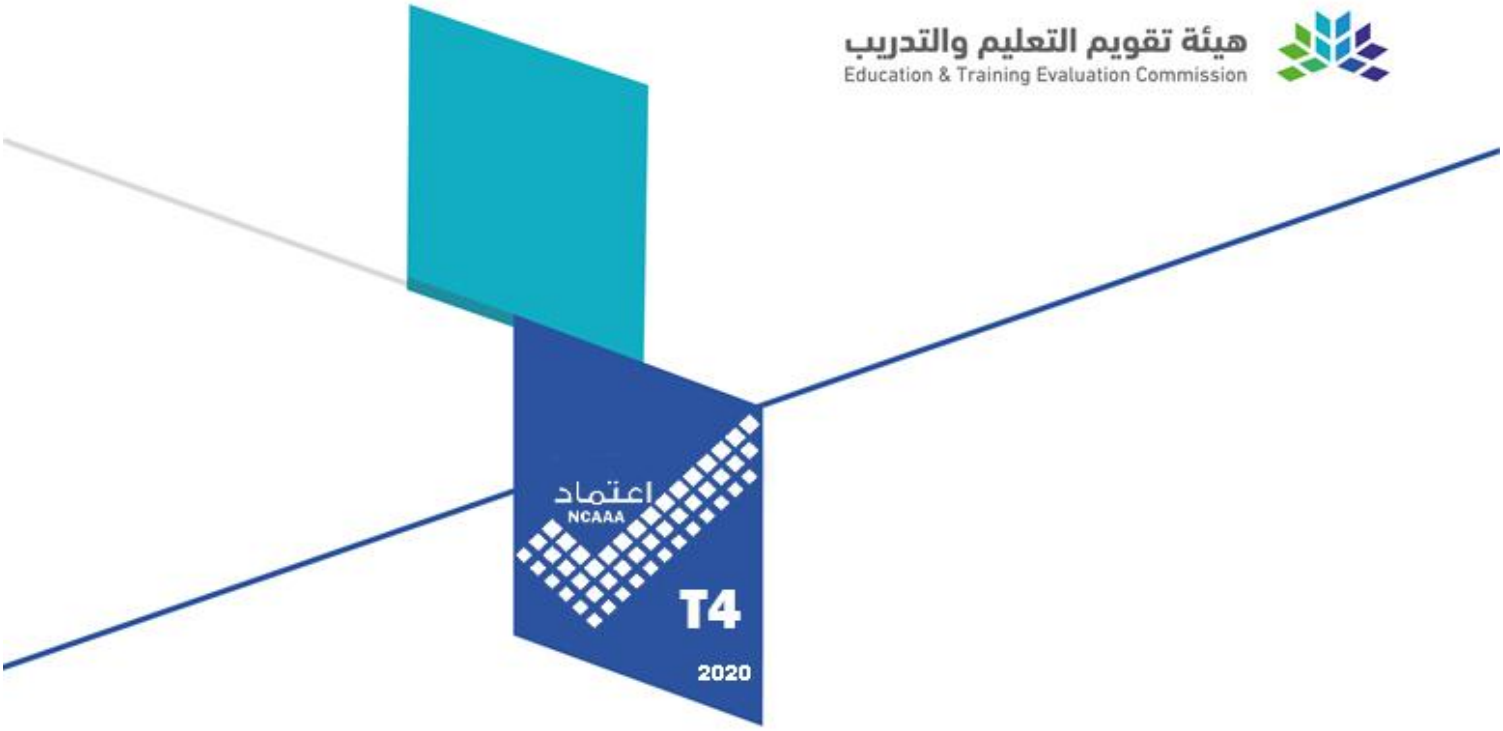
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	**Modern Physics II**
Course Code:	**441PHYS**
Program:	**Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Jazan University**

Table of Contents

A. Course Identification

1. Credit hours: 4
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 8th/4th
4. Pre-requisites for this course (if any)**:** **Modern Physics I (341PHYS)**
5. Co-requisites for this course (if any)**:** **NIL**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	**42**	**46.6 %**
2	**Blended**	**6**	**6.8 %**
3	**E-learning**		
4	**Distance learning**		
5	**Other**	**42**	**46.6%**

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**45**
2	**Laboratory/Studio**	**45**
3	**Tutorial**	**-**
4	**Others** (Problem Solving Sessions, Quizzes, Interactive Sessions, Excel Problem solving, Office Hours)	**50**
	Total	**140**

B. Course Objectives and Learning Outcomes

1. Course Description

This is an advanced and continued Modern Physics I course offered to the 8 level undergraduate senior students at the Jazan University. Molecular Spectroscopy, Modern Methods of Optical Spectroscopy, Cosmology and the Progress in Quantum Physics are the main chapters to be covered in this course. Students learn the theory of molecular bonding, their properties and spectroscopy by means of vibration, rotation and the selection rules of molecules. In the optical spectroscopy, students learn about quantum beats, Doppler-free saturation spectroscopy and two-photon absorption and finally the level-crossing spectroscopy. Students then move to learn about the Universe by means of it's origin, evolution and ultimate fate. Last but not least, students learn about the major advancement of quantum physics, e.g. quantum computers, entanglement etc. Students are also required to perform the practical classes (labs) concerning to the course contents.

