# SEMESTER 3



# University of Kerala

Discipline	CHEMISTRY						
Course Code	UK3DSCCHE200						
Course Title	PHYSICAL CH	PHYSICAL CHEMISTRY I					
Type of Course	DSC						
Semester	3						
Academic Level	200 - 299						
Course Details	Credit	Lecture	Tutorial	Practical	Total		
		per week	per week	per week	Hours/Week		
	4	3 hours	-	2 hours	5		
Pre-requisites	1. Higher se	condary leve	l science kno	wledge			
	2. Basic und	erstanding of	f calculus is p	preferred.			
Course Summary	This physical che	emistry cours	se covers a bi	road range of	topics including		
	solid state, liqui	d state, gase	eous state, d	ilute solution	s, and colloids,		
	providing student	ts with a com	prehensive u	nderstanding	of the properties		
	and behaviours of	of matter at v	various states	and concentration	rations. Through		
	theoretical princi	ples and pra	ictical experi	ments, studer	nts gain insights		
	these topics and to apply their knowledge to solve real-world problems.						
		XX					
etailed Syllabus:	A	C'Y					

# **Detailed Syllabus:**

Module	Unit	Content	Hrs
mouure	Cint	PHYSICAL CHEMISTRY I	75
Ι	SOLI	ID STATE	9
	1	Amorphous and Crystalline solids. Isotropy and anisotropy, size and shape of crystal, Interfacial angle, types of crystals: molecular crystals, ionic crystals, covalent crystals and metallic crystals- examples and properties.	2
X	2	Symmetry of crystals- plane of symmetry, axis of symmetry, centre of symmetry (definitions and basic idea only), Seven basic crystal systems, Space lattice and unit cell, Bravais lattices, (unit cell parameters and examples of 14 Bravis lattices), close packing structures of cubic and orthorhombic space lattices.	2
	3	Law of constancy of interfacial angles, Laws of rational indices, Miller indices, Representation of lattice planes of cubic crystals, interplanar spacing in crystals, Determination of Avogadro number from crystallographic data	2
	4	X-ray diffraction studies of crystals, Bragg's equation – derivation and applications, Rotating crystal and powder method. Structure of NaCl and CsCl, Imperfections in crystals. Stoichiometric and	2

IV	DILU	TE SOLUTIONS AND COLLOIDS	18		
		equation of state and virial coefficients. (no derivations).			
		Boyle temperature in terms of van der waal's constant. Virial			
		Experimental determination critical constants, Boyle temperature,			
		constants and van der Waals constants, Correction factors,			
		PV isotherm of Carbon dioxide, critical state, relation between critical			
	13	Law of corresponding states, liquefaction of gas, inversion temperature	2		
	7	pressures and at high temperature.			
		explaining real gas behaviour. Vander Waal's equation at low and high			
	12	Vander Waals equation of state, its derivation and application in	1		
		N <sub>2</sub> at several temperatures.			
		and the real gases $H_2$ , He, NH <sub>3</sub> , CO and methane at 0°C, Z-P plots of			
		gases, Causes of deviation from ideal behaviour. Z-P plots of ideal gas			
		compressibility factor, Z, and its variation with pressure for different			
	11	Behaviour of real gases: Deviations from ideal gas behaviour,	2		
		energy, law of equipartitions of energy and degrees of freedom.			
		(average, root mean square and most probable) and average kinetic			
	10	Maxwell distribution and its use in evaluating molecular velocities	2		
		viscosity; variation of viscosity with temperature and pressure.			
		dependence, relation between mean free path and coefficient of			
		viscosity of gases, including their temperature and pressure			
		equation: collision frequency: collision diameter: mean free path and			
		Postulates of Kinetic theory of Gases and derivation of the kinetic gas			
		expression			
		Dalton' Law of Partial pressure- Definition and mathematical			
	9	$(\mathbf{I}\mathbf{K}^{-1}\mathbf{mol}^{-1}\mathbf{I})$ at $\mathbf{K}^{-1}\mathbf{mol}^{-1}$ cal $\mathbf{K}^{-1}\mathbf{mol}^{-1}$	2		
111	GAS	LUUD DIAIE	<b>ソ</b> つ		
	CASI	Shaped nquid crystais, Polymer nquid crystais, uses of nquid crystais	0		
		-smectic, nematic and cholesteric liquid crystals- examples; Disc			
	8	Liquid crystals- introduction, characterization of liquid crystals, Types	3		
		Refractive index determination by Abbe refractometer			
	viscometer				
	Viscosity- Poiseuilles equation, Determination of viscosity- Ostwald's				
	method Viscosity Boisovilles equation Determination of viscosity Octivald's				
	7 Determination of Surface tension- capillary rise and stalagmometer				
		active agent, Explanation of cleansing action of detergents.			
		affecting surface tension and viscosity, Interfacial tension, Surface $\chi$	Ŝ		
		viscosity, and Refractive Index and their determination. Factors			
	6	Physical properties of liquids; vapour pressure, surface tension,	3		
II	LIQU	JID STATE	9		
	_	Glasses	_		
	5	Energy band theory of Conductor, Semiconductors and insulators.	1		
		defects. F-centre			
		Nonstoichiometric defects, point defects – Schottky and Frenkel			

