| Form: Course Syllabus | Form Number | EXC-01-02-02A |
|---|---|---|
| | Issue Number and Date | 2/3/24/2022/2963 05/12/2022 |
| | Number and Date of Revision or Modification | 2023/10/15 |
| | Deans Council Approval Decision Number | 265/2024/24/3/2 |
| | The Date of the Deans Council Approval Decision | 2024/1/23 |
| | Number of Pages | 09 |

| | | |
|---|---|---|
| 1. | Course Title | Theory of Special Relativity |
| 2. | Course Number | 0302360 |
| 3. | Credit Hours (Theory, Practical) | (2, 0) |
| | Contact Hours (Theory, Practical) | (2, 0) |
| 4. | Prerequisites/ Corequisites | Classical Mechanics-1 (0302351) |
| 5. | Program Title | BSc. In Physics |
| 6. | Program Code | |
| 7. | School/ Center | School of Science |
| 8. | Department | Physics |
| 9. | Course Level | Bachelor |
| 10. | Year of Study and Semester (s) | 2024/2025, 2nd semester |
| 11. | Program Degree | Bachelor |
| 12. | Other Department(s) Involved in Teaching the Course | - |
| 13. | Learning Language | English |
| 14. | Learning Types | ☒Face to face learning ☐Blended ☐Fully online |
| 15. | Online Platforms(s) | ☒Moodle ☐Microsoft Teams |
| 16. | Issuing Date | 20/02/2025 |
| 17. | Revision Date | 12/06/2025 |

**18. Course Coordinator:**

Name: Prof. Dr. Hanan Sa'adeh

Contact hours: announced on the website: https://eacademic.ju.edu.jo/hanan.saadeh/Pages/OfficeHours.aspx

Office number: 220 Phone number: 22029

Email: Hanan.Saadeh@ju.edu.jo

**19. Other Instructors:**

| |
|---|
| None |

**20. Course Description:**

| |
|---|
| As stated in the approved study plan.<br><br>Introductory Course of Special Relativity: This course introduces the basic ideas and equations of Einstein's Special Theory of Relativity; the physics of Lorentz contraction, time dilation, and $E=mc^2$. |

**21. Program Intended Learning Outcomes:** (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

| **PILO's** | ***National Qualifications Framework Descriptors*** | | |
|---|---|---|---|
| | **Competency (C)** | **Skills (B)** | **Knowledge (A)** |
| 1. Identify, formulate, and solve broadly-defined technical or scientific problems by applying knowledge of Mathematics and Science and/or technical topics to areas relevant to the discipline. | ☐ | ☐ | ☒ |
| 2. Formulate or design a system, process, procedure or program to meet desired needs. | ☐ | ☒ | ☐ |
| 3. Develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions. | ☐ | ☐ | ☒ |
| 4. Communicate effectively with a range of audiences in oral or written forms and exhibit ethical and professional values. | ☐ | ☒ | ☐ |
| 5. Reflect the impact of technical and/or scientific solutions in economic, environmental, and societal contexts. | ☒ | ☐ | ☐ |
| 6. Function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty. | ☒ | ☐ | ☐ |

* Choose only one descriptor for each learning outcome of the program, whether knowledge, skill, or competency.

**22. Course Intended Learning Outcomes:** (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

**1.** Understand the basic principles of the special theory of relativity.

**2.** Describe the setup and significance of Michelson-Morley experiment.

**3.** Perform basic calculations in relativistic kinematics.

**4.** Explain time dilation and length contraction.

**5.** Use the Lorentz Transformation equations to describe events in different frames of references, and to determine proper time and dilated time, and proper length and contracted length.

**6.** Master the idea of Lorentz Transformations to prove the invariability of physical laws.

| Course ILOs # | The learning levels to be achieved | | | | | | Competencies |
|---|---|---|---|---|---|---|---|
| | Remember | Understand | Apply | Analyse | evaluate | Create | |
| 1 | √ | √ | | √ | | | |
| 2 | | √ | √ | | √ | | |
| 3 | | √ | √ | √ | | | |
| 4 | √ | √ | √ | | | √ | |
| 5 | | √ | √ | √ | | | |
| 6 | | √ | √ | √ | | √ | |

