هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

# Course Specification

| | |
|---|---|
| Course Title: | laser physics |
| Course Code: | PHYS 435 |
| Program: | B.Sc. in Physics |
| Department: | Department of Physics and astronomy |
| College: | College of Science |
| Institution: | King Saud University |
| Version: | 2.0.0 |
| Last Revision Date: | Sep 2023 |

# Table of Contents:

# A. General information about the course:

| Course Identification | | | | | |
|---|---|---|---|---|---|
| **1. Credit hours:** | **3(3+0+0)** | | | | |
| **2. Course type** | | | | | |
| a. | University ☐ | College ☐ | Department☒ | Track☐ | Others☐ |
| b. | Required ☐ | Elective☒ | | | |
| **3. Level/year at which this course is offered:** | 7th level / four year. | | | | |
| **4. Course general Description**<br><br>The course aims to introduce students to Absorption and stimulated emission of light, Doppler effects, Einstein Relations, Population inversion.<br>**Amplification Criteria:** amplification conditions, Lorentzian line-shapes, Gaussian line-shapes, simple cavity model<br>**Fabry-Perot cavity**: optics of Fabry-Perot cavity, laser use of Fabry-Perot, laser gain conditions, laser modes, homogeneous broadening, inhomogeneous broadening.<br>Solid-state lasers, Semiconductor lasers, Gas Lasers, Dye lasers, Free electron laser, Titanium Sapphire Laser, Quantum Cascade Lasers and some new lasers.<br>**Cavity Stability:** matrix optics ray methods, matrix model of optical cavity, laser stability conditions, practical laser cavities<br>**Laser beam properties:** Laser Line width, Beam Divergence, Coherence, Brightness, Focusing properties of laser, Q-Switching, Frequency Doubling, Phase Conjugation, Mode Locking.<br>**Laser Applications:** Medical application, Industrial application, Military application, Scientific application, Holography and communications | | | | | |
| **5. Pre-requirements for this course (if any):** PHYS 331 | | | | | |
| **6. Co- requirements for this course (if any):** | | | | | |
| **7. Course Main Objective(s)**<br>1- Familiarity with laser light phenomena and application areas.<br>2- Understanding the scientific basis on which the interaction of the laser with the material and the properties of laser beams<br>3- Obtain the skills of dealing with optical devices through practical applications in laboratories | | | | | |

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

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1. | Traditional classroom | 45 | 100% |
| 2. | E-learning | 0 | 0 |
| 3. | Hybrid<br>• Traditional classroom<br>• E-learning | 0 | 0 |
| 4. | Distance learning | 0 | 0 |

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

| No | Activity | Contact Hours |
|---|---|---|
| 1. | Lectures | 45 |
| 2. | Laboratory/Studio | 0 |
| 3. | Field | 0 |
| 4. | Tutorial | 0 |
| 5. | Others (specify) | 0 |
| | 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 | Define and describe the concept of laser, its properties and generation of different types of laser | K1 | • Give extensive examples during lecture.<br>• Give problem sheets to be discussed during lecture.. | • Hold Class discussion, tutorial sessions.<br>• Give quizzes, mid-term exam and final exam. |
| 2.0 | Skills | | | |
| 2.1 | Solving problems relate to some topics | S1 | • Give extensive examples during lecture<br>• Give problem sheets to be discussed during lecture and labs.<br>• assignments.<br>• Discussions in the classes | • Hold Class discussion, tutorial and lab sessions.<br>• Give quizzes, mid-term exam and final exam. |
| 3.0 | Values, autonomy, and responsibility | | | |
| 3.1 | Master the oral presentation skills required for selected topics in laser physics | V1 | • assignments.<br>• Homework | Hold Class discussion |
| 3.2 | Work in a team and acknowledge others' work. | V2 | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | Absorption and stimulated emission of light, Doppler effects, Einstein Relations, Population inversion. | 4 |
| 2. | **Amplification Criteria:** amplification conditions, Lorentzian line-shapes, Gaussian line-shapes, simple cavity model | 6 |
| 3. | **Fabry-Perot cavity:** optics of Fabry-Perot cavity, laser use of Fabry-Perot, laser gain conditions, laser modes, homogeneous broadening, inhomogeneous broadening. | 6 |
| 4. | **Laser types:** Solid-state lasers, Semiconductor lasers, Gas Lasers, Dye lasers, Free electron laser, Titanium Sapphire Laser. | 8 |
| 5. | **Cavity Stability:** laser stability conditions, practical laser cavities | 6 |
| 6. | **Laser beam properties:** Laser Line width, Beam Divergence, Coherence, Brightness, Focusing properties of laser, Q-Switching, Frequency Doubling, Phase Conjugation, Mode Locking. | 8 |
| 7 | **Laser Applications:** Medical application, Industrial application, Military application, Scientific application, Holography and communications | 7 |
| Total | | 45 |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | First Midterm examination | Approx. 6 | 20% |
| 2. | Second Midterm examination | Approx. 12 | 20% |
| 3. | homework | Weekly | 20% |
| 4. | Final examination | From 16 to 18 | 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 | Lasers : principles and applications J.Wilson and J.F.B. Hawkes Prentice Hall 1992<br>مبادئ الليزرات و تطبيقاتها<br>ترجمة الصالحي ، د. عبد الله بن صالح الضويان، مطابع جامعة الملك سعود، 1424-2003 |
| Supportive References | Principles of laser, O. Svelto Springer, 2010 |
| Electronic Materials | None |

| Other Learning Materials | Internet sites relevant to the course |
|---|---|

## 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| facilities<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | A classroom which accommodates 25 students. |
| Technology equipment<br>(projector, smart board, software) | Whiteboard and Smart board |
| Other equipment<br>(depending on the nature of the specialty) | Not applicable |

# F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | Students\ Peer Reviewer | Indirect \ direct |
| Effectiveness of students assessment | Students- Faculty | Direct |
| Quality of learning resources | students | Indirect |
| The extent to which CLOs have been achieved | Faculty | Indirect |
| Other | None | None |

**Assessor** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

# G. Specification Approval Data

| | |
|---|---|
| **COUNCIL /COMMITTEE** | Physics Department's council |
| **REFERENCE NO.** | 9h (1st term/1445) |
| **DATE** | 16/06/1445 |