2. Course Main Objective

This course is designed to provide students with:

- The fundamental of molecular spectra, optical spectroscopy, modern cosmology and advance in quantum physics.
- Analyzing the molecular spectrum, explaining the optical spectroscopy, developing their ideas about modern cosmology and the advances in quantum world (e.g. quantum computing).
- Demonstrate concepts concerning the course by means of practical classes.
- To become familiar with the advanced and leading-edge current research fields in physics.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**Define** Relativistic Doppler shift, Resolving power, Covalent bond, Ionic bond, Bonding state, Antibonding state, Homonuclear bonding, Gravitational lensing, Einstein-Podolsky-Rosen (EPR) Paradox, Bell Inequalities	**PLO1.1**
1.2	**Describe** Cosmological Principle, Big Bang Hypothesis, The condition of laser frequency used in the Doppler free saturation spectroscopy, Rotational and vibrational selection rules of molecules, Hubble law, The factors which determine the relative number of neutrons and protons according to Big Bang hypothesis, the presence of dark matter and its types	**PLO1.1**
1.3	**Discuss** Entanglement, Bose-Einstein Condensates, Laser Cooling of Atoms, Quantum Computing.	**PLO1.2**
2	**Skills:**	
2.1	**Solve** the ionizing energy problems for molecules, coulomb energy of molecules, effective force constant calculation, vibrational energy, vibrational spacing, rotational energy, rotational spacing, distance galaxy, change in wavelength, universe age, universe temperature	**PLO2.1**
2.2	**Demonstrate** Doppler broadening represents an obstacle to measure a narrow spectral line, P_y states are less effective in binding the molecules than the P_x states, The measured bond angle for H_2O molecule is greater than the expected value (90°), at the universe age greater than 250 s, the formed ^3H and ^3He nuclei do not break apart and why.	**PLO2.2**
2.3	**Perform** experiments using different analog and digital devices and plot the characteristics of different types of devices, competencies in communication, critical thinking and reporting during lab work, interactive discussion and group assignments.	**PLO2.3**
2.4	**Develop** the basic idea of the laser cooling, the two photons absorption process, The problem of Doppler broadening, quantum entanglement, Lamb dip effect, quantum computing paradigm.	**PLO2.4**
3	**Values:**	
3.1	**Show** the paradigm of collaboration with effective collaboration, demonstrating the important skills to work in groups, while taking responsibility for individual tasks during group assignments and lab work and practice safety awareness in the lab.	**PLO3.1**

C. Course Content

No	List of Topics	Contact Hours
1	**Molecular Physics:** The Hydrogen molecule ion, Hydrogen molecule and covalent bond, Other covalent bonding molecule (pp covalent bonds, sp covalent bonds, sp hybrid states), Ionic bonding e.g NaCl and calculation of bonding energy, Molecular vibrations, Molecular rotations, Selection rules, Molecular spectra	
2	**Cosmology:** The origin of the universe, Expansion of the universe, Cosmic microwave background radiation, General Theory of Relativity, Test of General Theory of Relativity, Dark Matter and Black Holes, Big Bang cosmology, Formation of Nuclei and atoms, and Future of the universe	
3	**Modern Methods of Optical Spectroscopy:** Classical method, Quantum beats, Doppler effect, Doppler –free saturation spectroscopy, Doppler-free two –photon absorption, Level-crossing spectroscopy, and Laser cooling of atoms	
4	**Progress in Quantum Physics:** Quantum entanglement, Einstein-Podolsky-Rosen (EPR) Paradox, Bell's Inequalities, Introduction to quantum computers (History, Review of digital computers, Basic concept of the quantum computers), and Bose-Einstein Condensation.	
6	Review	**3**
Total		45

Experimental Part:

No	List of Topics	Contact Hours
1	Millikan's Oil-Drop Experiment	3
2	Determination of the specific Charge of the Electron (e/m) by the Deflection of Electrons in Thomson Tube	3
3	Determination of (e/m) from the full circular path of the electron moving in magnetic field	**6**
4	Photoelectric Effect	**3**
5	Investigating the energy spectrum of an X-ray tube as a function of the high voltage	3
6	Investigating the energy spectrum of an X-ray tube as a function of the emission current	3
7	Duane-Hunt relation and determination of Planck's Constant	3
8	Rutherford Scattering: measuring the scattering rate as a function of the scattering angle and the atomic number	3
9	Fine structure of the characteristic X-radiation of a molybdenum anode	**6**
10	Compton Effect: verifying the energy loss of the scattered X-ray quantum	**3**
	Total	**27**

