherent and limit points, boundary points; interior and closure of a set, dense sets. Basis, sub-basis, and equivalent bases. Continuous functions on topological spaces and their properties. Metrizable topological spaces, open and closed maps, homeomorphism; topological subspaces, Hausdorff spaces, product of topological spaces. | **24** |
| **Total** | | **72** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To outline the fundamental concepts of metric and topological spaces. | ●4 lecture hours\week | ●Regular Exams |
| 1.2 | To define connected and compact spaces on the real line. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of problem solving in the topology of the line. | Real-life problems | Short Quizzes |
| 2.2 | To present basic theorems of topology for the real line clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for topological spaces. | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate some proofs of theorems related to the topology of the real line. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | To work individually. | Personal questions | Participation |
| 3.2 | Develop personal values and attributes such as honesty, empathy and respect for others. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | **Principles of Topology, Fred H. Croom, Thomson Learning Asia 2008.** |
| **Essential References Materials** | ▪ **Topology: A First Course, Munkres, J.R., Prentice-Hall, Englewood Cliffs, NJ, 1st Edition 1975.**<br>▪ **Theory and Problems of General Topology, Seymour Lipschutz, Schaum's Outline Series, 1965.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL** |
| **Reference No.** | **11/1444** |
| **Date** | **22/04/1444 (16/11/2022)** |

| | |
|---|---|
| **Course Title:** | **Numerical Analysis (2)** |
| **Course Code:** | **MAT 1442** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 1 Lab, 1 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 10 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1334, MAT 1341** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 12 |
| 3 | Tutorial | 12 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course is the continuation of Numerical Analysis I (MAT 341). It introduces numerical methods for approximating functions and data, evaluating integrals and solving ODEs and PDEs. It provides theoretical and practical aspects of best approximation and provides also theoretical analysis of the problems along with algorithms for their solution. Topics include Solving systems of linear equations, Approximating Eigenvalues, Boundary value problems for ordinary differential equations, Numerical solution to partial differential equations.**

**2. Course Main Objective**

- **To study basic finite difference methods for partial differential equations.**
- **To understand the concepts of consistency, stability, and convergence.**
- **To learn to solve partial differential equations on the computer.**
- **To introduce finite element method.**

**The course will involve the use of Matlab or C++ in Lab.**

### 3. Course Learning Outcomes

| CLOs | | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | **To outline Least Squares, multistep, predictor-corrector methods, and some Iterative algorithms for eigenvalue problems:** | **K1, K2** |
| 1.2 | **To solve numerically PDE using finite difference methods.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop advanced techniques of numerical solutions.** | **S1, S2** |
| 2.2 | **To present numerical methods of differential equations clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for different numerical methods of ODEs and PDEs** | **S5** |
| 2.4 | **To demonstrate some proofs of numerical ODEs and PDEs by using finite difference techniques.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **work individually and in group.** | **V1, V3** |
| 3.2 | **Show the scientific attitude by mentioning and testing a hypothesis before accepting it.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Advanced Numerical Linear Algebra:** Least Squares Method, Matrix Eigenvalue Problems: Power Method, QR Factorization. | **15** |
| 2 | **Finite difference techniques:** Difference equation replacement, Implicit and explicit finite difference method. | **10** |
| 3 | **Boundary Value Problems for ODEs:** Multistep Methods, Finite Difference Methods for Systems of Differential Equations. | **15** |
| 4 | **Finite Difference Method for PDEs:** Finite Difference Method for Boundary Value Problems, Numerical Solution of Elliptic PDEs, Numerical Solution of Parabolic PDEs, Numerical Solution of Hyperbolic PDEs. | **20** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding** | | |
| 1.1 | To outline Least Squares, multistep, predictor-corrector methods, and some Iterative algorithms for eigenvalue problems: | ●3 lecture hours\week<br>●1 tutorial hour\week | ●Regular Exams |
| 1.2 | To solve numerically PDE using finite difference methods. | ●1 lab hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop advanced techniques of numerical solutions. | Real-life problems | Short Quizzes |
| 2.2 | To present numerical methods of differential equations clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for different numerical methods of ODEs and PDEs | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate some proofs of numerical ODEs and PDEs by using finite difference techniques. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | work individually and in group. | Personal questions | Participation |
| 3.2 | Show the scientific attitude by mentioning and testing a hypothesis before accepting it. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | *Elementary Numerical Analysis, 3rd Edition,* **Kendall Atkinson; Weimin Han; 2004. (Main Reference).** |
| **Essential References Materials** | ● *Numerical Solution of Partial Differential Equations: An Introduction,* 2nd Edition, **K. W. Morton & D. F. Mayers, Cambridge University Press, 2005.**<br>● *An Introduction to Numerical methods and Analysis,* **James F. Epperson, Wiley; 2002.**<br>● *Numerical Analysis,* **R. Burden and J. Faires, 8th Edition, Brooks/Cole, 2001.** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Introduction to Numerical Optimization** |
| **Course Code:** | **MAT 1444** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☐ Elective ☒ |
| **3. Level/year at which this course is offered:** | **Level 10 or 11 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1251, MAT 1341** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

- To provide students a good understanding on constrained and unconstrained optimization whose content is described in detail in this syllabus.
- To perform some algorithms and codes in order to deepen programming and numerical analysis tools used in this course. MATLAB software will be handled.
- To allow students understanding of the above concepts through study cases and occasional computer-based homework problems.

**2. Course Main Objective**

- Maximizing or minimizing a certain quantity, that is, an objective function that models a system and satisfies a required set of specifications, called constraints, is a frequent problem in science, engineering, business and economics. The function allows comparison of the different choices for determining which might be "best". For instance, by finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones.
- Numerical Optimization turns out to be considerably important for solving such problems. This course aims at training students for acquiring a basic mathematical understanding of modern approaches to numerical optimization and discussing practical aspects of implementation for solving optimization problems. The students learn how to find analytical solutions to some optimization problems.

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To outline the principles of optimization.** | **K1, K2** |
| 1.2 | **To memorize various types of algorithms for solving optimization problems.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop techniques of advanced optimization methods.** | **S1, S2** |
| 2.2 | **To present various numerical algorithms of optimization clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for new improvements of usual numerical algorithms of optimization.** | **S5** |
| 2.4 | **To compute orders and complexities of usual numerical optimization algorithms and their variants.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **Engage in group discussions and critical interactions** | **V1, V3** |
| 3.2 | **differentiate between valid and fallacious Mathematical arguments to model real problem involving differential equations.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Introduction:** Examples of optimization problem occurring in science, engineering and economics. | **6** |
| 2 | **Univariate optimization:** Local and global minima, Necessary and sufficient conditions of the first and second order, Iterative numerical methods for univariate optimization: Exhaustive grid search, Golden section search, Brent's method, Newton's method, Secant method. | **14** |
| 3 | **Unconstrained multivariate optimization:** Necessary and sufficient conditions of the first and second order, The case of convex functions, Numerical algorithms for nonlinear multivariate optimization: Linear and superliner convergence, Steepest descent algorithm, Quasi-Newton's methods, Broyden-Fletcher-Goldfarb-Shanno (BFGS) algorithm, Conjugate gradient Methods. | **15** |
| 4 | **Constrained multivariate optimization:** Examples, Equality constraints. Lawrentians and optimality conditions. Geometric interpretation, Equality and inequality constraints, The case of convex programs, Algorithms for constrained optimization: Primal methods: feasible directions methods, active set methods, gradient projection; Penalty and barrier methods. | **15** |
| 5 | **Introduction to evolutionary Algorithms:** Principles, Selection, Recombination, Mutation and Reinsertion, Examples and applications. | **10** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To outline the principles of optimization. | ●3 lecture hours\week | ●Regular Exams |
| 1.2 | To memorize various types of algorithms for solving optimization problems. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of advanced optimization methods. | Real-life problems | Short Quizzes |
| 2.2 | To present various numerical algorithms of optimization clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for new improvements of usual numerical algorithms of optimization. | Real-life problems | Short Quizzes |
| 2.4 | To compute orders and complexities of usual numerical optimization algorithms and their variants. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | Engage in group discussions and critical interactions | Personal questions | Participation |
| 3.2 | differentiate between valid and fallacious Mathematical arguments to model real problem involving differential equations. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | **Numerical Optimization, Jorge Nocedal, Stephen J. Wright, edition 2, Springer 2006 (Main Reference).** |
| **Essential References Materials** | ***-An introduction to algorithms for non-linear optimization*; N. Gould, S. Leyffer; Springer, 2003.**<br>***-Numerical Optimization with Applications*; 1st Edition, S. Chandra, Jayadeva, Aparna Mehra; Alpha Science Intl. Ltd., 2009.**<br>***-Genetic algorithms on search, optimization and machine learning; D. Goldberg; Addison-Wesley Professional, 1989.*** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Introduction to Cryptography and Coding** |
| **Course Code:** | **MAT 1461** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☒ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 10 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1321** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**The course is devoted to the fields of cryptography and coding theory. It gives an introduction, with proofs, to the algebra and number theory used in coding and cryptography. Basic problems of cryptography and coding are discussed. Topics include classical ciphers, public key cryptosystems (RSA, Diffie-Hellman key exchange, ElGamal), digital signatures, codes, linear codes, perfect codes and cyclic codes.**

**2. Course Main Objective**

- **To introduce student to Cryptography and Coding theory.**
- **To learn basics of cryptography, public-key systems and digital signatures.**
- **To introduce students to coding theory, especially cyclic codes.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To outline the principles of cryptology and of cryptanalysis of historical ciphers.** | **K1, K2** |
| 1.2 | **To recognize the theory and practice of coding and modern cryptographic systems.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop basic techniques of coding.** | **S1, S2** |
| 2.2 | **To present main algorithms in public key cryptography clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for up-to-date algorithms in cryptography.** | **S5** |
| 2.4 | **To demonstrate the validity of some cryptography algorithms.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To engage in group discussions and critical interactions** | **V1, V3** |
| 3.2 | **To differentiate between valid and fallacious Mathematical arguments to model real problem involving differential equations.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Classical Cryptography:** Introduction, shift ciphers and substitution ciphers, Affine cipher, Vigenere cipher, Permutation cipher, Hill cipher, stream cipher, Introduction to cryptanalysis, cryptanalysis of classical systems. | **17** |
| 2 | **Public-key cryptosystems:** RSA, Number Theory facts, Discrete logarithm, ElGamal cryptosystem, Massey-Omura cryptosystem, Diffie-Hellman key agreement. | **12** |
| 3 | **Digital signatures :** RSA signature, El-Gamal signature, Digital signature algorithm. | **10** |
| 4 | **Introduction to Coding Theory:** Introduction to codes, Hamming distance, error detection, error correction, information rate. Linear codes, Generator matrix and parity-check matrix, Perfect codes. | **12** |
| 5 | **Cyclic codes:** Cyclic codes, generator polynomials. | **9** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To outline the principles of cryptology and of cryptanalysis of historical ciphers. | ●3 lecture hours\week | ●Regular Exams |
| 1.2 | To recognize the theory and practice of coding and modern cryptographic systems. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop basic techniques of coding. | Real-life problems | Short Quizzes |
| 2.2 | To present main algorithms in public key cryptography clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for up-to-date algorithms in cryptography. | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate the validity of some cryptography algorithms. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | To engage in group discussions and critical interactions | Personal questions | Participation |
| 3.2 | To differentiate between valid and fallacious Mathematical arguments to model real problem involving differential equations. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | • *Cryptography: Theory and practice,* **Douglas R. Stinson, 3rd Edition, 2006, Chapman and Hall/CRC. (Main Reference).**<br>• *Coding Theory: A First course, San Ling, Chaoping Xing, Cambridge University Press, 2004.* |
| **Essential References Materials** | • *Introduction to Modern Cryptography,* **J. Katz, Y. Lindell, Chapman and Hall/CRC, 1st Edition, 2007.**<br>• *Making, Breaking Codes: An Introduction to Cryptology,* **Paul Garrett, 2001, Prentice-Hall.**<br>• *A First Course in Coding Theory, R. Hill, Oxford University Press, 1997.* |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and** |

