University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK2DSCPHY102**				
Course Title	**OPTICS AND THERMODYNAMICS**				
Type of Course	**DSC**				
Semester	**II**				
Academic Level	**100 - 199**				
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 fundamentals of ray optics such as reflection, refraction and total internal reflection. 2. Students should be aware of wavefront, Huygen's Principle and coherent sources. 3. