KU3DSCPHY211: Elementary Solid State Physics and Spectroscopy

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC	200	KU3DSCPHY211	4	75

Learning Approach (Hours/ Week)		Marks Distribution			Duration of ESE (Hours)
Lecture+ Tutorial	Practical	CE	ESE	Total	
3	2	35	65	100	2

Course Description:

This course provides a detailed examination of the structure and properties of solids, including crystal geometry, unit cells, and lattice structures. Students learn about the band theory of solids, focusing on electrical conduction and the classification of materials based on their energy band structures. The course also covers topics in microwave and infrared spectroscopy, exploring molecular rotation, vibrational spectra, and their applications in determining molecular properties and isotopic abundances.

Course Prerequisite: Higher secondary level Physics

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand fundamental terms of crystallography	U
2	Understand various crystal systems and crystallographic planes, miller indices	U
3	Analyse the basics of electrical conductivity in solids	An

4	Analyse the energy band structure of solids	An
5	Understand the microwave spectrum of rigid diatomic molecules and the infrared spectrum of harmonic and anharmonic systems	U

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	3	2	2	1	1	2	1
CO 2	3	3	1	1	1	2	2
CO 3	1	1	3	2	1	2	1
CO 4	2	1	3	2	2	2	1
CO 5	1	1	2	2	3	2	1

Correlation level 0-None, 1-Slight, 2-Medium, 3-High

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION	HOURS
1	**Structure Of Solids**		**12**
	1	Introduction, Classification of solids, Periodicity in crystals, Crystal structure,	3
	2	Geometry of a space lattice, Unit cell, Bravais lattices, Crystal systems, Crystal symmetry, Unit cell characteristics	3
	3	Three cubic lattices, Atom positions in cubic unit cell, Directions in cubic unit cell,	3
	4	Crystallographic planes and miller indices, Interplanar distance in a cubic crystal.	3
		Book 1: Sections 16.1 - 16.11 and 16.16 - 16.19.	

2	**Band Theory of Solids**		**11**
	1	Introduction, Electrical conduction, Conductivity, Drift velocity, Influence of external factors on conductivity	3
	2	Band theory of solids, Energy bands, Energy gap,	3
	3	Classification of solids,	2
	4	Energy band structure of a conductor, Energy band structure of an insulator, Energy band structure of a semiconductor.	3
	5	**Book 1: Sections 17.1 - 17.9 and 17.13 - 17.15**	
3	**Microwave Spectroscopy**		**11**
	1	The rotation of molecules, Rotational spectra	3
	2	The rigid diatomic molecule, Determination of bond length	2
	3	The intensities of spectral lines,	3
	4	The effect of isotopic substitution, , Determination of abundance of isotopes.	3
		Book 2: Sections 19.1 - 19.7	
4	**Infrared Spectroscopy**		**11**
	1	The energy of a diatomic molecule,	3
	2	Vibrating diatomic molecule as a harmonic oscillator, The anharmonic oscillator,	3
	3	The diatomic vibrating rotator,	2
	4	The vibration rotation spectra of carbon monoxide.	3
		Book 2: Sections 20.1 - 20.5	
5	**Practical Module**		**30**
	*Directions: **At least 5** experiments from the following + 2 Activities (can be selected from the list or can be designed by the course faculty.)*		
	1. Searle's Vibration magnetometer- moment and m_1/m_2 2. Zener diode voltage regulator (V_z given) 3. Melde's string - Frequency of a tuning fork. 4. Potentiometer- Calibration of ammeter 5. Full wave Rectifier- study of ripple factor with and without filter 6. Spectrometer dispersive power of a prism 7. Newton's Ring (Radius of Curvature) given- Wavelength of Sodium light 8. Voltage multiplier 9. Simulations		

Essential Readings:

1. A textbook of Engineering Physics by M N Avadhanulu and P G Kshirsagar, S Chand & Company Ltd., 9th revised edition, 2014.
2. Optics and Spectroscopy by R Murugeshan and Kiruthiga Sivaprasath, S Chand & Company Ltd., revised edition, 2010.

Suggested Readings:

1. Solid State Physics by S O Pillai, New Age International Publishers, 8th edition.
2. Solid State Physics by A J Dekker, Macmillan Publishers Ltd.
3. Modern Physics by R Murugeshan and Kiruthiga Sivaprasath, S Chand & Company Ltd., 18th edition.
4. Solid State Physics and Electronics by R K Puri and V K Babbar, S Chand & Company Ltd.,
5. Fundamentals of Molecular Spectroscopy by Colin N Banwell and Elaine M Mc Cash, McGraw-Hill Publishing Company, 5th edition.
6. Molecular Structure and Spectroscopy by G Aruldhas, PHI Learning Private Limited, 2nd edition.

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Lecture			**75**	**Practical**			**25**	**100**
a)	**ESE**		**50**	a)	**ESE**		**15**	
b)	**CCA**		**25**	b)	**CCA**		**10**	
	i	*Test Paper	10		i	Punctuality	3	
	ii	**Assignment/ Book-Article review	10		ii	Skill	4	
	iii	Seminar/ Viva-Voce	5		iii	Record	3	

*Best out of two test papers

** or any other activities like quiz, open book exam, group activity