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| | | **identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Discrete Simulation** |
| **Course Code:** | **MAT 1465** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☐ Elective ☒ |
| **3. Level/year at which this course is offered:** | **Level 10 or 11 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **STA 1202** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This elective course makes students familiar with the most important elements of the Monte Carlo method applied to the statistical and Queuing models of discrete event in order to simulate and visualize the solutions. The course puts the theoretical basis of the random number's generators and its application in discrete simulation.**

**2. Course Main Objective**

**This course provides an introduction to system modeling using both computer simulation and mathematical techniques. Emphasis will be on discrete-event simulation model development methodologies and implementation techniques.**

### 3. Course Learning Outcomes

| CLOs | | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To outline the basic Discrete Event Simulation Concept and language.** | **K1, K2** |
| 1.2 | **To memorize the Monte Carlo method and its importance in finance as well as other areas.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop basic techniques of discrete simulation.** | **S1, S2** |
| 2.2 | **To present Monte Carlo method clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for Markov chains** | **S5** |
| 2.4 | **To demonstrate the efficiency of Queuing models.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To listen to the teacher's explanation of Mathematics reasoning and illustration.** | **V1, V3** |
| 3.2 | **To show attitude of support the use of computers in learning/teaching mathematics.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Review of some probability and Statistics concepts:** Random variables, probability distribution, Estimation examples. | **6** |
| 2 | **Introduction to Simulation:** Random numbers, sequences of connected events, etc. | **9** |
| 3 | **Discrete Event Simulation Concept.** | **6** |
| 4 | **Monte Carlo simulation.** | **9** |
| 5 | **Statistical Models in Simulation** | **9** |
| 6 | **Analysis of Queuing Models.** | **6** |
| 7 | **Analysis of Simulation Data.** | **9** |
| 8 | **Markov chains Monte Carlo method.** | **6** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To outline the basic Discrete Event Simulation Concept and language. | ●3 lecture hours\week | ●Regular Exams |
| 1.2 | To memorize the Monte Carlo method and its importance in finance as well as other areas. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop basic techniques of discrete simulation. | Real-life problems | Short Quizzes |
| 2.2 | To present Monte Carlo method clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for Markov chains | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate the efficiency of Queuing models. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | To listen to the teacher's explanation of Mathematics reasoning and illustration. | Personal questions | Participation |
| 3.2 | To show attitude of support the use of computers in learning/teaching mathematics. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | *Simulation Modeling and Analysis with Expert fit Software*, **Averill Law, Averill M. Law & Associates, McGraw-Hill Science, 2007. (Main Reference).** |
| **Essential References Materials** | 1. *Discrete-Event Simulation: A First Course, Lawrence M. Leemis, Stephen K. Park0, Prentice Hall, 2005.*<br>2. *Simulation Model Design and Execution: Building Digital Worlds, Paul A. Fishwick, Prentice Hall, 1995.*<br>3. *Monte Carlo Methods, J.M. Hammersley and D.C. Handscomb, Publisher: Chapman and Hall, 1983.* |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Financial Mathematics (2)** |
| **Course Code:** | **MAT 1472** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☒ Others ☐ |
| **b.** | Required ☐ Elective ☒ |
| **3. Level/year at which this course is offered:** | **Level 10 or 11 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1371** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples of simple market model, risk-free assets, risky assets, discrete time market models, portfolio management, forward and future contracts, and option pricing. The course includes the essential fundamentals of these topics. The emphasis is on calculations, and some applications are mentioned.**

**2. Course Main Objective**

**By the end of this course students must be able to:**

- **Understand different financial models in discrete time;**
- **Do pricing and hedging options;**
- **Manage optimal portfolios.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To understand the fundamentals of the theory of one-period and multi-period financial models.** | **K1, K2** |
| 1.2 | **To understand techniques and features of Market Models with both continuous time and discrete time.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop techniques of problem solving.** | **S1, S2** |
| 2.2 | **To communicate mathematics clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for scientific information** | **S5** |
| 2.4 | **To carry out calculations orally and mentally.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To work individually.** | **V1, V3** |
| 3.2 | **To work in groups.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Introduction to a Simple Market Model:** Basic Notions and Assumptions, No-Arbitrage Principle, One-Step Binomial Model, Risk and Return, Forward Contracts, Call and Put Options, Managing Risk with Options. | **8** |
| 2 | **Risk-Free Assets:** Time Value of Money, Simple Interest, Periodic Compounding, Streams of Payments, Continuous Compounding, How to Compare Compounding Methods, Money Market, Zero-Coupon Bonds, Coupon Bonds, Money Market Account. | **8** |
| 3 | **Risky Assets:** Dynamics of Stock Prices, Return, Expected Return, Binomial Tree Model, Risk-Neutral Probability, Martingale Property, Other Models, Trinomial Tree Model, Continuous-Time Limit. | **12** |
| 4 | **Discrete Time Market Models:** Stock and Money Market Models, Investment Strategies, The Principle of No Arbitrage, Application to the Binomial Tree Model, Fundamental Theorem of Asset Pricing, Extended Models. | **8** |
| | **Portfolio Management:** Risk, Two Securities, Risk and Expected Return on a Portfolio, Several Securities, Risk and Expected Return on a Portfolio, Efficient Frontier, Capital Asset Pricing Model, Capital Market Line, Beta Factor, Security Market Line. | **8** |
| | **Forward and Futures Contracts:** Forward Contracts, Forward Price, Value of a Forward Contract, Futures, Pricing, Hedging with Futures. | **8** |
| | **Option Pricing:** European Options in the Binomial Tree Model, One Step, Two Steps, General N-Step Model, Cox–Ross–Rubinstein Formula, American Options in the Binomial Tree Model, Black–Scholes Formula. | **8** |
| **Total** | | 60 |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To understand the fundamentals of the theory of one-period and multi-period financial models. | ●3 lecture hours\week | ●Regular Exams |
| 1.2 | To understand techniques and features of Market Models with both continuous time and discrete time. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of problem solving. | Self-study | Participations |
| 2.2 | To communicate mathematics clearly and precisely both orally and in writing. | Real-life problems | Short Quizzes |
| 2.3 | To use Internet in searching for scientific information | Self-study | Participations |
| 2.4 | To carry out calculations orally and mentally. | Real-life problems | Short Quizzes |
| 3.0 | **Values** | | |
| 3.1 | To work individually. | Personal questions | Participation |
| 3.2 | To work in groups. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | *Mathematics for Finance: An Introduction to Financial engineering*, **2nd Edition. M. Capinski and T. Zastawniak, Springer Verlag, 2011. (Main Reference).** ISBN: 1852333308 |

| | |
|---|---|
| **Essential References Materials** | 1. *Stochastic Finance: An Introduction in Discrete Time*, **DeGruyter Studies in Mathematics, 2nd Edition, H. Föllmer and A. Schied, Walter de Gruyter, Berlin, 2011.**ISBN: 3110171198.<br>2. *Introduction to Mathematical Finance: Discrete Time Models, Stanley R. Pliska, Wiley, 1997.ISBN: 978-1-55786-945-6.* |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

## 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Actuarial Mathematics** |
| **Course Code:** | **MAT 1474** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☑ Others ☐ |
| **b.** | Required ☐ Elective ☑ |
| **3. Level/year at which this course is offered:** | **Level 10 or 11 / Year 3** |
| **4.Pre-requisites for this course** (if any)**:** | **MAT 1371** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course treats the economics of insurance, the future lifetime random variables (discrete and continuous), force of mortality, Life Tables: Select, Ultimate and Select and Ultimate, Annuities and Assurance in both discrete and continuous case, Commutation Functions. The emphasis is on calculations and some applications are mentioned.**

**2. Course Main Objective**

**By the end of this course students must be able to:**

- **Link interest rate with Loan and Mortgage refinancing,**
- **Understand mortality tables and interpret the force of mortality,**
- **Compute the net premium for types of Insurance and Life annuities.**

### 3. Course Learning Outcomes

| | CLOs | Aligned-PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To outline the fundamentals of the interest rate related to Loan and Mortgage refinancing.** | **K1, K2** |
| 1.2 | **To memorize mortality tables and the interpretation of its force.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To develop techniques of life insurance.** | **S1, S2** |
| 2.2 | **To present methods of premium calculations clearly and precisely both orally and in writing.** | **S4** |
| 2.3 | **To use Internet in searching for real insurance products** | **S5** |
| 2.4 | **To demonstrate the efficiency of some insurance techniques.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To work individually.** | **V1, V3** |
| 3.2 | **To work in groups.** | **V1, V2** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Basics of Probability & Interest:** Probability, Theory of Interest, Variable Interest Rates, Continuous-time Payment Streams. | **5** |
| 2 | **Interest & Force of Mortality:** More on Theory of Interest, Annuities & Actuarial Notation, Loan Amortization & Mortgage Refinancing, Illustration on Mortgage Refinancing, Coupon & Zero-coupon Bonds, Force of Mortality & Analytical Models, Comparison of Forces of Mortality. | **12** |
| 3 | **Probability & Life Tables:** Interpreting Force of Mortality, Interpolation between Integer Ages, Binomial Variables & Law of Large Numbers, Exact Probabilities, Bounds & Approximations, Simulation of Life Table Data, Expectation for Discrete Random Variables, Rules for Manipulating Expectations, Some Special Integrals. | **16** |
| 4 | **Expected Present Values of Payments:** Expected Payment Values, Types of Insurance & Life Annuity Contracts, Formal Relations among Net Single Premiums, Formulas for Net Single Premiums, Expected Present Values for $m = 1$, Continuous Contracts & Residual Life, Numerical Calculations of Life Expectancies. | **15** |
| 5 | **Premium Calculation:** $m$-Payment Net Single Premiums, Dependence Between Integer & Fractional Ages at Death, Net Single Premium Formulas \| Case (i), Net Single Premium Formulas \| Case (ii), Approximate Formulas via Case(i), Net Level Premiums, Benefits Involving Fractional Premiums. | **12** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding:** | | |
| 1.1 | To outline the fundamentals of the interest rate related to Loan and Mortgage refinancing. | ●3 lecture hours\week | ●Regular Exams |
| 1.2 | To memorize mortality tables and the interpretation of its force. | ●2 tutorial hours\week<br>●Self-study | ●Assignments<br>●Short Quizzes |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of life insurance. | Real-life problems | Short Quizzes |
| 2.2 | To present methods of premium calculations clearly and precisely both orally and in writing. | Self-study | Participations |
| 2.3 | To use Internet in searching for real insurance products | Real-life problems | Short Quizzes |
| 2.4 | To demonstrate the efficiency of some insurance techniques. | Self-study | Participations |
| 3.0 | **Values** | | |
| 3.1 | To work individually. | Personal questions | Participation |
| 3.2 | To work in groups. | Team work | Homework and Mini-projects |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Home works, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | ***Actuarial Mathematics and Life-Table Statistics*, Eric V. Slud, CRC Press (Verlag), 2001.** (Main Reference). ISBN: 9781439861974. |
| **Essential References Materials** | 1. ***Fundamentals of Actuarial Mathematics*, S. David Promislow, Wiley, 2010.**ISBN: 978-0-470-68411-5.<br>2. ***Actuarial Mathematics*, by Newton L. Bowers, Hans U. Gerber, James C. Hickman, Donald A. Jones and Cecil J. Nesbitt (1997).** ISBN 10: 0938959468, ISBN 13: 9780938959465.<br>3. ***Actuarial Mathematics for Life Contingent Risks, 2nd Edition, David C. M. Dickson, Mary R. Hardy and Howard R. Waters, Cambridge University Press, 2013. ISBN: 9781107044074.*** |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | **The rooms should be equipped with data show and Smart Board.** |
| **Other Resources**<br>(Specify, e.g., if specific laboratory equipment is required, list requirements or attach a list) | **None.** |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| Council / Committee | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| Reference No. | 11/1444 |
| Date | 22/04/1444 (16/11/2022) |