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	**Define** Relativistic Doppler shift, Resolving power, Covalent bond, Ionic bond, Dark matter, Bonding state, Antibonding state, Homonuclear bonding, Gravitational lensing, Einstein-Podolsky-Rosen (EPR) Paradox, Bell Inequalities	Lectures, blackboard and visualization, group and interactive guided discussion, Interactive discussion	**Direct:** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
1.2	**Describe** Cosmological Principle, Big Bang Hypothesis, The condition of laser frequency used in the Doppler free saturation spectroscopy, Rotational and vibrational selection rules of molecules, Hubble law, The factors which determine the relative number of neutrons and protons according to Big Bang hypothesis	Lectures, blackboard and visualization, group and interactive guided discussion, Interactive discussion	**Direct:** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student Survey
1.3	**Discuss** Entanglement, Bose-Einstein Condensates, Laser Cooling of Atoms, Quantum Computing.	Lectures, blackboard and visualization, group and interactive guided discussion, Interactive discussion,	**Direct:** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.0	**Skills**		
2.1	**Solve** the ionizing energy problems for molecules, coulomb energy of molecules, effective force constant calculation, vibrational energy, vibrational spacing, rotational energy, rotational spacing, distance galaxy, change in wavelength, universe age, universe temperature	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration, Problem-based Learning, Using Excel Sheet for problem solving	**Direct:** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student Survey
2.2	**Describe** The presence of dark matter, Doppler broadening represents an obstacle to measure a narrow spectral line, P_y states are less effective in binding the molecules than the P_x states, The measured bond angle for	Lectures, blackboard and visualization, group and interactive guided discussion, Interactive discussion. Movies	**Direct:** (formative and summative): In class interactive questioning, quizzes, written exams

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	H_2O molecule is greater than the expected value (90°), At the universe age greater than 250 s, the formed ^{3}H and ^{3}He nuclei are not break apart.		**Indirect:** student survey
2.3	**Develop** the basic idea of the laser cooling, the two photons absorption process, The problem of Doppler broadening, quantum entanglement, Lamb dip effect, quantum computing paradigm	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration, Problem-based Learning	**Direct:** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student Survey
2.4	**Perform** experiments using different analog and digital devices and plot the characteristics of different types of devices	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration, Problem-based Learning	**Direct:** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student Survey
3.0	**Values**		
3.1	**Show** the paradigm of collaboration with effective collaboration, demonstrating the important skills to work in groups, while taking responsibility for individual tasks during group assignments and lab work and practice safety awareness in the lab.	Interactive and Group discussion, expository and discovery teaching	**Direct:** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student Survey

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework assignment- Contribution in interactive discussion	3	2 (2%)
2	Quiz 1	4	2 (2%)
3	First Mid-term exam	7	8 (8%)
4	Quiz 2	8	1 (1%)
5	Homework assignment- Contribution in interactive discussion	9	2 (2%)
6	Second mid-term exam	11	8 (8%)
7	Homework assignment- Contribution in interactive discussion- Group work-essay or Project discussion	12	2 (2%)
8	Laboratory Examination	14	25(25%)
9	Final Examination	16	50(50%)

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

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice : Each group of students is assigned to a staff member who will be available for help and academic guidance office hours at specific 2hours on daily basis.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	1. **Modern Physics**; K. S. Krane, Wiley, John &Sons, Inc., 1995. 2. **The Physics of Atoms and Quanta**; H. Haken and H.C. Wolf, Springer, 6th edition 2000.
Essential References Materials	1. Concepts of Modern Physics; Arthur Beiser, McGraw-Hill Book Co., 1987. 2. Modern Physics, P. A. Tipler, and R. A. Llewellyn, Freeman, 4th edition 2002.
Electronic Materials	**http://www.wikipedia.org/**
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Class Room
Technology Resources (AV, data show, Smart Board, software, etc.)	Multi-Media Projector
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Modern Physics Laboratory

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students, Peers and Program Leader	Indirect (CES)- Indirect peer evaluation
Assessment	Students, Program assessment committee	Direct/Indirect
Extent of achievement of course learning outcomes	Instructor	Direct/Indirect
Quality of learning resources	Students, Faculty members	Indirect (CES)- Indirect peer evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning 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.	**8**
Date	**16/4/1442**