# Course Specification

(Postgraduate)

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|---|
| Course Title: **Functional Analysis II** |
| Course Code: **MATH641** |
| Program: **Master Program in Mathematics** |
| Department: **Mathematics** |
| College: **Science** |
| Institution: **University of Tabuk, KSA** |
| Version: **2** |
| Last Revision Date:**1/12/1443 H** |

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# A. General information about the course:

| Course Identification | | | | | |
|---|---|---|---|---|---|
| **1. Credit hours:** | 3 H | | | | |
| **2. Course type** | | | | | |
| a. | University ☐ | College ☐ | Department☒ | Track☐ | Others☐ |
| b. | Required ☐ | Elective☒ | | | |
| **3. Level/year at which this course is offered:** Level-2 or higher | | | | | |
| **4. Course general Description**<br><br>Compact Linear Operators and Their Spectral Properties, Spectral Properties of Bounded and Self-adjoint Operators, Spectral Family of Bounded Self-adjoint Operators, Spectral Representation of Bounded Self-adjoint Operators, Banach Algebra, Commutative Banach Algebra, Spectral Theory in Banach Algebra, Gelfand Mapping, Spectral Theorem for Normal Operators, Some Questions and Applications. | | | | | |
| **5. Pre-requirements for this course (if any):** MATH653 | | | | | |
| **6. Co- requirements for this course (if any):** None | | | | | |
| **7. Course Main Objective(s)**<br><br>1. Student continues to mature in their understanding of operators and their applications.<br>2. Students know about the spectral representation of bounded linear operators.<br>3. Students know about spectral properties in Banach Algebra.<br>4. Student acquires cognitive skills through thinking and solving of problems.<br>5. Student become responsible for their own learning through solutions of assignments and time management. | | | | | |

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

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1. | Traditional classroom | 45 | 100 % |
| 2. | E-learning | - | - |
| 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 | 3 H /week |
| 2. | Laboratory/Studio | |
| 3. | Field | |
| 4. | Tutorial | |
| 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<br>The students will be able to: | | | |
| 1.1 | Demonstrate theoretical concepts of advanced functional analysis and related topics. | K1 | Lectures, Group works, Presentations, Classroom discussion, Seminar, Case study, problem solving session | Exams, Quizzes, Research project, presentation, interactive discussion and participation,<br>Survey |
| 1.2 | Describe advanced analytical methods to solve problems of spectral theory of operators. | K2 | | |
| 1.3 | Enhance Knowledge of research methodology in functional analysis. | K3 | | |
| 2.0 | Skills<br>The students will be able to: | | | |
| 2.1 | Apply advanced concepts and solve mathematical problems in functional analysis. | S1 | Lectures, Group works, Presentations, Classroom discussion, Seminar, Case study, problem solving session | Exams, Quizzes, Home works, Assignments, Research project, presentation, interactive discussion and participation, Surveys. |
| 2.2 | Analyze complicated problems and applications of operators. | S2 | | |
| 2.4 | Communicate ideas accurately and | S4 | | |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | effectively using modern technology. | | | |
| 3.0 | Values, autonomy, and responsibility<br>The students will be able to: | | | |
| 3.1 | Perform academic integrity and professional ethics when dealing with academic issues. | V1 | Lectures, Group works, Presentations, Classroom discussion, Seminar, Case study, problem solving session | Research project, Home works, Assignments, presentation, interactive discussion and participation, Surveys |
| 3.2 | Demonstrate and managing their time and duties with friends and with groups. | V2 | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | Introduction to Bounded Linear Operators | 3 |
| 2 | Introduction to Compact Linear Operators | 3 |
| 3 | Introduction to Spectral Properties of Operators | 3 |
| 4 | Spectral Properties of Compact Linear Operators | 3 |
| 5 | Spectral Properties of Bounded Linear Operators | 3 |
| 6 | Spectral Properties of Self-adjoint Operators | 3 |
| 7 | Spectral Family of a Bounded Self-adjoint Operators | 3 |
| 7 | **Mid-Exam-#** | -- |
| 8 | Spectral Representation of Bounded | 3 |
| 9 | Self-adjoint Operators | 3 |
| 10 | Introduction to Banach Algebra | 3 |
| 11 | Commutative Banach Algebra | 3 |
| 11 | Spectral Theory in Banach Algebra | 3 |
| 12 | Gelfand Mapping and Its Applications | 3 |
| 13 | Gelfand Mapping and Its Applications | 3 |
| 14 | Spectral Theorem for Normal Operators | 3 |
| 15 | Some Questions and Applications | 3 |
| 16+17 | **Revision & Final Exam** | |
| Total | | 45 |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | Home works and Assignments | Weekly basis | 20% |
| 2. | Mid-term exam | 7th week | 25% |
| 3. | Presentation and discussion | During the Semester | 15% |
| 4. | Final Exam | At End of Semester | 40 % |

*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 | **1.** Eberhard Malkowsky ،Vladimir Advanced Functional Analysis, CRC Press (2020). |
| Supportive References | 1. Kolmogorov A.N. and Fomin S.V., Elements of the theory of functions and functional analysis, Dover Publications, (1999). |
| Electronic Materials | Saudi Digital Library |
| Other Learning Materials | None |

### 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Lecture Room with capacity of 30 students and equipped with White Board, Library |
| Technology equipment (projector, smart board, software) | Overhead projector and internet connection. |
| 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 | Direct and Indirect |
| Effectiveness of students assessment | Teacher | Direct |
| Quality of learning resources | Students | Indirect |
| The extent to which CLOs have been achieved | Teacher, Quality Committee | Direct and Indirect |
| Other | | |

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

**Assessment Methods**(Direct, Indirect)

## G. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **Approval by the Department Council** |
| **Reference No.** | DEPARTMENT COUNCIL NO (26) |
| **Date** | **11/9/1444 H** |