| | |
|---|---|
| **Course Title:** | **Mathematical Statistics** |
| **Course Code:** | **STA 1203** |
| **Program:** | **Bachelor of Science in Applied Statistics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** University ☐ College ☐ Department ☑ Others ☐ | |
| **b.** Required ☑ Elective ☐ | |
| **3. Level/year at which this course is offered:** | **Level 6 / Year 2** |
| **4. Pre-requisites for this course (if any):** | **STA 1202** |
| **5. Co-requisites for this course (if any):** | **None** |

**6. Mode of Instruction** (mark all that apply)

| *No* | *Mode of Instruction* | *Contact Hours* | *Percentage* |
|---|---|---|---|
| 1 | **Traditional classroom** | **60** | **100%** |
| 2 | **Blended** | | |
| 3 | **E-learning** | | |
| 4 | **Distance learning** | | |
| 5 | **Other** | | |

**7. Contact Hours (based on academic semester)**

| *No* | *Activity* | *Contact Hours* |
|---|---|---|
| 1 | **Lecture** | **36** |
| 2 | **Laboratory/Studio** | **0** |
| 3 | **Tutorial** | **24** |
| 4 | **Others** (specify) | **0** |
| | **Total** | **60** |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course describes the most important ideas, theoretical results, and examples of bivariate probability distributions, sampling distributions and the CLT, functions of random variables, parameter estimations and hypothesis testing. The course includes the essential fundamentals of these topics. The emphasis is on calculations, and some applications are mentioned.**

## 2. Course Main Objective

- **Use joint probability mass functions and joint probability density functions to calculate probabilities;**
- **Calculate means and variances for linear combinations of random variables.**
- **Determine the distribution of a general function of a random variable;**
- **Calculate moment generating functions and use the functions to determine moments and distributions;**
- **Understand the central limit theorem;**
- **Know how to compute and explain the precision with which a parameter is estimated;**
- **Construct confidence intervals on the mean, variance, standard deviation and population proportion.**
- **To teach students techniques of estimations.**

## 3. Course Learning Outcomes

| | *CLOs* | *Aligned-PLOs* |
|---|---|---|
| 1 | **Knowledge and Understanding:** | |
| 1.1 | **To define the moment generating function, the joint probability mass functions, and joint probability density functions.** | **K1, K2** |
| 1.2 | **To reproduce the confidence intervals on the mean, variance, standard deviation and on a population proportion.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To explain the importance of central limit theorem** | **S1, S2** |
| 2.2 | **To calculate means and variances for linear combinations of random variables.** | **S4** |
| 2.3 | **To construct confidence intervals on the appropriate case.** | **S2, S3** |
| 2.4 | **To explain important properties of point estimators, including bias, variance, and mean square error** | **S5** |
| 2.5 | **To construct point estimators using the method of moments and the method of maximum likelihood.** | **S3** |
| **3** | **Values:** | |
| 3.1 | **To defend the formulated conclusions individually.** | **V1, V2** |
| 3.2 | **To operate meaningfully and productively with others.** | **V1, V3** |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Bivariate Probability Distribution:** Two Discrete Random Variables, Two Continuous Random Variables, Covariance and Correlation, Bivariate Normal Distribution, Linear Combinations of Random Variables. | **6** |
| 2 | **Sampling distributions and the central limit theorem:** Sampling distributions, Sampling Distributions of the Means, The chi-square distribution, The t distribution, The F distribution. | **6** |
| 3 | **Functions of Random Variables:** Finding the probability distribution of a function of random variable. The method of distribution function, The method of transformations, Using the Moment-Generating Functions | **8** |
| 4 | **Sampling Distributions and The Central Limit Theorem:** Sampling Distributions related to the Normal Distribution; The Central Limit Theorem; A proof of the Central Limit Theorem. | **8** |
| 5 | **Estimation: Point estimation:** The Bias and Mean Square Error of Point Estimation; Some Common Point Estimators; Evaluating The goodness of a Point Estimator. | **8** |
| 6 | **Confidence Interval Estimation:** Confidence interval for the Mean when σ is Known: Confidence interval for the Mean when σ is Unknown. Confidence Interval and Sample Sizes for Proportions. Confidence Intervals for Variance And standard Deviations. | **15** |
| 7 | **Properties of Point Estimators and Methods of Estimation:** Relative Efficiency. Consistency. Sufficiency. Rao-Blackwell Theorem and Minimum Variance Estimation. The Method of Moments. The Method of Maximum Likelihood. | **9** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding** | | |
| 1.1 | **To define the moment generating function, the joint probability mass functions, and joint probability density functions.** | **Lectures, problem solving, Classroom discussions** | **Regular Exams, Lab Assignments, Short Quizzes** |
| 1.2 | **To reproduce the confidence intervals on the mean, variance, standard deviation and on a population proportion.** | **Lectures, problem solving, Classroom discussions** | **Regular Exams, Lab Assignments, Short Quizzes** |
| **2.0** | **Skills** | | |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 2.1 | Explain the importance of central limit theorem | Use of statistical software, Lecturing, Interactive learning. | Lab Exam, Participations, Short Quizzes |
| 2.2 | Calculate means and variances for linear combinations of random variables and calculate probabilities for linear combinations of normally distributed random variables | Use of statistical software, Lecturing, Interactive learning. | Lab Exam, Participations, Short Quizzes |
| 2.3 | Construct confidence intervals on the appropriate case. | Use of statistical software, Lecturing, Interactive learning. | Lab Exam, Participations, Short Quizzes |
| 2.4 | To explain important properties of point estimators, including bias, variance, and mean square error | Use of statistical software, Lecturing, Interactive learning. | Lab Exam, Participations, Short Quizzes |
| 2.5 | To construct point estimators using the method of moments and the method of maximum likelihood. | Use of statistical software, Lecturing, Interactive learning. | Lab Exam, Participations, Short Quizzes |
| **3.0** | **Values** | | |
| 3.1 | To defend the formulated conclusions individually. | Interactive learning, Group interaction, Problem solving. | Lab Exam, Practical exam |
| 3.2 | To operate meaningfully and productively with others. | Group interaction, Problem solving. | Assignments and Mini-projects |

**2. Assessment Tasks for Students**

| # | *Assessment task** | *Week Due* | *Percentage of Total Assessment Score* |
|---|---|---|---|
| 1 | Homeworks, Quizzes, Mini-projects | During the semester | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

### 1. Learning Resources

| | |
|---|---|
| *Required Textbooks* | ***Probability & Statistics for Engineers & Scientists,*** 9th Edition, R. Walpole, R. Myers, S. Myers, K. Ye, Pearson Education International, 2012. ISBN 9780321629111. **(Main Reference).**<br>***Introduction to Mathematical Statistics,*** 6th Edition, Robert V. Hogg, Joseph McKean, Allen T. Craig, Prentice Hall, 2005. **(Main Reference).** |
| *Essential References Materials* | 1. ***Mathematical Statistics with Applications,*** 7th Edition, D. Wackerly, W. Mendenhall, R.L. Scheaffer, Brooks/Cole-Cengage Learning, 2008. ISBN-13: 9780495385080.<br>2. ***Probability and Statistics in Engineering***, 4th Edition, William W. Hines, Douglas C. Montgomery, David M. Goldsman, Connie M. Borror, John Wiley & Sons Inc, 2003. ISBN: 9780471240877.<br>3. ***Introduction to Mathematical Statistics,*** 6th Edition, Robert V. Hogg, Joseph McKean, Allen T. Craig, Prentice Hall, 2005. |
| *Electronic Materials* | **None** |
| *Other Learning Materials* | **None** |

### 2. Facilities Required

| *Item* | *Resources* |
|---|---|
| ***Accommodation*** *(Classrooms, laboratories, demonstration rooms/labs, etc.)* | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection (Equipped with Microsoft Excel and SPSS).** |
| ***Technology Resources*** *(AV, data show, Smart Board, software, etc.)* | **The rooms should be equipped with data show and Smart Board.**<br>**All computers should be equipped with the following software:**<br>▪ **Microsoft Excel**<br>▪ **IBM SPSS**<br>▪ **R-Project**<br>▪ **MATLAB** |
| ***Other Resources*** *(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)* | **See the attached file** |

## G. Course Quality Evaluation

| *Evaluation Areas/Issues* | *Evaluators* | *Evaluation Methods* |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| *Council / Committee* | **MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL** |
| *Reference No.* | **11/1444** |
| *Date* | **22/04/1444 (16/11/2022)** |

| | |
|---|---|
| **Course Title:** | **Introduction to Regression** |
| **Course Code:** | **STA 1321** |
| **Program:** | **Bachelor of Science in Applied Statistics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** University ☐ College ☐ Department ☑ Others ☐ | |
| **b.** Required ☑ Elective ☐ | |
| **3. Level/year at which this course is offered:** | **Level 7 / Year 3** |
| **4. Pre-requisites for this course** (if any)**:** | **STA 1203** |
| **5. Co-requisites for this course** (if any)**:** | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 36 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 24 |
| 4 | Others (specify) | 0 |
| | Total | 60 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**In statistics, linear regression is a fundamental technique to approach linearly of statistical modelling, in which we aim to model a response variable using one or more explanatory variables. This course covers the broad class of linear regression models, which are widely used in practice by using basic example data set. The course aims to teach how to formulate such models and fit them to data, how to make predictions with associated measures of uncertainty, and how to select appropriate explanatory variables. Both theory and practical aspects are covered, including the use of computer software for regression.**

## 2. Course Main Objective

**Regression analysis consists of a collection of techniques used to explore and understand the relationship between variables and is perhaps the most widely-used and most useful of all the techniques in modern Statistics. The objectives of this course are:**

- **to help student to have a firm understanding of the underlying theory;**
- **to learn the tools needed to carry out the statistical regression analysis in a variety of applications;**
- **to provide student with facility and experience in regression model building, evaluation, and analysis using a modern computer approach.**

