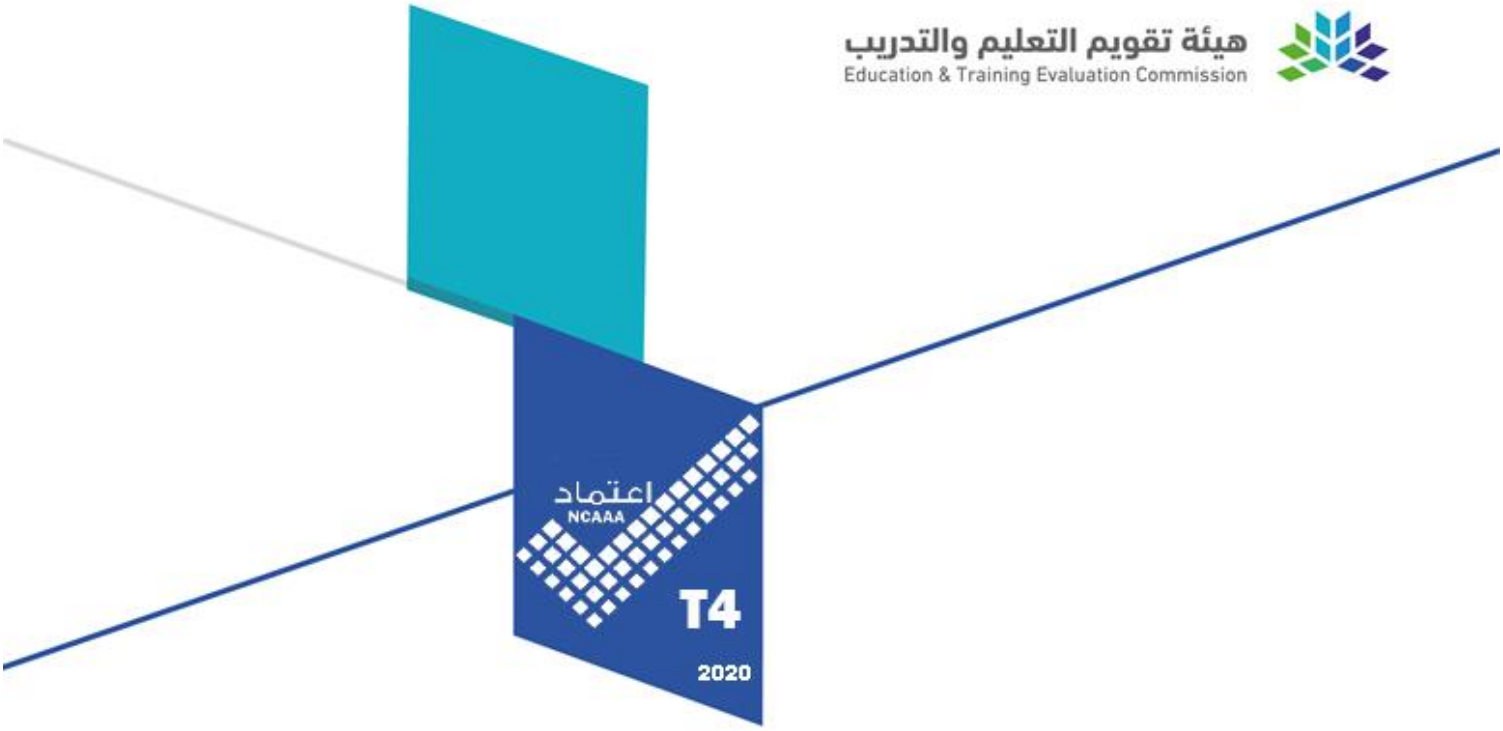
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission




# Course Specifications

| | |
|---|---|
| **Course Title:** | **Mathematical Physics (2)** |
| **Course Code:** | **2033203-3** |
| **Program:** | **Bachelor in Physics** |
| **Department:** | **Physics Department** |
| **College:** | **College of Science** |
| **Institution:** | **Taif University** |

## Table of Contents

## A. Course Identification

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|---|
| **1. Credit hours:3** |
| **2. Course type**<br>**a.** University ☐ College ☐ Department ☑ Others ☐<br>**b.** Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered: 9th Level / 3rd year** |
| **4. Pre-requisites for this course** (if any)**: Mathematical physics (1) (2033102-3)** |
| **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** | 4 | 100% |
| 2 | **Blended** | 0 | 0% |
| 3 | **E-learning** | 0 | 0% |
| 4 | **Distance learning** | 0 | 0% |
| 5 | **Other** | 0 | 0% |

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

| No | Activity | Contact Hours |
|---|---|---|
| 1 | **Lecture** | 40 |
| 2 | **Laboratory/Studio** | 0 |
| 3 | **Tutorial** | 0 |
| 4 | **Others** (specify) | 0 |
| | **Total** | 40 |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

Fourier series - Periodic functions – Fourier series and Fourier coefficients - Dirichlet conditions and Parseval's Theorem - Partial differential equations : separation of variables method – Solution of Laplace equation in different coordinate systems - The diffusion equation in Cartesi coordinates – The wave equation in Cartesian and polar coordinates - Functions of complex variables – Analytical functions – Cauchy - Riemann conditions - Cauchy theorem – Cauchy inte formula- The residue theorem – methods of finding the residue - Evaluation of definite integral by using residue theorem- Solution of differential equation by using Laplace and Fourier transforms– Convolution.

