

T-104 2022

# **Course Specification**

| Course | l itle: | laser lab |  |
|--------|---------|-----------|--|
|        |         |           |  |

Course Code: PHYS 457

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





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| CC  | ourse Identificati           | on                  |         |                                |       |        |
|---|------------------------------|---------------------|---------|--------------------------------|-------|--------|
| 1.  | Credit hours:                | 2(0+0+4)            |         |                                |       |        |
| 2.  | Course type                  |                     |         |                                |       |        |
| a.  | University 🗆                 | College 🗆           | Dep     | partment⊠                      | Track | Others |
| b.  | Required                     | Elective⊠           |         |                                |       |        |
| 3.  | Level/year at wl             | hich this course    | e is    | 7 <sup>th</sup> level / four y | vear. |        |
| off                                       | ered:                        | Description         |         |                                |       |        |
| 4.<br>The                                 | Course general               | Description         | ubiocts |                                |       |        |
| THE                                       | 1. Fabry Perot Res           | sonator             | ubjects |                                |       |        |
|   | 2. Helium Neon la            | ser                 |         |                                |       |        |
|   | 3. Pulsed diode la           | ser                 |         |                                |       |        |
|   | 4. Spectral analysi          | is                  |         |                                |       |        |
|   | 5. Measuring the             | laser power or ener | rgy:    |                                |       |        |
| 6. Measuring beam diameter and divergence |                              |                     |         |                                |       |        |
| 7. Emission and Absorption                |                              |                     |         |                                |       |        |
| 8. Laser range finder                     |                              |                     |         |                                |       |        |
|   | 9. Diode Pumped Nd:YAG Laser |                     |         |                                |       |        |

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

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

- 1. The student should be able to acquire a good background about the basic concepts of laser radiation and its applications in different fields
- 2. The student should have experience on the concept of how lasers work and the principles of laser safety.
- 3. The student should have a preliminary experience on laser spectroscopic techniques.

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

| No | Mode of Instruction   | Contact Hours | Percentage |
|----|---|---------------|------------|
| 1. | Traditional classroom   | 36            | 100%       |
| 2. | E-learning  | 0             | 0          |
| 3. | <ul><li>Hybrid</li><li>Traditional classroom</li><li>E-learning</li></ul> | 0             | 0          |
| 4. | Distance learning   | 0             | 0          |





| No | Activity          | Contact Hours |
|----|-------------------|---------------|
| 1. | Lectures          | 0             |
| 2. | Laboratory/Studio | 36            |
| 3. | Field             | 0             |
| 4. | Tutorial          | 0             |
| 5. | Others (specify)  | 0             |
|    | Total             | 36            |

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

| Code | Course Learning<br>Outcomes   | Code of CLOs aligned<br>with program |   | Teaching<br>Strategies  | Assessment<br>Methods   |
|------|---|--------------------------------------|---|---|---|
| 1.0  | Knowledge and unde  | rstanding                            |   |   |   |
| 1.1  | summarize experiments<br>and applications in the<br>laser field                         | K1                                   | • | Give pre<br>questions about<br>different topics   | • Hold Class discussion,  |
| 1.2  | Recognizing<br>knowledge of how<br>lasers work and the<br>principles of laser<br>safety | K2                                   | • | in laser and its<br>applications.<br>Give different<br>experiments<br>include different<br>topic of laser | <ul> <li>tutorial sessions.</li> <li>Give quizzes, mid-term exam and final exam.</li> </ul> |
| 2.0  | Skills  |                                      |   |   |   |
| 2.1  | record a preliminary<br>experience on laser<br>spectroscopic<br>techniques              | S1                                   | • | Work in   | • Hold Class discussion, tutorial and lab   |
| 2.2  | perform experiments related to laser field  | <b>S</b> 2                           |   | different<br>experiments in<br>laser  | sessions.<br>Give<br>quizzes,<br>mid-term<br>exam and<br>final exam.                        |
| 3.0  | Values, autonomy, ar  | nd responsibility                    |   |   |   |
| 3.1  | Write scientific reports<br>on different<br>experiments                                 | V1                                   | • | Write different<br>lab reports  | Hold Class<br>discussion  |