## 3. Course Learning Outcomes

| | CLOs<br>After successful completion of the course, students will able to: | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | **To outline the concept of linear regression model and properties of model parameters for prediction purposes.** | **K1, K2** |
| 1.2 | **To define regression analysis and its limitations.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To summarize and explain the general procedures of statistical inference for linear regression models.** | **S1, S2** |
| 2.2 | **To differentiate the situation where linear regression is appropriate** | **S2** |
| 2.3 | **To interpret estimates and diagnostic statistics.** | **S3, S4** |
| 2.4 | **To construct and fit linear regression models with the appropriate software.** | **S5** |
| 2.5 | **To design and implement advanced methods in regression analysis for applications.** | **S2, S3** |
| **3** | **Values:** | |
| 3.1 | **To employ ethical concepts and rules to determine viable alternatives in any given situation.** | **V1, V2** |
| 3.2 | **To show findings and discuss the results with others.** | **V1, V3** |

## C. Course Content

| *No* | *List of Topics* | *Contact Hours* |
|---|---|---|
| 1 | **Introduction to Regression Analysis:** Regression Models. Formal uses of regression analysis. The data base. | **7** |
| 2 | **The Simple Linear Regression Model:** The model description; Assumption and interpretation of model parameters; Last square formulation; Partitioning total variability; Test of hypothesis on a slope and intercept; Quality of fitted model; Confidence interval on mean response and prediction intervals; A look at a residual. | **13** |

| No | List of Topics | Contact Hours |
|---|---|---|
| 3 | **The Multiple Linear Regression Model:** Model description and assumptions; Estimation; Properties of the least square estimators; Various hypotheses tests; Multicollinearity in multiple data; Quality of fit and prediction. | **16** |
| 4 | **Selection of Variables:** Contribution of a variable in the model; Forward selection and backward elimination; Stepwise procedure; All possible subsets and other techniques of selection variables. | **12** |
| 5 | **Statistical diagnostics:** Analysis of residual; Diagnostic plots; Detection of outliers; Influence diagnostics. | **12** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding** | | |
| 1.1 | **To outline the concept of linear regression model and properties of model parameters for prediction purposes.** | • **Using lectures to introduce the subjects of the course's materials.**<br>• **Using examples to demonstrate the introduced methodologies.**<br>• **Discussion within lectures/tutorials/lab sessions.**<br>• **Letting students to raise questions regarding the homework and lectures every week.** | • **Continuous Assessment (assignments, test, and mini-project).**<br>• **Final Examination** |
| 1.2 | **To define regression analysis and its limitations.** | **Discussion within lectures/tutorials Letting students to raise questions regarding the homework and lectures every week.** | **Continuous Assessment (assignments, test, and mini-project), Final Examination** |
| **2.0** | **Skills** | | |
| 2.1 | **To summarize and explain the general procedures of statistical inference for linear regression models.** | • **Lectures to introduce the subjects of the course's materials.**<br>• **Using examples to demonstrate the introduced methodologies.** | • **Continuous Assessment (assignments, test, and mini-project).**<br>**Final Exam** |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| | | • Discussion within lectures/tutorials/lab sessions.<br>• Letting students to raise questions regarding the homework and lectures every week. | |
| 2.2 | To differentiate the situation where linear regression is appropriate | Using programming assignments, to allow students to apply the methodologies learnt in the lecture and to solidify their understanding of the statistical procedures. | • Continuous Assessment (assignments, test, and mini-project).<br>• Final Exam |
| 2.3 | To interpret estimates and diagnostic statistics | Using programming assignments, to allow students to apply the methodologies learnt in the lecture and to solidify their understanding of the statistical procedures. | • Lab exams and reports<br>• and mini-project).<br>• Homeworks<br>• Final exam. |
| 2.4 | To construct and fit linear regression models with the appropriate software. | Using programming assignments, to allow students to apply the methodologies learnt in the lecture and to solidify their understanding of the statistical procedures. | Lab exams and reports, Continuous Assessment (assignments, test, and mini-project). , Final exam. |
| 2.5 | To carry out calculations orally and mentally. | Open discussion at classroom. Letting students to raise questions regarding the homework and lectures every week. | Written assignment and written final exam. Presentation of mini-projects. |
| 3.0 | Values | | |
| 3.1 | To employ ethical concepts and rules to determine viable alternatives in any given situation. | Open discussion at classroom. | Participation, Lab assignments, Mini-project(s) |
| 3.2 | To show findings and discuss the results with others. | Small team tasks, Open discussion at classroom. | Lab assignments, Mini-project(s) |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | **Homeworks, Quizzes, Mini-projects** | **During the semester** | **20%** |
| 2 | **First Midterm** | **Week 4-5** | **20%** |
| 3 | **Second Midterm** | **Week 7-8** | **20%** |
| 4 | **Final Exam** | **Week 13** | **40%** |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**
- **All students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.**

## F. Learning Resources and Facilities

### 1. Learning Resources

| | |
|---|---|
| *Required Textbooks* | ***Classical and Modern Regression with Applications*;** 2nd Edition, Raymond H. Myers, Duxbury Classic, 2000. ISBN-13: 978-0534380168. **(Main Reference)** |
| *Essential References Materials* | 1. ***Regression analysis by example,*** 5th Edition, Samprit Chatterjee and Alis S. Hadi, Wiley Series in Probability and Statistics, 2012.<br>2. ***Applied Regression,*** 4th Edition, Sanford Weisberg, Wiley Series in Probability and Statistics, 2013.<br>3. ***Applied Regression Analysis and Multivariable Methods*,** 5th Edition, D. G. Kleinbaum, L. L. Kupper, A. Nizam, and E. S. Rosenberg, Cengage Learning, 2013.<br>4. ***Introduction to Linear Regression Analysis*, 5th Edition;** Douglas C. Montgomery, Elizabeth A. Peck, and G. Geoffrey Vining, Wiley Series in Probability and Statistics, 2012. |
| *Electronic Materials* | **Regression Analysis, Theory, Methods and Applications**, A Sen and M. Srivastava, Springer-Verlag, 1990. (it can be download from IMAMU domain) |
| *Other Learning Materials* | • **Online Linear Regression Calculator**<br>• **linear regression (**UC Business Analytics R Programming Guide) |

## 2. Facilities Required

| *Item* | *Resources* |
|---|---|
| ***Accommodation*** *(Classrooms, laboratories, demonstration rooms/labs, etc.)* | ▪ **Each of the class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| ***Technology Resources*** *(AV, data show, Smart Board, software, etc.)* | **The rooms should be equipped with data show and Smart Board.**<br>**All computers should be equipped with the following software:**<br>▪ **Microsoft Excel**<br>▪ **IBM SPSS**<br>▪ **R-Project**<br>▪ **MATLAB** |
| ***Other Resources*** *(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)* | **See the attached file** |

## G. Course Quality Evaluation

| *Evaluation Areas/Issues* | *Evaluators* | *Evaluation Methods* |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL** |
| **Reference No.** | **11/1444** |
| **Date** | **22/04/1444 (16/11/2022)** |

| | |
|---|---|
| **Course Title:** | **Introduction to Stochastic Processes** |
| **Course Code:** | **STA 1351** |
| **Program:** | **Bachelor of Science in Applied Statistics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | **4 (3 Lectures, 0 Lab, 2 Tutorial)** |
| **2. Course type** | |
| **a.** University ☐ College ☐ Department ☑ Others ☐ | |
| **b.** Required ☑ Elective ☐ | |
| **3. Level/year at which this course is offered:** | **Level 9 / Year 3** |
| **4. Pre-requisites for this course (if any):** | **STA 1202, MAT 1223** |
| **5. Co-requisites for this course (if any):** | **None** |

**6. Mode of Instruction** (mark all that apply)

| *No* | *Mode of Instruction* | *Contact Hours* | *Percentage* |
|---|---|---|---|
| 1 | **Traditional classroom** | **60** | **100%** |
| 2 | **Blended** | | |
| 3 | **E-learning** | | |
| 4 | **Distance learning** | | |
| 5 | **Other** | | |

**7. Contact Hours** (based on academic semester)

| *No* | *Activity* | *Contact Hours* |
|---|---|---|
| 1 | **Lecture** | **36** |
| 2 | **Laboratory/Studio** | **00** |
| 3 | **Tutorial** | **24** |
| 4 | **Others** (specify) | **0** |
| | **Total** | **60** |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**Markov chains are used to model many phenomena which arise in some statistical problems. The course covers an introduction to probability theory, conditional probability, and conditional expectation. Moreover, discrete time Markov chains are introduced, as well as branching processes, time reversible Markov chains, and hidden Markov chains. Then exponential distributions and the Poisson processes are defined. Finally, Continuous time Markov chains are introduced as well as their transition probability function.**

**2. Course Main Objective**

**The course introduces students to the basic theory of probability, enable students to assimilate properties of stochastic processes. learn how to build Markov chain in discrete and continuous time and learn how to use Markov chain in modelling.**

## 3. Course Learning Outcomes

| | *CLOs* | *Aligned-PLOs* |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | **To describe the basics of stochastic modeling of real-world systems related to the physical sciences, computer science, and (possibly) finance.** | **K1, K2** |
| 1.2 | **To define exponential distribution to model arrival times, the Poisson process, and outline its application to continuous time Markov chains** | **K1, K2** |
| 1.3 | **To state the concept of conditional probability, Markov chain, Branching process, Poisson process, and Birth and Death process.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **To use probability and matrix theory to solve stochastic models.** | **S1, S2** |
| 2.2 | **To evaluate stochastic process problems mathematically and using software.** | **S1, S2, S5** |
| 2.3 | **To assess how sensitive stochastic models are to changes that might occur in model variables.** | **S2, S3, S4** |
| 2.4 | **To interpret and explain the solution for a stochastic process application.** | **S3, S4** |
| **3** | **Values:** | |
| 3.1 | **To work individually.** | **V1, V2** |
| 3.2 | **To show findings and discuss the results with others.** | **V1, V3** |

