# Course Specification
(Postgraduate)

| | |
|---|---|
| **Course Title:** | **Theory of Thermoelasticity** |
| **Course Code:** | **202601-3** |
| **Program:** | **Master of Applied Mathematics** |
| **Department:** | **Mathematics and Statistics** |
| **College:** | **Science** |
| **Institution:** | **Taif university** |
| **Version:** | 1 |
| **Last Revision Date:** | **20/10/2023** |

## Table of Contents

# A. General information about the course:

## 1. Course Identification:

| 1. Credit hours: (3) | | | | |
|---|---|---|---|---|
| | | | | |
| **2. Course type** | | | | |
| A. | ☐University | ☐College | ☐Department | ☐Track |
| B. | ☐Required | | ☒ Elective | |
| **3. Level/year at which this course is offered: Level 3/Second Year** | | | | |
| **4. Course general Description:** | | | | |
| **This course introduces the main laws of theory of thermoelasticity. The course is intended to provide basic laws of Thermodynamics of elastic continuum; Basic Problems of Thermoelasticity; Heat conduction; Thermal Stresses; Coupled and Generalized Thermoelasticity.** | | | | |
| **5. Pre-requirements for this course** (if any)**:** | | | | |
| **None** | | | | |
| **6. Pre-requirements for this course** (if any)**:** | | | | |
| **None** | | | | |
| **7. Course Main Objective(s):** | | | | |
| **The student will be taught as follows:**<br>1. **To make students understand the Basic Laws of Thermoelasticity.**<br>2. **To make students conversant with Thermodynamics of Elastic Continuum.**<br>3. **To expose students to Basic Problems of Thermoelasticity.**<br>4. **To make student able to solve Heat conduction problems.**<br>5. **To make students conversant with Thermal Stresses in beams.**<br>6. **To make students understand the Coupled and Generalized Thermoelasticity.** | | | | |

## 2. Teaching Mode: (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | √ | 100% |
| 2 | E-learning | | |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | | |

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 4 | Distance learning | | |

### 3. Contact Hours: (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | **45** |
| 2. | **Laboratory/Studio** | NA |
| 3. | **Field** | NA |
| 4. | **Tutorial** | NA |
| 5. | **Others (specify)……** | NA |
| | **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 | **Describe** the basic laws of Thermoelasticity. | K1 | Lectures, group discussion | Exams, Quizzes, Assignments |
| 1.2 | **Recognize** Thermodynamics of Elastic Continuum. | K1 | Lectures, group discussion | Exams, Quizzes, Assignments |
| 1.3 | **Identify** the Basic Problems of Thermo-elasticity. | K1 | Lectures, group discussion | Exams, Quizzes, Assignments |
| **2.0** | **Skills** | | | |
| 2.1 | **Demonstrate** the basic problems of Thermoelasticity. | S2 | Lectures, group discussion | Exams, Quizzes, Assignments, report |
| 2.2 | **Explain** the Heat Conduction and thermal stresses problems with various solution methodologies. | S2 | Lectures, group discussion | Exams, Quizzes, Assignments, report |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 2.3 | **Use** mathematical techniques to analyze the thermoelasticity problems using software coding. | S3 | Lectures, group discussion | Exams, Quizzes, Assignments, report |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | **Accept** critical thinking, communication skills, and the thermoelasticity solutions to structural mechanics problems. | V1 | Lectures, group discussion | Exams, Quizzes, Assignments, report |
| 3.2 | **Participate** the capability to use programing in thermoelasticity problems. | V2 | Lectures, group discussion | Exams, Quizzes, Assignments, report |

## C. Course Content:

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | **Basic Laws of Thermoelasticity**: Constitutive Laws of Linear Thermoelasticity- Displacement Formulation of Thermoelasticity- Stress Formulation of Thermoelasticity - Two-Dimensional Thermoelasticity. | **9** |
| 2. | **Thermodynamics of Elastic Continuum:** Thermodynamics Definitions- First Law of Thermodynamics -Second Law of Thermodynamics-Variational-Formulation of Thermodynamics- Thermodynamics of Elastic Continuum. | **6** |
| 3. | **Basic Problems of Thermoelasticity.** General Theory of Thermoelasticity– Temperature distribution for zero thermal stresses- General solutions of thermoelastic problems. | **9** |
| 4. | **Heat conduction.** Fourier's Law and Heat Conduction Equation-Problems in rectangular cartesian coordinates. | **6** |
| 5. | **Thermal Stresses.** Thermal stresses in beams – Boundary Conditions-Share stresses in beams. | **9** |
| 6. | **Coupled and Generalized Thermoelasticity.** Governing equations of coupled thermoelasticiy - Generalized thermoelasticiy of a layer-Problems. | **6** |
| **Total** | | **45** |

## D. Students Assessment Activities:

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | Quizzes and HomeWorks | Continues | 10 % |
| 2. | Midterm exam | $8^{th}$ -$9^{th}$ | 20 % |
| 3. | Final exam | $16^{th}$ | 70% |

*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 | Richard B. Hetnarski and M. Reza Eslami, "Thermal Stresses-Advanced Theory and Applications", Springer (2008). |
| Supportive References | Nowinski J. L., "Theory of Thermo-elasticity with Applications", Alpena a den Rijn (1978). |
| Electronic Materials | https://nptel.ac.in/courses/105/105/105105177/ |
| Other Learning Materials | Nowacki W., "Thermo - Elasticity", PWN, Pergamon Press (1986).<br>Nowacki W., "Theory of Asymmetric Elasticity", PWN, Pergamon Press (1981). |

### 2. Educational and Research Facilities and Equipment Required:

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Classrooms containing whiteboard and electronic monitors |
| **Technology equipment**<br>(Projector, smart board, software) | Laptop- Smart board- Projector. |
| **Other equipment**<br>(Depending on the nature of the specialty) | Wi-Fi internet connections |

## F. Assessment of Course Quality:

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | Students | Indirect |
| Effectiveness of students assessment | Students | Indirect |
| Quality of learning resources | Students | Indirect |
| The extent to which CLOs have been achieved | Peer reviewer | Direct |

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| **Other** | | |

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

Assessment Methods (Direct, Indirect)

## G. Specification Approval Data:

| | |
|---|---|
| **COUNCIL /COMMITTEE** | **Department of Mathematics and Statistics** |
| **REFERENCE NO.** | |
| **DATE** | **20/10/2023** |

قسم الرياضيات والإحصاء
Mathematics and Statistics Department
TU
جامعة الطائف
TAIF UNIVERSITY