	14	Dilute solutions: Binary solutions, Concentration- Molarity, Molality,	2					
		Normality and Mole fraction. (numerical problems)						
	15	Raoult's Law for solutions of non-volatile solutes, vapour pressure of	1					
		ideal solutions and relative lowering of vapour pressure.						
	16	Colligative properties- lowering of vapour pressure; elevation of	4					
		boiling point and depression in freezing point; molal elevation						
		constant, molal depression constant, Thermodynamic derivation of $\Delta T$ ;						
		Osmosis and Osmotic pressure, van't Hoff equation; Isotonic,	C					
		hypertonic and hypotonic solutions, Abnormal molecular mass and	$\langle \cdot \rangle$					
		van't Hoff factor, Determination of degree of dissociation and						
		association, Reverse osmosis (numerical problems).						
	17	Experimental determination of molecular mass of solutes by cooling	2					
	curve method, Rast's and Beckmann methods							
	18	<b>Colloids:</b> Classification of colloids – Preparation of colloids	2					
	19	Purification of colloids – dialysis, electrodialysis, hot dialysis, ultra	2					
		filtration ultra centrifugation						
	20	Kinetic, optical and electrical properties of colloids – Tyndall effect &	3					
		applications - Ultra microscope, Electrical double layer and zeta						
	potential - Coagulation of colloids, Hardy-Schulz rule, Gold number,							
		sedimentation and streaming potential						
	21	Gels: Elastic and non-elastic gels, Imbibition and syneresis, Micelles						
		and critical micelle concentration						
	22	Application of colloids – Cottrell precipitator, purification of water and 1						
	DD 4	delta formation.						
V	PRA	delta formation. CTICALS: PHYSICAL CHEMISTRY PRACTICALS	30					
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26	D. Viscosity:	4
	7. Determination of viscosity of any three liquids	
	8. Viscosity of binary mixtures and determination of	
	concentration of an unknown mixture	
27	E. Refractive index experiments:	4
	9. Determination of refractive indices of any three liquids	
	10. Refractive indices of KCl solutions of different concentrations	
	and determination of concentration of unknown KCl solution	
28	F. Solid state:	S
	11. Indexing powder XRD patterns and determination of unit cell	$\searrow$
	parameters of simple and/or bcc and/or fcc systems (Instructors	
	must provide the powder XRD patterns and ask students to	
	index it and calculate unit cell parameters)	