## C. Course Content

| *No* | *List of Topics* | *Contact Hours* |
|---|---|---|
| 1 | **Basic probability:** Random variable, Limit Theorems, Stochastic Processes. | **7** |
| 2 | **Conditional Probability and Conditional Expectation:** Introduction, The Discrete Case, The Continuous Case, Computing Expectations by Conditioning, Computing Probabilities by Conditioning, Some Applications, An Identity for Compound Random Variables. | **12** |

| No | List of Topics | Contact Hours |
|---|---|---|
| 3 | **Markov Chains:** Introduction, Chapman–Kolmogorov Equations, Classification of States, Limiting Probabilities, Some Applications, Mean Time Spent in Transient States, Branching Processes, Time Reversible Markov Chains, Markov Chain Monte Carlo Methods, Markov Decision Processes, Hidden Markov Chains. | **13** |
| 4 | **The Exponential Distribution and the Poisson Process:** Introduction, The Exponential Distribution, The Poisson Process, Generalizations of the Poisson Process. | **10** |
| 5 | **Continuous-Time Markov Chains:** Introduction, Continuous-Time Markov Chains, Birth and Death Processes, The Transition Probability Function $P_{ij}(t)$, Limiting Probabilities. | **9** |
| 6 | **Renewal Theory and Its Applications:** Introduction. Distribution of $N(t)$. Limit Theorems and Their Applications. Renewal Reward Processes. Regenerative Processes. Semi-Markov Processes. The Inspection Paradox. Computing the Renewal Function. Applications to Patterns. The Insurance Ruin Problem. | **9** |
| **Total** | | **60** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding** | | |
| 1.1 | **To describe the basics of stochastic modeling of real-world systems related to the physical sciences, computer science, and (possibly) finance.** | • **Using lectures to introduce the subjects of the course's materials.**<br>• **Using examples to demonstrate the introduced methodologies.**<br>• **Discussion within lectures/tutorials/lab sessions.** | **Continuous Assessment (assignments, test, and mini-project), Final Examination** |
| 1.2 | **To define exponential distribution to model arrival times, the Poisson process, and outline its application to continuous time Markov chains** | **Discussion within lectures/tutorials Letting students to raise questions regarding the homework and lectures every week.** | **Continuous Assessment (assignments, test, and mini-project), Final Examination** |
| 1.3 | **To state the concept of conditional probability, Markov chain, Branching process,** | **Letting students to raise questions regarding the** | **Continuous Assessment (assignments, test, and mini-** |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| | Poisson process, and Birth and Death process. | homework and lectures every week. | project), Final Examination |
| 2.0 | **Skills** | | |
| 2.1 | To use probability and matrix theory to solve stochastic models. | • Self-study<br>• Lecture.<br>• Real-life problems | • Participations<br>• Short Quizzes |
| 2.2 | To evaluate stochastic process problems mathematically and using software. | Using assignments, to allow students to apply the methodologies learnt in the lecture and to solidify their understanding of the statistical procedures. | • Continuous Assessment (assignments, test, and mini-project).<br>• Final Exam |
| 2.3 | To assess how sensitive stochastic models are to changes that might occur in model variables. | Using assignments, to allow students to apply the methodologies learnt in the lecture and to solidify their understanding of the statistical procedures. | • Lab exams and reports<br>• and mini-project).<br>• Homework's<br>• Final exam. |
| 2.4 | To interpret and explain the solution for a stochastic process application. | • Self-study<br>• Lecture.<br>• Real-life problems | • Participations<br>Short Quizzes |
| 3.0 | **Values** | | |
| 3.1 | To work individually. | Personal questions | • Participation<br>• Class Assignments |
| 3.2 | To show findings and discuss the results with others. | Team work | Homework and Mini-projects |

## 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Homeworks, Quizzes, Mini-projects | During the term | 20% |
| 2 | First Midterm | Week 4-5 | 20% |
| 3 | Second Midterm | Week 7-8 | 20% |
| 4 | Final Exam | Week 13 | 40% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

# E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

- **There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.**
- **All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.**

## F. Learning Resources and Facilities

### 1. Learning Resources

| | |
|---|---|
| *Required Textbooks* | • ***Introduction to Probability Models,*** S. Ross, 11th Edition, Academic Press, 2014. ISBN: 9780123756862 (Main Reference).<br>• ***Introduction to Stochastic Processes With R,*** Robert P. Dobrow, John Wiley & Sons, Inc, 2016. (Main Reference) |
| *Essential References Materials* | 1. ***An Introduction to Stochastic Modeling,*** M. A. Pinsky and S. Karlin, 4th Edition, Academic Press Elsevier, 2011.<br>2. ***Introduction to Probability,*** D. Bertsekas and J. Tsitsiklis, 2nd Edition; Athena Scientific, 2008.<br>3. ***Fundamentals of Probability with Stochastic Processes,*** 3rd Edition; Saeed Ghahramani, Prentice Hall, 2004. |
| *Electronic Materials* | **None** |
| *Other Learning Materials* | **None** |

### 2. Facilities Required

| *Item* | *Resources* |
|---|---|
| ***Accommodation*** *(Classrooms, laboratories, demonstration rooms/labs, etc.)* | ▪ **Each class room should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection.** |
| ***Technology Resources*** *(AV, data show, Smart Board, software, etc.)* | **The rooms should be equipped with data show and Smart Board.**<br>**All computers should be equipped with the following software:**<br>▪ **Microsoft Excel**<br>▪ **IBM SPSS**<br>▪ **R-Project**<br>▪ **MATLAB** |

| *Item* | *Resources* |
|---|---|
| ***Other Resources***<br>*(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)* | **None.** |

## G. Course Quality Evaluation

| *Evaluation Areas/Issues* | *Evaluators* | *Evaluation Methods* |
|---|---|---|
| **Effectiveness of teaching and assessment, Quality of learning resources** | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| **Extent of achievement of course learning outcomes, Quality of learning resources** | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.** |

***Evaluation areas*** *(e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)*

***Evaluators*** *(Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)*

***Assessment Methods*** *(Direct, Indirect)*

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL** |
| **Reference No.** | **11/1444** |
| **Date** | **22/04/1444 (16/11/2022)** |

| | |
|---|---|
| **اسم المقرر:** | مبادىء الاقتصاد |
| **رمز المقرر:** | قصد 100 |
| **البرنامج:** | البكالوريوس – المستوى الرابع- |
| **القسم العلمي:** | قسم الاقتصاد |
| **الكلية:** | كلية الاقتصاد والعلوم الإدارية |
| **المؤسسة:** | جامعة الإمام محمد بن سعود الإسلامية |

## المحتويات

أ. التعريف بالمقرر الدراسي:

| |
|---|
| **1. الساعات المعتمدة:** ثلاثة ساعات |
| **2. نوع المقرر**<br>أ. متطلب جامعة ☐ متطلب كلية ☑ متطلب قسم ☐ أخرى ☐<br>ب. إجباري ☑ اختياري ☐ |
| **3. السنة / المستوى الذي يقدم فيه المقرر:**<br>السنة الثانية/المستوى الرابع |
| **4. المتطلبات السابقة لهذا المقرر** (إن وجدت)<br>لا يوجد |
| **5. المتطلبات المتزامنة مع هذا المقرر** (إن وجدت)<br>لا يوجد |

**6. نمط الدراسة** (اختر كل ما ينطبق)

| م | نمط الدراسة | عدد الساعات التدريسية | النسبة |
|---|---|---|---|
| 1 | المحاضرات التقليدية | 30 ساعة | %100 |
| 2 | التعليم المدمج | | |
| 3 | التعليم الإلكتروني | | |
| 4 | التعليم عن بعد | | |
| 5 | أخرى | | |

**7. ساعات الاتصال** (على مستوى الفصل الدراسي)

| م | النشاط | ساعات التعلم |
|---|---|---|
| 1 | محاضرات | 30 ساعة |
| 2 | معمل أو إستوديو | |
| 3 | دروس إضافية | |
| 4 | أخرى (تذكر) | |
| | **الإجمالي** | 30 ساعة |

ب- هدف المقرر ومخرجاته التعليمية:

**1. الوصف العام للمقرر:**

يتضمّن هذا المقرر المفاهيم الأساسية لعلم الاقتصاد سواء من منظور جزئي (سلوك المستهلك وسلوك المنتج) أو منظور كلي (الدخل القومي, البطالة, التضخم...) بالاضافة الى دراسة مواضيع تهم القطاع المصرفي وآلية عمل المؤسسات المالية وأيضا التجارة الخارجية.

**2. الهدف الرئيس للمقرر**

يهدف هذا المقرر للتعريف بمفاهيم واسس علم الاقتصاد وسلوك المنتج والمستهلك وآليات الاقتصاد الإسلامي في معالجة القضايا الاقتصادية المرتبطة بالسوق والتوزيع وحسن تخصيص الموارد النادرة بالإضافة إلى دراسة القطاع المصرفي وآلية عمل المؤسسات المالية وأيضا التجارة الخارجية.

**3. مخرجات التعلم للمقرر:**

| | مخرجات التعلم للمقرر | رمز مخرج التعلم المرتبط للبرنامج |
|---|---|---|
| 1 | **المعرفة والفهم** | |
| 1.1 | ▪ يعرف الطالب المصطلحات والمفاهيم الأساسية الخاصة بعلم الاقتصاد.<br>▪ يعرف الطالب المشكلة الإقتصادية من منظور إسلامي.<br>▪ يعدد الخصائص والضوابط الإسلامية للمستهلك والمنتج والسوق | ١ع |

| | مخرجات التعلم للمقرر | رمز مخرج التعلم المرتبط للبرنامج |
|---|---|---|
| | ▪ يعرف النظم والمؤسسات التي تحكم أداء الاقتصاد الاسلامي | |
| 1.2 | ▪ يعرف الطالب موضوعات الاقتصاد الجزئي والكلي بمنظور اسلامي | ع2 |
| 1.3 | ▪ يستعرض فاعلية آليات الاقتصاد الاسلامي في حسن تخصيص الموارد الاقتصادية النادرة مقارنة بالنظم الأخرى<br>▪ يستعرض الطالب القضايا والنوازل الاقتصادية المعاصرة في الاسلام<br>▪ يعدد آليات عمل المؤسسات المالية و التجارة الخارجية | ع3 |
| **2** | **المهارات** | |
| 2.1 | ▪ يطبق المعارف والضوابط في حل المشكلات الاقتصادية المطروحة<br>▪ يستنبط الطالب المبادئ الاقتصادية من النصوص الشرعية<br>▪ يعرض الطالب عقيدته الاسلامية باسلوب عقلاني عصري وبتفهم جيد للتحديات الاقتصادية المعاصرة<br>▪ يقارن بين اليات الاقتصاد الإسلامي والنظم الاقتصاد الأخرى في مختلف المجالات. | م1 |
| 2.2 | ▪ يتعرف الطالب على الأساليب الرياضية والإحصائية المناسبة لحل مسألة معينة، وتطبيقها، وتفسير النتائج.<br>▪ يتعرف الطالب على كيفية تعظيم المنفعة لمستهلك.<br>▪ يتعرف الطالب على كيفية تعظيم الأرباح للمنتج. | م2 |
| 2.3 | ▪ يتواصل بفاعلية شفهيًا وكتابيًا مع الاخرين<br>▪ يحلل الطالب القضايا الاقتصادية العصرية | م3 |
| **3** | **القيم** | |
| 3.1 | ▪ يتحمل مسؤولياته ويطور من قدراته الذاتية<br>▪ يطور الطالب قدراته الشخصية من خلال التعلم الذاتي<br>▪ يتجاوب الطلاب أثناء المحاضرات مع أستاذ المقرر، وتقبل الملاحظات والنصائح المقدمة لهم من أجل تحسين عملية التعلم<br>▪ تحمل الطلاب مسئولية إنجاز التمارين والبحوث العلمية المطلوبة منهم | ق1 |
| 3.2 | ▪ يتعامل مع الاخرين بروح الفريق ويعبر عن رايه باستقلالية وفي ظل الاحترام المتبادل<br>▪ يحضر الطالب المحاضرات بروح ايجابية من أدب الاصغاء وروح المشاركة الفاعلة.<br>▪ يتعاون الطلاب مع زملائه في المجموعات بروح الفريق لإنجاز المهام التي توكل عليهم وممارسة الدور القيادي عند الحاجةِ<br>▪ يتَصَرُّفُ الطالب بروح عالية من المسؤولية الشخصية تجاه الغير<br>▪ يجيب الطالب على اسئلة المناقشة المتولدة عن كل فصل من فصول المقرر تحت اشراف الاستاذ. | ق2 |
| 3.3 | ▪ يلتزم الطالب في اعداد واجباته بالدقة والشفافية والامانة<br>▪ قبول الطالب النتائج التي تحصل عليها في الاختبارات بروح ايجابية وتعلمه من أخطائه<br>▪ يتصرف الطالب بشكل أخلاقي والالتزام بالقيم الأخلاقية العالية على النطاق الشخصي والاجتماعي. | ق3 |