**23. The matrix linking the intended learning outcomes of the course course -CLOs with the intended learning outcomes of the program -PILOs:**

| PILOs* / CILOs | 1 | 2 | 3 | 4 | 5 | 6 | Descriptors** | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A | B | C |
| 1 | √ | | | | | | √ | | |
| 2 | | | √ | | | | √ | | |
| 3 | | √ | | | | | | √ | |
| 4 | √ | | | | | | √ | | |
| 5 | √ | | | | | | √ | | |
| 6 | √ | | | | | | √ | | |

***Linking each course learning outcome (CLO) to only one program outcome (PLO) as specified in the course matrix.**

****Descriptors are determined according to the program learning outcome (PLO) that was chosen and according to what was specified in the program learning outcomes matrix in clause (21).**

**24. Topic Outline and Schedule:**

| Week | Lecture | Topic | ILO/s Linked to the Topic | Learning Types (Face to Face/ Blended/ Fully Online) | Platform Used | Synchronous / Asynchronous Lecturing | Evaluation Methods | Learning Resources |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | **Introduction:** All Motion is Relative | 1, 4 | Face to Face | Lecture room | Syn | Discussion | Text book |
| | 1.2 | | | | | | | |
| 2 | 2.1 | | | | | | | |
| | 2.2 | | | | | | | |
| 3 | 3.1 | **Departure from Newtonian Dynamics**<br>Newton<br>"The Ultimate Speed"<br>Photons<br>The Energy-Momentum Relation for Photons<br>Matter and Radiation: The Inertia of Energy<br>Energy, Momentum, and Mass<br>Is the New Dynamics Correct?<br>Motion Under a Constant Force<br>"Einestien's Box Unhinged"<br>Some Comments | 1, 3 | Face to Face | Lecture room | Syn | Discussion | Text book<br>Ch 1 |
| | 3.2 | | | | | | | |
| 4 | 4.1 | | | | | | | |
| | 4.2 | | | | | | | |
| 5 | 5.1 | | | | | | | |
| | 5.2 | | | | | | | |
| 6 | 6.1 | **Perplexities in the Propagation of Light**<br>The Nature of Light<br>The Luminiferous Ether | 1, 2 | Face to Face | Lecture room | Syn | Discussion<br>Exam | Text book<br>Ch 2 |
| | 6.2 | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | 7.1<br>7.2 | Stellar Aberration<br>A Modified Aberration Experiment<br>Fizeau's Measurement of the Drag Coefficient<br>Prelude to the Michelson-Morely Experiment<br>The Michelson Morely Experiment<br>Concluding Remarks | | | | | | |
| 8 | 8.1<br>8.2 | | | | | | | |
| 9 | 9.1<br>9.2 | **Einstein and the Lorentz-Einstein Transformations**<br>Preamble: The Contraction Hypothesis<br>Einstein Reasserts Relativity<br>Relativity According to Galileo and Newton<br>The Transformation of Newton's Law<br>Einstein and the Universality of c<br>The Second Postulate and Observational Evidence<br>The Relativity of Simultaneity<br>The Lorentz-Einstein Transformations<br>More About the Lorentz Transformations<br>Minkowski Diagrams: Space-Time<br>A Space-Time Invariant | 3, 5, 6 | Face to Face | Lecture room | Syn | Discussion<br>Exam | Text book<br>Ch 3 |
| 10 | 10.1<br>10.2 | | | | | | | |
| 11 | 11.1<br>11.2 | | | | | | | |
| 12 | 12.1<br>12.2 | **Relativity and the Measurement of Lengths and Time Intervals**<br>Observers<br>Point Events and Their Transformations<br>Time Measurements<br>The Lorentz Contraction<br>Time Dilation<br>Observation of Time Dilation with Cosmic-Ray Mesons | 3, 4, 6 | Face to Face | Lecture room | Syn | Discussion<br>Exam | Text book<br>Ch 4 |
| 13 | 13.1<br>13.2 | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 14 | 14.1<br>14.2 | Another Interpretation of the Time-Dilation Experiment<br>More About Time and Length Measurements<br>A Michelson-Morely Experiment With Lasers<br>Relativity Is Truly Relative<br>Space-Time Intervals and Causality | | | | | | |
| 15 | 15.1<br>15.2 | **Relativistic Kinematics**<br>Transformation of Velocities<br>Radiation from a Rapidly Moving Source<br>Light in a Moving Medium: The Drag Coefficients<br>Transverse Motions; Stellar Aberration<br>The Doppler Effect<br>More About Doppler Effects | 1, 3 | Face to Face | Lecture room | Syn | Discussion<br>Exam | Text book<br>Ch 5 |