# **References:**

# Textbooks

- 1. P W Atkins, "Physical Chemistry", Oxford University Press
- 2. R L Madan, *Physical Chemistry*, Mc Graw Hill
- 3. Glasstone and Lewis, *Elements of Physical Chemistry*, Macmillan
- 4. Puri, Sharma & Pathania, Principles of Physical Chemistry, Vishal Publishing Co
- 5. P. C. Rakhit, Physical Chemistry, Sarat Book House, Calcutta
- 6. J. B. Yadav Advanced Practical Physical Chemistry, Krishna Prakashan Media (P) Ltd For Further Reading
- 1. R J Selby and RA Alberty, Physical Chemistry, John Wiley &sons
- 2. Levin, *Physical Chemistry*, 5th edn, TMH.
- 3. Gurdeep Raj, Advanced Physical Chemistry, Goel publishing house
- 4. G W Castellan, "Physical Chemistry", Narosa Publishing House
- 5. B. Viswanathan, P. S. Raghavan, A Practical Physical Chemistry, Viva Books.

# **Course Outcomes**

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Gain a clear understanding of the structure and behaviour of solids to equip for its applications in materials science, electronics, and engineering.	R, U, Ap	PSO -1,2,3
CO-2	Possess a comprehensive understanding of the physical properties of liquids and liquid crystals	R, U	PSO -1,2,3
CO-3	Gain insight into the behaviour and applications of liquid crystals, leading to their utilization in various	U, Ap, An	PSO - 1,2,3,4

	technologies such as displays, sensors, and optical devices.		
CO-4	Understand the behaviour of gases, ranging from the ideal gas equation to the complexities of real gases	R, U	PSO -1,2,3
CO-5	Gain the idea of the principles governing dilute solutions, including concentration units such as molarity, molality, normality, and mole fraction and apply in analytical measurements.	U, Ap	PSO -1,2,3
CO-6	Gain insights into phenomena like coagulation, gels, and micelles, to address complex challenges in related fields.	U, Ap	PSO - 1,2,3,4
CO-7	Hands-on experience in conducting experiments related to the physical properties of solutions and solids	U, Ap, An	PSO - 1,2,3,5

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

# Name of the Course: PHYSICAL CHEMISTY I

Credits: 3:0:1 (Lecture: Tutorial: Prac
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CO No.	СО	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO -1,2,3	R, U, Ap	F, C	L	-
2	CO-2	PO-1,6 PSO -1,2,3	R, U	F, C	L	-
3	CO-3	PO-1,6 PSO -1,2,3,4	U, Ap, An	F, C, M	L	-
4	CO-4	PO-1,6 PSO -1,2,3	R, U	F, C	L	-
5	CO-5	PO-1,6 PSO -1,2,3	U, Ap	F, C, M	L	-
6	CO-6	PO-1,6 PSO -1,2,3,4	U, Ap	F, C, M	L	-
7	CO-7	PO-1,2,6 PSO -1,2,3,5	U, Ap, An	F, C, P	-	Р

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

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	3	3	-	-	1	-	-	-	-	2	- 0	-
CO 2	3	3	3	-	-	1	-	-	-	-	2	-	2 -
CO 3	3	2	3	2	-	1	-	-	-	-	2		-
<b>CO 4</b>	3	3	3	-	-	1	-	-	-	-	2	<b>Y</b> -	-
CO 5	3	2	2	-	-	1	-	-	-		2	-	-
<b>CO 6</b>	3	2	2	2	-	1	-	-	-	-	2	-	-
CO 7	1	2	3	-	2	1	2	-	-	S	3	-	_

# Mapping of COs with PSOs and POs:

**Correlation Levels:** 

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

### **Assessment Rubrics:**

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

# Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	$\checkmark$	$\checkmark$		$\checkmark$
CO 2	$\checkmark$	$\checkmark$		$\checkmark$
CO 3	$\checkmark$		$\checkmark$	$\checkmark$
CO 4	$\checkmark$	$\checkmark$		$\checkmark$
CO 5	$\checkmark$		$\checkmark$	$\checkmark$
CO 6	$\checkmark$	$\checkmark$		$\checkmark$
CO 7	$\checkmark$			$\checkmark$