ج. موضوعات المقرر

| م | قائمة الموضوعات | ساعات الاتصال |
|---|---|---|
| 1 | **مفاهيم أساسية في علم الإقتصاد:**<br>• تعريف علم الإقتصاد<br>• النظم الإقتصادية : النظام الإقتصادي الرّأسمالي, النظام الإقتصادي الإشتراكي, النظام الإقتصادي المختلط و النظام الإقتصادي الإسلامي. | 4 |
| 2 | **النظام الاقتصاد الاسلامي والمشكلة الاقتصادية**<br>• التفرقة بين مفهومي الاقتصاد الإسلامي: علماً ونظاماً.<br>• الخصائص المميزة للنظام الاقتصاد الإسلامي: عقدية وأخلاقية وفقهية | 4 |

| | | |
|---|---|---|
| | • أهداف النظام الاقتصاد الإسلامي.<br>• المشكلة الاقتصادية وموقف الاقتصاد الاسلامي منها.<br>• مدخل لعلاج المشكلة الاقتصادية من منظور النظام الاقتصاد الإسلامي. | |
| 3 | **سلوك المنتج**<br>• مفهوم الإنتاج.<br>• ضوابط الإنتاج.<br>• تعظيم الأرباح.<br>• خصائص المنتج في الإقتصاد الإسلامي<br>• عناصر الإنتاج في الاقتصاد الإسلامي: (راس المال النقدي، رأس المال العيني، الأرض، العمل، المنظم). | 2 |
| 4 | **سلوك المستهلك**<br>- عناصر نظرية سلوك المستهلك<br>- الحرية الاقتصادية المنضبطة<br>- دالة المنفعة الاستهلاكية<br>- تعظيم المنفعة<br>- الرشد الاقتصادي وضوابطه. | 2 |
| 5 | **السوق : تعريفه و أنواعه**<br>مفهوم السوق وهيكله التنافسي.<br>السوق التنافسية: السعر العادل، الضوابط الفقهية حيال الغش، النجش، بيوع الغرر، الغبن، بيع لا يملك الخ.<br>السوق الاحتكارية: مقارنة بين فهومها الفقهي والاقتصادي، بيان حكمها الشرعي، توضيح مفاسدها الاقتصادية | 2 |
| | **البطالة و التضخم**<br>تعريف البطالة و أنواعها<br>البطالة و مستويات الأجور.<br>تعريف التضخم و أنواعه.<br>الآثار الإقتصادية للتضخم. | 4 |
| 6 | **السياسات المالية و النقدية**<br>- السياسة المالية الإنكماشية و السياسة المالية التوسعية.<br>- السياسة النقدية: السوق المفتوحة و الإحتياطي النقدي<br>- دور السياسة المالية و السياسة النقدية في تحقيق الإستقرار الإقتصادي.<br>- توزيع الدخل على عناصر الإنتاج. | 4 |
| 7 | **النقود و البنوك**<br>- . تعريف النقود و وظائفها<br>- تعريف البنوك , أنواعها و وظائفها.<br>- البنك المركزي: دوره و أهميته | 4 |
| 8 | **التجارة الخارجية (الدولية)**<br>- أهمية التجارة الخارجية و خصائصها.<br>- محددات التبادل التجاري<br>- المكاسب الثنائية من التبادل التجاري | 4 |
| **المجموع** | | 30 |

د. التدريس والتقييم:

1. ربط مخرجات التعلم للمقرر مع كل من استراتيجيات التدريس وطرق التقييم

| الرمز | مخرجات التعلم | استراتيجيات التدريس | طرق التقييم |
|---|---|---|---|
| 1.0 | **المعرفة والفهم** | | |
| 1.1 | ▪ يعرف الطالب المصطلحات والمفاهيم الخاصة بالاقتصاد الإسلامي<br>▪ يعرف الطالب أسس استخدام قواعد الاقتصاد الإسلامي في التحليل الاقتصادي<br>▪ يعدد الخصائص والضوابط الإسلامية للمستهلك والمنتج والسوق<br>▪ يعرف النظم والمؤسسات التي تحكم أداء الاقتصاد الاسلامي | ▪ محاضرات<br>▪ مناقشة<br>▪ العصف الذهني<br>▪ التعلم التعاوني | ▪ اختبارات.<br>▪ الواجبات.<br>▪ أسئلة شفهية |
| 1.2 | ▪ يعرف الطالب موضوعات الاقتصاد الجزئي والكلي بمنظور اسلامي | | |
| 1.3 | ▪ يستعرض فاعلية آليات الاقتصاد الاسلامي في حسن تخصيص الموارد الاقتصادية النادرة مقارنة بالنظم الأخرى<br>▪ يستعرض الطالب القضايا والنوازل الاقتصادية المعاصرة في الاسلام<br>▪ يعدد التطبيقات في مجال القطاع المصرفي والتمويلي الإسلامي | | |
| 2.0 | **المهارات** | | |
| 2.1 | ▪ يطبق المعارف والضوابط في حل المشكلات الاقتصادية المطروحة<br>▪ يستنبط الطالب المبادئ الاقتصادية من النصوص الشرعية<br>▪ يعرض الطالب عقيدته الاسلامية بأسلوب عقلاني عصري وبتفهم جيد للتحديات الاقتصادية المعاصرة<br>▪ يقارن بين اليات الاقتصاد الإسلامي والنظم الاقتصاد الأخرى خاصة في مجال المصرفي | ▪ محاضرات<br>▪ مناقشة<br>▪ العمل الجماعي<br>▪ العصف الذهني<br>▪ التعلم التعاوني<br>▪ | ▪ اختبارات.<br>▪ الواجبات.<br>▪ البحوث والواجبات.<br>▪ أسئلة شفهية |
| 2.2 | ▪ يتعرف الطالب على الأساليب الرياضية والإحصائية المناسبة لحل مسألة معينة، وتطبيقها، وتفسير النتائج.<br>▪ يستخدم الطالب تقنيات المعلومات والاتصالات، خاصة الإنترنت، لجمع المعلومات، وفهمها، وتبادل المعلومات والأفكار مع الآخرين. | | |
| 2.3 | ▪ يتواصل بفاعلية شفهيًا وكتابيًا مع الاخرين<br>▪ يحلل الطالب القضايا الاقتصادية العصرية | | |
| 3.0 | **القيم** | | |
| 3.1 | ▪ يتحمل مسؤولياته ويطور من قدراته الذاتية<br>▪ يطور الطالب قدراته الشخصية من خلال التعلم الذاتي<br>▪ يتجاوب الطلاب أثناء المحاضرات مع أستاذ المقرر، وتقبل الملاحظات والنصائح المقدمة لهم من أجل تحسين عملية التعلم<br>▪ تحمل الطلاب مسئولية إنجاز التمارين والأعمال المطلوبة منهم | ▪ مناقشة<br>▪ العمل الجماعي<br>▪ التعلم التعاوني<br>▪ | ▪ البحوث والواجبات.<br>▪ أسئلة شفهية |

| الرمز | مخرجات التعلم | استراتيجيات التدريس | طرق التقييم |
|---|---|---|---|
| 3.2 | ▪ يتعامل مع الاخرين بروح الفريق ويعبر عن رايه باستقلالية وفي ظل الاحترام المتبادل<br>▪ يحضر الطالب المحاضرات بروح ايجابية من أدب الاصغاء وروح المشاركة الفاعلة.<br>▪ يتعاون الطلاب مع زملائه في المجموعات بروح الفريق لإنجاز المهام التي توكل عليهم وممارسة الدور القيادي عند الحاجة<br>▪ يتَصَرُّفُ الطالب بروح عالية من المسؤولية الشخصية تجاه الغير<br>▪ يجيب الطالب على اسئلة المناقشة المتولدة عن كل فصل من فصول المقرر تحت اشراف الاستاذ. | | |
| 3.3 | ▪ يلتزم الطالب في اعداد واجباته بالدقة والشفافية والامانة<br>▪ قبول الطالب النتائج التي تحصل عليها في الاختبارات بروح ايجابية وتعلمه من أخطائه<br>▪ يتصرف الطالب بشكل أخلاقي والالتزام بالقيم الأخلاقية العالية على النطاق الشخصي والاجتماعي. | | |

**2. أنشطة تقييم الطلبة**

| م | أنشطة التقييم | توقيت التقييم (بالأسبوع) | النسبة من إجمالي درجة التقييم |
|---|---|---|---|
| 1 | اختبار فصلي 1 | 4 | %20 |
| 2 | اختبار فصلي 2 | 12 | %20 |
| 3 | كوزات وحضور بحوث علمية ومشاركة | خلال الفصل | %20 |
| 4 | اختبار نهائي | 16 | %40 |
| 5 | | | |
| 6 | | | |

أنشطة التقييم (اختبار تحريري، شفهي، عرض تقديمي، مشروع جماعي، ورقة عمل الخ)

**هـ - أنشطة الإرشاد الأكاديمي والدعم الطلابي:**

- الساعات المكتبية المخصصة لأستاذ المادة من قبل القسم
- تواصل أستاذ المادة مع الطلاب عبر مجلد المقرر على شبكة الانترنت أو البريد الإلكتروني.

