University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSCPHY202**				
Course Title	**SOLID STATE PHYSICS & SPECTROSCOPY**				
Type of Course	**DSC**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	1. Students should know the atom model 2. Students should be aware of different types of materials				
Course Summary	This course aims to provide the basic concepts of solid state physics and spectroscopy and make the students aware of some of the applications of spectroscopy.				

BOOKS FOR STUDY:

1. Modern Physics: R.Murugesan, S.Chand & Co.
2. University Physics Vol.3, OpenStax

BOOKS FOR REFERENCE:

1. Fundamentals of Molecular Spectroscopy: Banwell, TMH
2. Molecular Spectroscopy: G.Aruldhas, PHI, 2004

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Solid State Physics (Book 1 : Sections 7.15, 7.16, 7.17, 7.18)**	**7**	
	1	Types of crystals, crystal lattice and translation vectors, basis, unit cell, primitive lattice cell	2	1
	2	Elements of symmetry, two dimensional lattice types	2	1
	3	Bravais lattices, miller indices	3	1
II		**Band Theory of Solids (Book 2 : Section. 9.5)**	**7**	
	4	Energy bands- Valence band, Conduction band, Energy Gap	2	1
	5	Classification of solids as conductors, semiconductors and insulators based on band theory	1	1
	6	Semiconductors and doping	1	1
	7	Semiconductor devices- diodes, Transistors.	3	1
III		**Spectroscopy (Book 1 : 6.4, 6.12, 6.22, 7.11, 7.12, 7.13, 19.7, 23.2, 23.3, 23.8, 23.10, 23.11)**	**13**	
	8	Bohr atom model, bohr formulae, calculation of total energy, Bohr's interpretation of the Hydrogen spectrum. Spectral series of hydrogen atom, energy level diagram (Sections 6. 4)	4	2
	9	The vector atom model (Section 6.12)	2	2
	10	Optical spectra- spectral terms and notations, selection rules (Section -6.22)	1	2
	11	X-ray spectrum, Characteristic X-ray Spectrum, Moseley's law (Sections- 7.11, 7.12, 7.13)	2	2
	12	Molecular spectra- Nature, Different modes, Theory of the Origin of Pure Rotational Spectrum of a Molecule (Sections 19.7, 23.2, 23.3, 23.8)	2	2
	13	Energy of a diatomic molecule, Vibrating Diatomic Molecule as a Harmonic Oscillator (Sections 23.10, 23.11)	2	2

IV	**Spectroscopic Techniques (Book 1 : 24.2, 24.3, 24.4, 24.5, 24.6, 24.9, 24.10, 24.11, 24.12, 24.13)**		**9**	
	14	EM Spectrum- UV, Visible, IR, Radio and microwave regions	1	2
	15	Spectroscopy of the visible region- Constant Deviation Spectrograph, Recording the spectrum, Enhancement of Spectra: Computer Averaging	2	2
	16	Ultraviolet spectroscopy - Introduction, Quartz Spectrograph for Near U.V.Region	2	2
	17	IR Spectroscopy- prism - mirror, grating spectrometer	2	2
	18	Absorption spectroscopy, Block diagram of absorption spectrometer	2	2
V*	**Laser (19.1,19.2, 19.3, 19.4, 19.5- Book 1)**		**9**	
	20	Induced Absorption, Spontaneous Emission and Stimulated Emission, principle of laser, population inversion, pumping	3	3
	21	Types of Laser- Ruby laser, He-Ne laser, Semiconductor laser	4	3
	22	Application- Holography	2	3

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Study the forward characteristics of a PN junction diode.	4
2	Photo diode characteristics: To study the output characteristics of a photo diode	4
3	Half wave rectifier-Measurement of ripple factor with and without filter capacitor	4
4	Full wave rectifier- Measurement of ripple factor with and without filter capacitor	4
5	Study the V-I characteristics of Light Emitting Diode	4

6	Zener diode as a voltage regulator-To construct a voltage regulator using Zener diode and to study the output voltage variation (i) for different RL and (ii) for different input voltage with same RL.	4
7	Bridge rectifier-To construct a bridge rectifier using junction diodes and to calculate the ripple factor with and without shunt filter (10 readings for RL 100 to 5000).	4
Part B* – At least One Experiment to be performed		
8	To determine the Planck's constant using LEDs of at least 4 different colours	4
9	Bridge rectifier- Dual power supply-To construct a dual power supply using bridge rectifier and measure the output voltages for different pair of identical load resistors.	4
10	Transistor characteristics-CE-To draw the input and output characteristic curves of a transistor in the CE configuration	4

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Analyse the types of crystals, elements of symmetry, Bravais lattices, and Miller indices of crystalline materials, and examine the band structure of solids to interpret the properties and operation of semiconductors and semiconductor devices	An	PSO – 1, 2
CO-2	Develop practical solutions by utilising the fundamental principles of atomic models, optical spectra, X-ray spectra, molecular spectra, and different spectroscopic techniques.	C	PSO – 1, 7
CO-3	Apply the basic principles of lasers to demonstrate their use in various practical applications.	Ap	PSO – 1, 2
CO-4	Inculcate experimental skills and to interpret experimental data through laboratory experiments	Ap	PSO - 1,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SOLID STATE PHYSICS & SPECTROSCOPY

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Analyse the types of crystals, elements of symmetry, Bravais lattices, and Miller indices of crystalline materials, and examine the band structure of solids to interpret the properties and operation of semiconductors and semiconductor devices	PO-1,6 PSO-1, 2	An	F, C	L	-
CO-2	Develop practical solutions by utilising the fundamental principles of atomic models, optical spectra, X-ray spectra, molecular spectra, and different spectroscopic techniques.	PO-1,6 PSO-1	C	F, C	L	-
CO-3	Apply the basic principles of lasers to demonstrate their use in various practical applications.	PO-1,2,6 PSO-1, 2	Ap	F, C	L	-

CO-4	Inculcate experimental skills and to interpret experimental data through laboratory experiments	PO-1,2, PSO-1,7	Ap	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO-1	2	2	-	-	-	-	-	1	-	-	-	-	2	-	-
CO-2	2	-	-	-	-	-	2	1	-	-	-	-	2	-	-
CO-3	2	1	-	-	-	-	1	1	2	-	-	-	2	-	-
CO-4	2	-	-	-	-	-	2	1	2	-	-	-	2	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	-
CO-4	✓	-	-	✓