**25. Evaluation Methods:**

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

| Evaluation Activity | *Mark wt. | CILOs | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** |
| Midterm Exam | 30 | √ | √ | √ | | √ | √ |
| Second Exam | 20 | √ | | √ | √ | | |
| Final Exam | 50 | √ | √ | √ | √ | √ | √ |
| **Class work | | | | | | | |
| Total 100% | 100 | | | | | | |

*** According to the instructions for granting a Bachelor's degree.**

****According to the principles of organizing semester work, tests, examinations, and grades for the bachelor's degree.**

## Mid-term exam specifications table*

| No. of questions/ cognitive level | | | | | | No. of questions per CLO | Total exam mark | Total no. of questions | CILO/ Weight | CILO no. |
|---|---|---|---|---|---|---|---|---|---|---|
| Create **%10** | Evaluate **%10** | Analyse **%10** | Apply %20 | Understand **%20** | Remember %30 | | | | | |
| | | | 1 | 2 | 3 | 3 | 30 | 8 | 38% | 1 |
| | | 1 | | | 1 | 1 | | | 13% | 2 |
| | 2 | 3 | 1 | | | 3 | | | 38% | 3 |
| | | 1 | 1 | | | 1 | | | 13% | 4 |
| 2 | 2 | 3 | 1 | | | 3 | | | 38% | 5 |
| 2 | 2 | 3 | 1 | | | 3 | | | 38% | 6 |

## Final exam specifications table

| No. of questions/ cognitive level | | | | | | No. of questions per CLO | Total exam mark | Total no. of questions | CILO Weight | CILO no. |
|---|---|---|---|---|---|---|---|---|---|---|
| Create **%10** | Evaluate **%10** | Analyse **%10** | Apply %20 | Understand **%20** | Remember %30 | | | | | |
| | | | | 2 | 2 | 3 | 50 | 9 | 33% | 1 |
| | | | | | | | | | 0% | 2 |
| | | | 2 | | 2 | 5 | | | 56% | 3 |
| | | | | | 2 | 2 | | | 22% | 4 |
| 1 | 1 | | 1 | | 1 | 1 | | | 11% | 5 |
| 2 | 2 | 2 | 2 | 3 | 2 | 3 | | | 33% | 6 |

## 26. Course Requirements:

(e.g.: students should have a computer, internet connection, webcam, account on a specific software/platform…etc.):

Textbook, Lecture Notes, Scientific Calculator, Internet Connection.

## 27. Course Policies:

A- Attendance policies:

Class attendance is expected. Past experience has shown that students who do not attend the lectures invariably receive poor grades. A student whose absence exceeds 15% of lectures will be dismissed.

B- Absences from exams and submitting assignments on time:

Absence from exams without an acceptable excuse means ZERO. No late submission of homework assignments is allowed.

C- Health and safety procedures:

No special precautions.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

All these issues will be considered according to the regulations and laws adopted at the University of Jordan.

E- Grading policy:

Midterm Exam: 30%

Second Exam: 20%

Final Exam: 50%

F- Available university services that support achievement in the course:

Class Room, Library, Students Computer Lab, E-Learning Platform

**28. References:**

A- Required book(s), assigned reading and audio-visuals:

Special Relativity, MIT Introductory Physics Series (1968), by A. P. French.

B- Recommended books, materials, and media:

1- Spacetime Physics, 2nd Edition (1992), by E.F. Taylor & J.A. Wheeler.

2- Introduction to Special Relativity, 1968, by R. Resnick.

3- Modern Physics for Scientists and Engineers, 4 th Edition (2013), by S.T. Thornton & A. Rex.

4- Modern Physics, 3rd Edition (2005), by R.A. Serway, C.J. Moses, & C.A. Moyer.

**29. Additional information:**

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| Name of the Instructor or the Course Coordinator: | Signature: | Date: |
|---|---|---|
| …… **Prof. Dr. Hanan Sa'adeh** …… | ……..…… | 13/06/2025 |

| | | |
|---|---|---|
| Name of the Head of Quality Assurance Committee/ Department | Signature: | Date: |
| ……. | ……..…… | ……..…… |
| Name of the Head of Department | Signature: | Date: |
| ……. | ……..…… | ……..…… |
| Name of the Head of Quality Assurance Committee/ School or Center | Signature: | Date: |
| ……. | ……..…… | ……..…… |
| Name of the Dean or the Director | Signature: | Date: |
| ……. | ……..…… | ……..…… |