**و – مصادر التعلم والمرافق:**

**1. قائمة مصادر التعلم:**

| | |
|---|---|
| **المرجع الرئيس للمقرر** | - الأسس النظرية للاقتصاد الاسلامي: د. خالد بن سعد المقرن، مكتبة المتنبي، الرياض 1434هـ<br>الأساس في علم الإقتصاد: د. محمود الوادي و آخرون, الإسكندرية 1418 هـ |
| **المراجع المساندة** | - النظرية الاقتصادية الاسلامية: د.يوسف بن عبد الله الزامل ود. بوعلام بن جيلاني، 1417هـ<br>- تطور الفكر الاقتصادي الاسلامي: د. عبد الرحمن يسري أحمد، الاسكندرية، 1419هـ<br>مدخل للفكر الإقتصادي الإسلامي: د. سعيد مرطان |

| | |
|---|---|
| **المصادر الإلكترونية** | ☐ الموقع العالمي للاقتصاد الإسلامي<br>☐ موقع البنك المركزي السعودي.<br>☐ موقع وزارة الاقتصاد والتخطيط السعودية |
| **أخرى** | قائمة بمواد مرجعية أساسية (المجلات العلمية والتقارير وغيرها):<br>☐ مجلة الاقتصاد الإسلامي / بنك دبي الإسلامي .<br>☐ أبحاث الاقتصاد الإسلامي<br>☐ مجلة مجمع الفقه الإسلامي<br>. |

## 2. المرافق والتجهيزات المطلوبة:

| العناصر | متطلبات المقرر |
|---|---|
| **المرافق**<br>(القاعات الدراسية، المختبرات، قاعات العرض، قاعات المحاكاة ... إلخ) | قاعات دراسية تتسع لأربعين طالب |
| **التجهيزات التقنية**<br>(جهاز عرض البيانات، السبورة الذكية، البرمجيات) | قاعات دراسية بها أجهزة عرض (DATA SHOW) |
| **تجهيزات أخرى** (تبعاً لطبيعة التخصص) | منصات تعليمية الكترونية (BALCK BOARD) |

**ز. تقويم جودة المقرر:**

| مجالات التقويم | المقيمون | طرق التقييم |
|---|---|---|
| فاعلية التدريس | ▪ الطلاب | ▪ غير مباشر<br>(نتائج مسح تقويم الطلاب للمقرر. مرئيات الطلاب التي يتم الحصول عليها من الطلاب مشافهة وكتابيا أو عبر البريد الالكتروني. تعليق الطلاب على المقرر في منتدى طلاب الكلية) |
| | ▪ منسقي المقررات<br>▪ قيادة البرنامج | ▪ مباشر<br>(في نهاية كل فصل دراسي يقوم منسق المقرر بإعداد تقرير مقرر يلخص فيه الايجابيات والسلبيات ويحدد التغييرات التي ينصح باتخاذها لتطوير المقرر. التواصل مع الخريجين والجهات الموظفة ) |
| فاعلة طرق تقييم الطلاب | ▪ قيادة البرنامج<br>▪ الطلاب<br>▪ | ▪ مباشر<br>(المقارنة المرجعية)<br>▪ غير مباشر<br>(استطلاع آراء) |
| مدى تحصيل مخرجات التعلم للمقرر | ▪ أعضاء هيئة التدريس | ▪ مباشر<br>(التقييم المباشر للطلاب, تبادل النتائج مع اقسام وكليات أخرى) |
| مصادر التعلم | ▪ أعضاء هيئة التدريس<br>▪ منسقي المقررات<br>▪ قيادة البرنامج<br>▪ الطلاب | ▪ مباشر<br>(المراجعة الدورية لمفردات المقرر, تقارير المقررات)<br>▪ غير مباشر<br>(استطلاع آراء الطلاب) |

مجالات التقويم (مثل. فاعلية التدريس، فاعلة طرق تقييم الطلاب، مدى تحصيل مخرجات التعلم للمقرر، مصادر التعلم ... إلخ)
المقيمون (الطلبة، أعضاء هيئة التدريس، قيادات البرنامج، المراجع النظير، أخرى (يتم تحديدها)
طرق التقييم (مباشر وغير مباشر)

### ح. اعتماد التوصيف

| | |
|---|---|
| **جهة الاعتماد** | مجلس القسم |
| **رقم الجلسة** | 30 |
| **تاريخ الجلسة** | 1442/9/21 |

| | |
|---|---|
| **Course Title:** | **Research Project** |
| **Course Code:** | **MAT 1499** |
| **Program:** | **Bachelor of Science in Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Course Identification

| | |
|---|---|
| **1. Credit hours:** | 4 |
| **2. Course type** | |
| **a.** | University ☐ College ☐ Department ☑ Others ☐ |
| **b.** | Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered:** | **Level 12 / Year 4** |
| **4.Pre-requisites for this course** (if any): | **Research project course starts in the last trimester of the program study (4th year – 12thtrimester).** |
| **5. Co-requisites for this course** (if any): | **None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | | |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | 60 | 100% |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 0 |
| 2 | Laboratory/Studio | 0 |
| 3 | Tutorial | 0 |
| 4 | Others (specify)<br>Readings, Discussions, Reports, and Oral Presentations | 60 |
| | Total | 60 |

*Comments:*

**The student works on a problem in an area of advanced mathematics at bachelor level with the guidance of the supervisor**

## B. Course Objectives and Learning Outcomes

**1. Course Description**

**This course allows students to undertake a research project on a topic of interest. It gives the students an opportunity to perform a subject within the field of mathematics under supervision according to an individual study plan and independence thinking. Also, document and summarize results by writing a research report and present the results of the project.**

**2. Course Main Objective**

- **This course enables distinguished students to carry out a sustained, guided, independent study of a topic in mathematics.**
- **This course is a faculty directed project that could be considered advanced in nature.**
- **To develop an appropriate mathematical literacy as well as competency in documentation, analyses and presentation of results.**

- To develop experience of report-writing, oral presentation and visual presentation.

**3. Course Learning Outcomes**

| | CLOs | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | To apply mathematical knowledge and skills to a specific research project. | K1, K2 |
| 1.2 | To provide in-depth knowledge of currently active research areas in Mathematics. | K1, K2 |
| 2 | **Skills:** | |
| 2.1 | To develop techniques of problem solving. | S1, S2 |
| 2.2 | To communicate mathematics clearly and precisely both orally and in writing. | S4 |
| 2.3 | To use Internet in searching for scientific information | S5 |
| 2.4 | To carry out calculations orally and mentally. | S3 |
| 3 | **Values:** | |
| 3.1 | To work individually. | V1, V3 |
| 3.2 | To work in groups. | V1, V2 |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | The student undertakes supervised independent study and review of research documentation in active field of Mathematics with the guidance of the research supervisor. | 60 |
| | **Total** | 60 |

## D. Teaching and Assessment

**1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods**

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding** | | |
| 1.1 | To apply mathematical knowledge and skills to a specific research project. | 5 hours weekly of discussions with the supervisor | • Continuous evaluation of the research by the supervisor |
| 1.2 | To provide in-depth knowledge of currently active research areas in Mathematics. | Self-study and personal work | • Written report<br>• Oral presentation |
| 2.0 | **Skills** | | |
| 2.1 | To develop techniques of problem solving. | Real-life problems | • Continuous evaluation of the research by the supervisor |
| 2.2 | To communicate mathematics clearly and precisely both orally and in writing. | Self-study | • Written report<br>• Oral presentation |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 2.3 | To use Internet in searching for scientific information | Self-study | • Written report |
| 2.4 | To carry out calculations orally and mentally. | Real-life problems | Oral presentation and discussions |
| 3.0 | Values | | |
| 3.1 | To work individually. | Personal questions | Participation |
| 3.2 | To work in groups. | Team work | Homework and small parts of the project |

**2. Assessment Tasks for Students**

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | First continuous evaluation (reported by the supervisor) | 4thweek | 20% |
| 2 | Second continuous evaluation (reported by the supervisor) | 8th week | 30% |
| 3 | Written report in English (20-35 pages) | During the trimester | 50% |
| 4 | Short talk in English language (oral presentation 15 minutes) | 13thweek | |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**

- There are 6 office hours per week reserved by each professor, planed on his timetable, to help the students on their problems.
- All department students are assigned two academic advisors who will act as a mentor, providing academic and career advice, and general counseling.

## F. Learning Resources and Facilities

**1.Learning Resources**

| | |
|---|---|
| Required Textbooks | Students will be guided by study notes, books, research articles and original sources (or English translations where necessary), which are provided. The students will need to master the appropriate mathematics and ultimately present his /her work in the form of a final presentation. Other appropriate learning resources are possible related to the nature of the research project. |
| Essential References Materials | Subject dependent |
| Electronic Materials | Subject dependent |
| Other Learning Materials | Subject dependent |

## 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | ▪ Each class room should be equipped with a whiteboard and a projector.<br>▪ Laboratories should be equipped with computers and an internet connection. |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | The rooms should be equipped with data show and Smart Board. |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | None. |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching and assessment, Quality of learning resources | Students | During the term and at the end of the course each student will complete two evaluation forms. |
| Extent of achievement of course learning outcomes, Quality of learning resources | Instructor | At the end of each term the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| **Reference No.** | 11/1444 |
| **Date** | (16/11/2022) 22/04/1444 |

| | |
|---|---|
| **Course Title:** | **Field Training** |
| **Course Code:** | **MAT 1497** |
| **Program:** | **Bachelor of Science in Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **College of Science** |
| **Institution:** | **Imam Mohammad Ibn Saud Islamic University** |

## Table of Contents

## A. Field Experience Identification

| |
|---|
| **1. Credit hours: 4** |
| **2. Level/year at which this course is offered: 12/4 (last term of the program).** |
| **3. Dates and times allocation of field experience activities.**<br>• Number of weeks: **(12)**<br>• Number of days: **(36)**<br>• Number of hours: **(180)** |
| **4. Pre-requisites to join field experience** (if any)**:**<br>**Student must complete at least 160 credit hours.** |

## B. Learning Outcomes, and Training and Assessment Methods

**1. Field Experience Learning Outcomes**

| | CLOs<br>Upon completion of this field training, students should be able to: | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | **Demonstrate knowledge of the context of the professional career before graduation.** | **K1, K2** |
| 1.2 | **Explain professional interests in related fields of Mathematics program.** | **K1, K2** |
| 1.3 | **Identify a range of opportunities for learning, development and mentoring throughout the duration of the training.** | **K1, K2** |
| **2** | **Skills:** | |
| 2.1 | **Apply what has been learned in classroom to real-world situations.** | **S1** |
| 2.2 | **Build critical thinking and innovative problem-solving skills with confidence and rigor.** | **S1, S2** |
| 2.3 | **Proficiently communicate oral and written information in a manner that reflects professional social work skills.** | **S4** |
| 2.4 | **Confront the various pressures that he/she may face in the labor market.** | **S1** |
| 2.5 | **Proficiently interact with other professionals.** | **S4** |
| **3** | **Values:** | |
| 3.1 | **Develop discipline, self and social responsibility.** | **V1, V2** |
| 3.2 | **Apply ethic principles of the profession.** | **V1, V3** |
| 3.3 | **Enhance integrity and honesty.** | **V1** |

**2.Alignment of Learning Outcomes with Training Activities and Assessment Methods**

| Code | Learning Outcomes | Training Methods/Activities | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding** | | |
| 1.1 | **Demonstrate knowledge of the context of the professional career before graduation.** | **participation with the field supervisor at work place.** | **Discussion**<br>**Specific rubric** |
| 1.2 | **Explain professional interests in related fields of Mathematics program.** | **Subject-based study essays** | **Rubric of evaluation** |

| Code | Learning Outcomes | Training Methods/Activities | Assessment Methods |
|---|---|---|---|
| | | written-short answer/long answer/report | |
| 1.3 | Identify a range of opportunities for learning, development and mentoring throughout the duration of the training. | Oral test<br><br>Presentation<br><br>Written report | Evaluate student's Discussion |
| 2.0 | Skills | | |
| 2.1 | Apply what has been learned in classroom to real-world situations. | workplace performance;<br><br>Oral Presentations | • Portfolio<br>• Student's diary/journal. |
| 2.2 | Build critical thinking and innovative problem-solving skills with confidence and rigor. | Written research questions/ Reflection | Student portfolio |
| 2.3 | Proficiently communicate oral and written information in a manner that reflects professional social work skills. | Written tasks<br><br>Discussion | Evaluation of Report and mails. |
| 2.4 | Confront the various pressures that he/she may face in the labor market. | participation with the field supervisor at workplace | Direct observation |
| 2.5 | Proficiently interact with other professionals. | participation with the field supervisor at workplace | Direct observation |
| 3.0 | Values | | |
| 3.1 | Develop discipline, self and social responsibility | Discussion, behavior | Portfolio and direct observation |
| 3.2 | Apply ethic principles of the profession. | Discussion, behavior | Direct observation portfolio |
| 3.3 | Enhance integrity and honesty | Discussion, behavior | Direct observation |

