نموذج توصيف مقرر
Course Description Form

Name of College\Faculty : Science **اسم الكلية:**

Name of Department: Chemistry **اسم القسم العلمي:**

Course Name	Physical Chemistry III	**اسم المقرر**
Course No.	0420316	**رقم المقرر**
No. of Credits	4	**عدد الوحدات**
Theoretical Hours	3	**عدد الساعات النظرية**
Practical Hours	3	**عدد الساعات المحلية**

Course topics **مواضيع المقرر**

1. Quantum theory
2. Wavefunctions and operators
3. Particles motions
4. Atomic Structure and Spectra
5. Molecular Spectroscopy
6. Magnetic resonance

Text book: (Name, Author , Year , Publisher) **عنوان الكتاب : (الاسم ، المؤلف ، سنة الطبع ، دار النشر)**

Peter Atkins, Physical Chemistry, Oxford University Press, Oxford, Latest Edition.

References: (Name , Author , Year . Publisher) **عنوان المرجع : (الاسم ، المؤلف ، سنة الطبع ، دار النشر)**

1. Physical Chemistry by R.A. Alberty and R. J. Silbey, latest edition, J. Wiley & Sons., Chichester, Latest Edition.
2. Physical Chemistry by I. N. Levine, latest edition, McGraw-Hill, New York, Latest Edition.
3. Experiments in Physical Chemistry by D. P. Shoemaker, C. W. Garland and J. W. Nibler, latest edition, McGraw-Hill, London, Latest Edition.

Prerequisites					متطلبات المقرر	
Grading	Exams	30	%		الاختبارات	آلية رصد المقرر
	Quizzes	5	%		امتحانات قصيرة	
	Lab	25	%		واجبات	
	Final	40	%		الاختبار النهائي	
	100%					

Chapters included:

Chapter	Topic	page
CH.1	Quantum theory	237-244
CH.2	Wavefunctions and operators	246-250, 241-259
CH.3	Particles motions	261-288
CH.4	Atomic Structure and Spectra	303-336
CH.5	Molecular Spectroscopy	417-473
CH.6	Magnetic resonance	487-522

Course objectives					
No.	Course Objectives (Learning Outcomes)	Example(s) of relevant (Topics and activities)	Recommended Level to satisfy the objectives		
			High	Medium	Low
1	To convey the basic concepts and methods of quantum mechanics that describe the discrete energies and statistical behaviour of microscopic systems.	• Relate the frequency, wavelength, and speed of light. • Describe blackbody radiation, molar heat capacities, atomic and molecular spectra, photoelectric effect and the diffraction of electrons and discuss how these paradoxes of classical physics was resolved by quantum mechanics. • Use the law of conservation of energy, relate the work function of a metal to the wavelength of	x		

		light used to eject electrons in the photoelectric effect and kinetic energy of these electrons. • Discuss the de Broglie relation and use it to calculate the wavelengths associated with particles in motion. • Use the Schrödinger equation to obtain dynamical information about the system. • Understand the Born interpretation of wavefunction, probability density, probability amplitude and normalization constant. • Identify the information in a wavefunction. • State the Heisenberg uncertainty principle and use it to establish bounds within which the position and momentum of a particle can be known. • Understand wavefunction of free particle.			
2	To account for angular momentum theory for orbitals and electrons and describe both coupled and uncoupled representation - account for the Born-Oppenheimer.	• Determine the energy levels for a particle in a box (one, two and three dimensions). • Relate the moments of inertia, bond length, and vibrational force constant of diatomic molecule. • To their rotational and vibrational spectra. • Determine the rotational and vibrational energy levels. • Discuss the Boltzmann distribution of population among possible molecular quantum states. • Understand the Franck-Condon principle. • Describe the preparation of excited electronic states by absorption of radiation and	**x**		

		subsequent flow of energy (Florescence, Phosphorescence, and Dissociation). • Use photoelectron spectroscopy to determine the binding energies for atoms (UPS and XPS).			
3	To account for approximation methods such as variational theory and perturbation theory and explain qualitative differences between them.	• Understand electric dipole moments and polarizability. • Appreciate the relation of the dipole moment to molecular structure. • Explains magnetic properties of molecules. • Discusses temperature dependence of dia- and paramagnetism.	**x**		
4	To discuss energy states of molecules and explain interaction of radiation with molecules (Molecular Spectroscopy).	• Understand the origin of spectral lines in molecular spectroscopy (absorption, emission and scattering of a photon) when the energy of a molecule changes.	**x**		
5	To explain electric and magnetic properties of molecules.	• Explain the electric and magnetic properties of nuclei.	**x**		
6	To outline the principles of magnetic resonance.	• Outline the principles of NMR and ESR.	**x**		
7	To demonstrate experimentally the topics covered in this course.	• Use UV spectroscopy to estimate hydrogen bond energy. • Determine rotational spectrum of CO and rotational-vibrational spectrum of HCl. • Study hydrogen emission spectrum. • Record and interpret the absorption spectrum of a conjugate dye. • Use photoelectron spectroscopy.	**x**		

		• Measure dipole moment from magnetic susceptibility. • Record and interpret spectrum from NMR and ESR. • Study electronic absorption spectrum of molecular iodine. • Record and interpret the vibrational spectrum of CCl4 using Raman spectroscopy. • Measure polarizability and refractive index. • Calculate conformation energy of cyclohexane and its derivative using molecular modeling.			
Fields	Physical Chemistry				
Skills					
Coordinator (Name and Rank) :		Physical Chemistry Coordinator			
Signature and stamp :					
Date:		**10/11/2025**			