# Course Specification
## (Bachelor)

| | |
|---|---|
| Course Title: | **Linear Algebra** |
| Course Code: | **324MATH-3** |
| Program: | **B.Sc. in Math** |
| Department: | **Mathematics** |
| College: | **Science** |
| Institution: | **Jazan University** |
| Version: | **2024** |
| Last Revision Date: | **9/2024** |

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## A. General information about the course:

### 1. Course Identification

| | |
|---|---|
| **1. Credit hours:** | 3 |

| | | | | | |
|---|---|---|---|---|---|
| **2. Course type** | | | | | |
| A. | University ☐ | College ☐ | Department☒ | Track☐ | Others☐ |
| B. | Required ☒ | | Elective☐ | | |

**3. Level/year at which this course is offered:**

**Level 6 / Year 3**

**4. Course general Description**

This course is designed to provide students with

- **Vector Spaces over a Field**: Definition, theorem and examples of vector space.
- **Linear Combination of Vectors and Spanning Set**.
- **Sub-Spaces**: Definition and theorem, examples of sub-space, subset generated by vector space, sub-space generated by subset from vector space, sum and direct sum of two subspaces, intersection of two subspaces.
- **Linear Independence and Correlation**: Definition and examples, basis and dimension of vector space, linear dependence.
- **Coordinate Matrices and Change of Basis.**
- **Inner Product Space**: Definition and examples, orthogonality, angle and distance between two vectors in inner product space.
- **Linear Transformations**: definition, examples and theorems on liner transformation, kernel and range of linear transformations, matrices of general linear transformations.
- **Eigen values**, Eigen vectors and diagonalization.

**5. Pre-requirements for this course (if any): Math 223**

**6. Co- requirements for this course (if any):**

**7. Course Main Objective(s)**

After finishing the course, the student is expected to be familiar with the following:

- Basic topics of linear algebra such as matrices and vectors
- Spaces, linear transformations, basis and dimension
- Methods for solving linear equations in *n* variables
- Methods of solving systems of linear equations and algebraic properties of matrices and determinants
- Methods to find eigenvalues and eigenvectors.

### 1. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1. | Traditional classroom | 45 | 100% |
| 2. | E-learning | | |

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 3. | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4. | Distance learning | | |

## 2. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | Lectures | 42 |
| 2. | Laboratory/Studio | |
| 3. | Field | |
| 4. | Tutorial | 3 |
| 5. | Others (specify) | |
| | Total | 45 |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 1.0 | Knowledge and understanding | | | |
| 1.1 | Distinguish mathematical concepts relevant to vector space, subspace, linear combination and span, linear independence, inner product, eigenvalue and eigenvector. | K1 | Lectures, Web based work, Classroom discussion. | Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments |
| 1.2 | Identify required notations and concepts of vector space, subspace, linear combination and span, linear independence, inner product, eigenvalue and eigenvector. | K2 | Lectures, Web based work, Classroom discussion. | Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments |
| 2.0 | Skills | | | |
| 2.1 | Apply theoretical, computational or | S1 | Lectures, problem solving, web based | Written exam (Problem solve, |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | practical aspect relevant to vector space, subspace, linear combination and span, linear independence, inner product, eigenvalue and eigenvector. | | work, Classroom discussion. | MCQ, true/false, Proof, Short answer), Quizzes, Assignments |
| 2.2 | Apply various math rules, techniques and theorems in vector space, subspace, linear combination and span, linear independence, inner product, eigenvalue and eigenvector. | S3 | Lectures, problem solving, web based work, Classroom discussion. | Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments |
| 2.3 | Solve mathematical problem using critical thinking in vector space, subspace, linear combination and span, linear independence, inner product, eigenvalue and eigenvector. | S4 | Lectures, problem solving, web based work, Classroom discussion. | Written exam (Problem solve, MCQ, true/false, Proof, Short answer), Quizzes, Assignments |
| 3.0 | Values, autonomy, and responsibility | | | |
| 3.1 | Realize the importance of responsibilities through different modes of practice, competition and related activities. | V2 | Group work, problem solving, web based work | Assignments |
| 3.2 | Inculcating values and ethics in thought, expression and deed. | V3 | Group work, problem solving, web based work | Assignments |
| ... | | | | |
| | | | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | **Vector spaces** over a field, Definition, Theorem and Examples | 8 |
| 2. | **Sub-spaces:** Definition and Theorem, Examples of sub-space, subset generate vector space, sub-space generated by subset from vector space, Sum and direct sum of two subspaces- Intersection of two subspaces. | 9 |
| 3 | **Linear combinations of vectors and spanning set**.<br>**Linear independence and dependence**: Definition and examples, Basis and dimension of vector space, linear dependence. Coordinate matrices and Change of Basis | 9 |
| 4 | **Inner product space:** Definition and examples, Orthogonality, Angle and Distance between two vectors in Inner product space | 6 |
| 5 | **Linear Transformations:** definition and examples, and theorems, Kernel and Range of Linear transformations, Matrices of general Linear transformations | 6 |
| 6 | **Eigenvalues, Eigenvectors and diagonalization** | 9 |
| Total | | 45 |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | Homework and Quiz | 3 | 5 |
| 2. | First exam | 6 | 20 |
| 3. | Homework and Quiz | 10 | 5 |
| 4 | Second exam | 12 | 20 |
| 5 | Final exam | 15 | 50 |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| | |
|---|---|
| Essential References | -Elementary Linear Algebra, H. Anton, John Wiley (2001).<br>- Elementary Linear Algebra, R. E. Larson and B. E. Edwards, Edition Heath 5th, D.H. and Company, (2004) |
| Supportive References | -Theory and problems of Linear Algebra, S. Lipschutz, Schaum's Outline Series (2000)<br>- Linear Algebra and its Applications, David C. Lay, Addisson Wesley (2003). |
| Electronic Materials | - Web sites dedicated to Linear Algebra available on the internet |
| Other Learning Materials | |

## 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Classroom, Computer Lab. |
| Technology equipment (projector, smart board, software) | Data show; Smart Board, Mathematics software |
| Other equipment (depending on the nature of the specialty) | None |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | Students, Peer and program leader | Indirect (Course Evaluation Survey)- Indirect peer evaluation |
| Effectiveness of students assessment | Students, Program assessment committee | Direct/ Indirect |
| Quality of learning resources | Students, Faculty members | Indirect |
| The extent to which CLOs have been achieved | Instructor | Direct/Indirect |
| Other | | |

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

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval Data

| | |
|---|---|
| COUNCIL /COMMITTEE | **Board Of Mathematics Department** |
| REFERENCE NO. | **2417** |
| DATE | **29/03/1446 A. H.; 2/10/2024 A. D.** |