### 3. Field Experience Learning Outcomes Assessment

**a. Students Assessment Timetable**

| # | *Assessment task** | *Assessment timing (Week)* | *Percentage of Total Assessment Score* |
|---|---|---|---|
| 1 | Orientation session attendance. | First week | 5% by the teaching staff advisor. |
| 2 | Site Visit | About Week 4 & week 8 | 10% by the teaching staff advisor. |
| 3 | Appreciation on student's performance (using supervisor's reports and student's weekly) | During the 12 weeks of the training. | 10% by the teaching staff advisor. |
| 4 | Week log of activities | Weekly | 10% by the teaching staff advisor and 5% by training advisor. |
| 5 | Demonstrate Learning Outcomes. | During the 12 weeks of the training. | 50% by training advisor. |
| 6 | Student Field Performance Appraisal | Between Week 12 and week 13. | 10% by student. |

***Assessment task** (i.e., Practical test, oral test, presentation, group project, essay, etc.)

**b. Assessment Responsibilities**

| # | Category | Assessment Responsibility |
|---|---|---|
| 1 | Teaching Staff | The teaching staff supervisor assesses:<br>• the attendance and participation of the student in the orientation session,<br>• the performance during the field visit,<br>• student's performance by using supervisor's reports and student's weekly, which express the application of student's knowledge to actual practice. |
| 2 | Field Supervisor | The field supervisor assesses overall performance and progress of the student during the training. |
| 3 | Others (specify) | N.A. |

## C. Field Experience Administration

### 1. Field Experience Locations

**a. Field Experience Locations Requirements**

| Suggested Field Experience Locations | General Requirements* | Special Requirements** |
|---|---|---|
| Maaden<br>Saudi Aramco<br>KACST | The workplace must be registered and approved by the competent Saudi instances. | The field experience location activities must be appropriate and consistent with the mission of Imam university |

| | | |
|---|---|---|
| The Zakat, Tax and Customs Authority (ZATCA)<br>Public School<br>Private School<br>General Authority for Statistics | Legal status as determined by the law in Saudi Arabia.<br><br>Efficiency and safety. | and the requirements for field experience learning outcomes. |

*Ex: provides information technology ,equipment ,laboratories ,halls ,housing ,learning sources ,clinics etc.
**Ex: Criteria of the training institution or related to the specialization, such as: safety standards, dealing with patients in medical specialties, etc.

**b. Decision-making procedures for identifying appropriate locations for field experience**

Before starting the process for field experience, the college should state a range of **partnerships with potential training organizations that may provide high-level training opportunities.**
**The list of partnerships should be available in college of science website.**
**These partnerships should be based on requirements listed above.**
**The college should communicate the present document (including qualifications and responsibilities) to the training organization to ensure skills requirements to determine an appropriate field supervisor.**

## 2. Supervisory Staff

**a. Selection of Supervisory Staff**

| Selection Items | Field Supervisor | Teaching Staff |
|---|---|---|
| Qualifications | A permanent member of the training organization. | A member of the teaching staff at the department of Mathematics and Statistic is assigned authority and responsibility of supervising and evaluating the overall components of the field experience according the present specifications document. |
| Selection Criteria | depending to the training organization criteria. | • Ability to supervise a team, to establish priorities and manage competing deadlines for self and others.<br>• Experience in the supervision and leadership of staff.<br>• Well-developed oral and written communication skills.<br>• Ability to build and maintain effective working relationships and act with diplomacy and discretion when dealing with sensitive and confidential issues<br>• Ability to develop effective social and professional networks. |

**b. Qualification and Training of Supervisory Staff**

(Including the procedures and activities used to qualify and train the supervisory staff on supervising operations, implementing training activities, the follow-up and evaluation of students, etc.)

**The field supervisor is able for supervising, training and evaluating the student throughout the training period., including the follow-up and monitoring. He should notify the**

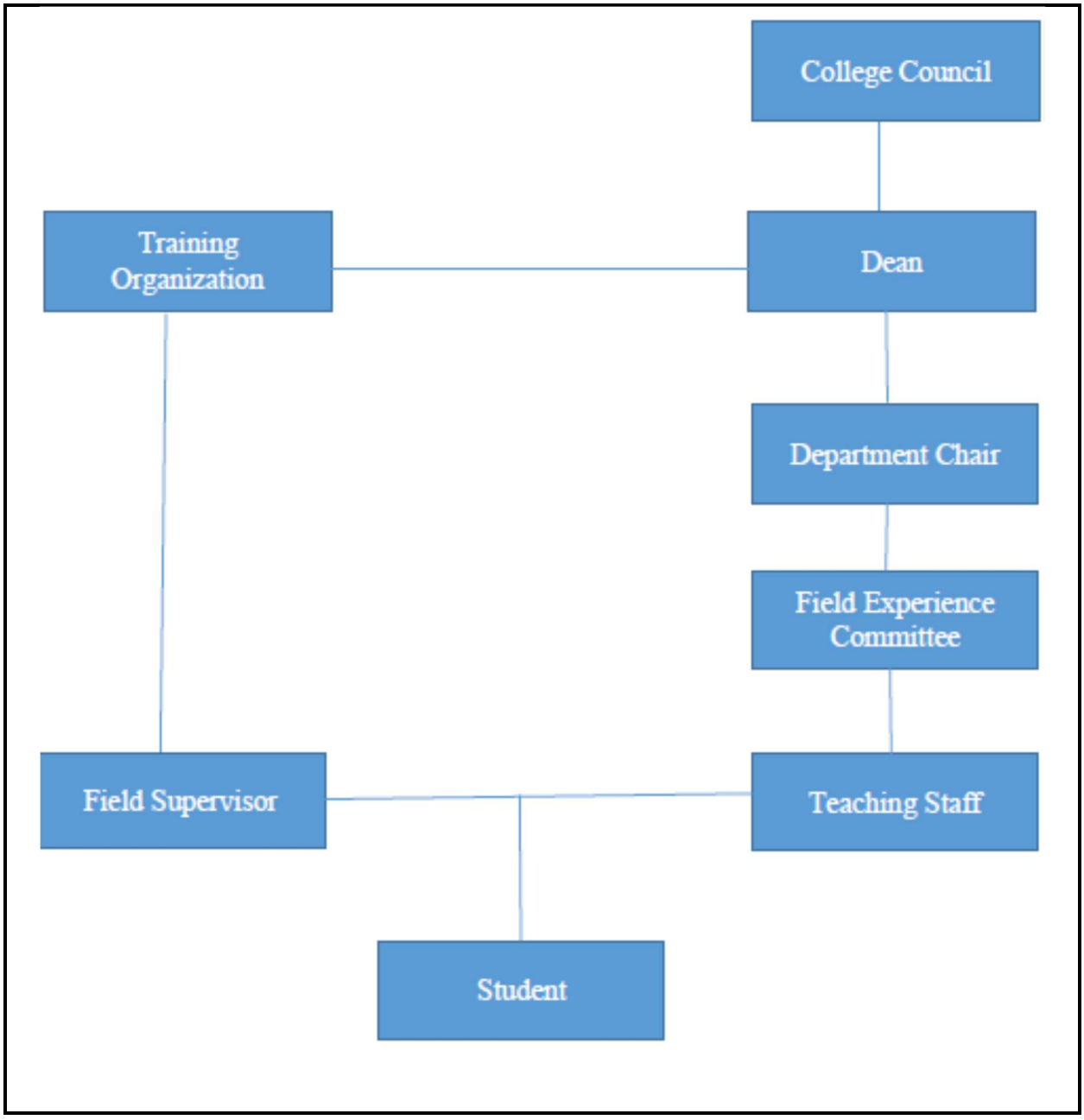
**corresponding teaching staff of any concerns or problems. In addition, s/he has the following key skills and qualifications:**

- **Scientific academic path.**
- **Leadership and team management skills.**
- **Attention to detail and problem-solving skills.**
- **Written and verbal communication skills**
- **Advanced expertise in a specific training organization activities**
- **Deep knowledge of training organization policies.**

## 3. Responsibilities

### a. Field Experience Flowchart for Responsibility

including units, departments, and committees responsible for field experience, as evidenced by the relations between them.




### b. Distribution of Responsibilities for Field Experience Activities

| Activity | Department or College | Teaching Staff | Student | Training Organization | Field Supervisor |
|---|---|---|---|---|---|
| **Selection of a field experience site** | ☑ | | ☑ | | |
| **Selection of supervisory staff** | ☑ | | | | |
| **Provision of the required equipment** | | | | ☑ | |
| **Provision of learning resources** | | | | ☑ | |
| **Ensuring the safety of the site** | | | | ☑ | |
| **Commuting to and from the field experience site** | | ☑ | ☑ | | ☑ |
| **Provision of support and guidance** | | ☑ | | | ☑ |
| **Implementation of training activities (duties, reports, projects, .....)** | | ☑ | | | ☑ |
| **Follow up on student training activities** | | ☑ | | | ☑ |
| **Adjusting attendance and leave** | | ☑ | | | ☑ |
| **Assessment of learning outcomes** | | ☑ | | | ☑ |
| **Evaluating the quality of field experience** | ☑ | ☑ | ☑ | ☑ | ☑ |
| **Others** (specify) | | | | | |

## 4. Field Experience Implementation

### a. Supervision and Follow-up Mechanism

The mechanism used for supervision and follow-up student is essentially based on:

- Follow-up forms
- Interview follow-up
- Student portfolio
- Daily attendance record.
- Evaluation rubric

**b. Student Support and Guidance Activities**

- ✓ Session of orientation, necessary documentations (forms and rubrics, and guide manual).
- ✓ The workplace is expected to provide documents for student training (including internal policy manuals, electronic sources).
- ✓ The workspace is expected to provide also appropriate desk gadgets including printer/internet access with appropriate electronic devices and software.

**5. Safety and Risk Management**

| Potential Risks | Safety Actions | Risk Management Procedures |
|---|---|---|
| Potential Risks depend on the workspace and production activities of the training organization.<br><br>Potential sources of harm and hazards should be identified. This issue should be discussed with Training Organization before starting the training | Basic safety rules and tips that need to be followed at the worksite.<br><br>Safety guidelines must be established and maintained: safety procedures for laboratory investigations and field trips should be implemented. | • Respecting the last updated version of the booklet "Implementation of Risk Management and Safety Culture" published by The Ministry of Labor and Social development.<br>• providing an understanding of how to deal with different types of work-training in order to help reduce exposure risks.<br>• Offering short risk management training at the beginning of training. |

## G. Training Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Student performance, effectiveness and efficiency | Field Supervisor, | Direct and Indirect |
| Quality of learning resources<br>Effectiveness of Training and assessment.<br>Student performance | Teaching staff | Indirect |
| Evaluation of the field Experience (workspace, Quality of learning resources, supervisory, achievements, skills, behavior, time) | Student | Indirect |

**Evaluation areas** (e.g., Effectiveness of Training and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Supervisory Staff, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## E. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **Quality Unit Mathematics and Statistics Department** |
| **Reference No.** | **Department council No. 11** |
| **Date** | **22/11/1444** |