| C. C | Course Content   |               |
|------|--|---------------|
| No   | List of Topics   | Contact Hours |
| 1.   | <ul> <li>Fabry Perot Resonator</li> <li>Measurement of the Free Spectral Range (FSR)</li> <li>Measurement of the finesse</li> <li>Mode spectrum</li> <li>The plane mirror Fabry Perot</li> </ul>   | 4             |
| 2.   | <ul> <li>The optical stability range</li> <li>The optical output as a function of the position of the laser tube inside the resonator</li> <li>The measurement of the beam radii path inside the resonator.</li> </ul>   | 4             |
| 3.   | <ul> <li>Pulsed diode laser</li> <li>Measuring the repetition rate and the pulse width</li> <li>the spatial intensity distribution and determine a three-<br/>dimensional plot of the emission cross section</li> <li>Analyzing the polarization properties</li> <li>Collimating the divergent radiation beam</li> </ul>   | 4             |
| 4.   | <ul> <li>Spectral analysis</li> <li>Investigation of the principle of gratings</li> <li>Principles of spectrograph and Czerny-Turner monochromator</li> <li>Investigation of a spectral lamp and line spectrum</li> </ul>  | 4             |
| 5.   | <ul> <li>Measuring the laser power or energy:</li> <li>To measure the laser power and energy (two types of lasers).</li> <li>To observe the character of laser (Frequency, width beam of laser, voltage)</li> <li>To measure width of beam laser Vs output laser power or energy at different point at least 10 points.</li> <li>To measure voltage of laser Vs output laser power or energy at different point at least 10 points.</li> </ul> | 4             |
| 6.   | <ul> <li>Measuring beam diameter and divergence</li> <li>Determine Spot size of beam laser (DIMO (diode laser module, 532 nm) and measure Divergence Angle.</li> </ul>   | 4             |





|    | Total  | 36 |
|----|--|----|
| 9. | Diode Pumped Nd:YAG Laser  | 4  |
| 8. | <ul> <li>Laser range finder</li> <li>Investigate the optical spectra of LED and laser light sources</li> <li>Investigate other properties of these sources like polarization and spatial emittance</li> </ul>  | 4  |
| 7  | <ul> <li>Emission and Absorption</li> <li>Measuring the absorption and wavelength of the laser diode</li> <li>Measuring Absorption spectrum</li> <li>Measuring Wavelength and temperature dependence</li> <li>Wavelength and temperature dependence</li> </ul>                                       | 4  |
|    | <ul> <li>Measured the distribution of the intensity of the scattered probe<br/>using a sensor connected with the Digital multi-meter at<br/>different degrees.</li> <li>Measured the density of beam laser of CW after put different<br/>filters and compared with density before put it.</li> </ul> |    |

## **D. Students Assessment Activities**

| No | Assessment Activities * | Assessment<br>timing<br>(in week no) | Percentage of Total<br>Assessment Score |
|----|-------------------------|--------------------------------------|---|
| 1. | Experiments reports     | Approx. 9                            | 40%                                     |
| 2. | Final theoretical exam  | 1 week                               | 20%                                     |
| 3. | Final Practical exam    | 1 week                               | 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  | The Physics of Atoms and Molecules: Introduction to Experiments<br>and Theory, W. D. Brewer, Springer, 7th edition 2005 -Special<br>Experiment sheets for Laser experiments. |
|-----------------------|--|
| Supportive References |  |





Electronic Materials Other Learning Materials

None

Internet sites relevant to the course

#### 2. Required Facilities and equipment

| Items   | Resources                                   |
|---|---|
| facilities<br>(Classrooms, laboratories, exhibition rooms,<br>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<br>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.      | 9 <sup>h</sup> (1 <sup>st</sup> term/1445) |
| DATE               | 16/06/1445                                 |