**2. Course Main Objective**

Use Fourier series to expand periodic functions. Analyze partial differential equations using separation of variable. Utilize Cauchy integral theorem in analyzing physical problems. Evaluation of definite integrals by using residue theorem. Find solution of differential equation by using Laplace and Fourier Transform.

### 3. Course Learning Outcomes

| | CLOs | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | • State the basic concepts of Fourier series, Dirichlet condition, Parseval's Theorem, Partial differential equation and its physical Signifance | K1 |
| 1.2 | • Define variable separation method and superposition theory and write Cauchy integral theorem | K2 |
| **2** | **Skills :** | |
| 2.1 | • Expand the Periodic function by using Fourier series, deduce the value of an infinite sum of a numerical series and evaluate of definite integrals of analytical function by using residue theorem. | S1 |
| 2.2 | • Solve differential equations by using separation of variables, Laplace and Fourier Transform | S2 |
| **3** | **Values:** | |
| 3.1 | • Show responsibility for working independently and interacting with staff to extract important information and identifying key issues to make progress | V1 |
| 3.2 | • Use mathematical, numerical, statistical tools, information and communications technology and effective searching for needed information | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Section 1: Fourier series**<br>▪ Periodic functions<br>▪ Applications of Fourier series<br>▪ Fourier coefficients<br>▪ Complex form of Fourier series<br>▪ Fourier series for odd and even functions<br>▪ Dirichlet conditions and Parseval's Theorem | 8 |
| 2 | **Section 2: Partial differential equation**<br>▪ Laplace's equations<br>▪ The diffusion or heat flow equation<br>▪ The wave equation - the vibrating String<br>▪ Steady state temperature in a cylinder and sphere<br>▪ Vibration of a circular membrane<br>▪ Poisson's equation | 12 |
| 3 | **Section 3: Functions of a complex variable**<br>▪ Analytic functions<br>▪ Contour integrals<br>▪ The residue theorem<br>▪ Methods of finding residue<br>▪ Evaluation of definite integrals by using residue theorem | 10 |

| | | |
|---|---|---|
| 4 | **Section 4: Integral transforms**<br>▪ Laplace transform and its inversion<br>▪ Solution of differential equation by using Laplace transform<br>▪ Fourier transforms and its inversion<br>▪ Solution of differential equation by using Fourier transform<br>▪ Convolution, Parseval's theorem | 10 |
| **Total** | | 40 |

## 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 | • State the basic concepts of Fourier series, Dirichlet condition, Parseval's Theorem, Partial differential equation and its physical significance | • lecture | •Written exam |
| 1.2 | •Define separation of variables method and superposition theory and write Cauchy integral theorem | • Enhanced with lecture | •Written exam |
| **2.0** | **Skills** | | |
| 2.1 | •Expand the Periodic function by using Fourier series and deduce the value of an infinite sum of a numerical series, from the application of the Parseval's theorem and the Dirichlet conditions | • Class Lecture | • Periodical and final exams |
| 2.2 | •Solve second order partial differential equations by using separation of variables and superposition theory | • Lecture<br>• Problem-Solving | •Home work |
| **3.0** | **Values** | | |
| 3.1 | • Show responsibility for working independently and interacting with staff to extract important information and identifying key issues to make progress | •Group discussion | •Homework reports |
| 3.2 | • Interacting, working in groups and having a willingness to take initiative. | • Groups discussion | •Homework reports<br>Research activities |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Activities | Periodically | 10% |
| 2 | Midterm exam | 6th | 30% |
| 3 | Short exam | 9th | 10% |
| 4 | Final exam | 12th | 50% |

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

## E. Student Academic Counseling and Support

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| **Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**<br><br>6 Hours per week during office-hours, in the instructor's office or by appointment. |

## F. Learning Resources and Facilities

### 1.Learning Resources

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|---|---|
| **Required Textbooks** | • Mathematical methods in the physical sciences , M.L.Boas , John Wiley &sons ,2nd edition ,1983 |
| **Essential References Materials** | • Mathematics for Physics, Michael Stone and Paul Goldbart<br>• Mathematical Tools for Physics,by James Nearing Physics Department University of Miami |
| **Electronic Materials** | • http : // hyperphysics ,phy-astr.gsu.edu / hbase / hframe.htm<br>• Wikipedia.org / Wiki / physics subjects<br>• http://www.physics.miami.edu/nearing/mathmethods/mathematical_methods-three.pdf |
| **Other Learning Materials** | • Mathematica, Mathlab |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | Lecture room with max 60 seats<br>Labs |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | data show, Smart Board, software |
| **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 |
|---|---|---|
| Student Feedback on Effectiveness of Teaching | Students | Indirect |
| Evaluation of Teaching | Pear reviewer<br>Program coordinator<br>Departmental council<br>Faculty council | Indirect |
| Improvement of Teaching | Program coordinator<br>Relevant committee | Direct |

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Quality of learning resources | Students<br>Instructor<br>Faculty | Indirect |
| Extent of achievement of course learning outcomes, | Program coordinator<br>Instructor | Direct |
| Course effectiveness and planning for improvement | Program coordinator<br>Instructor | Indirect |

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

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | **Department Council** |
| **Reference No.** | |
| **Date** | October 2, 2022 |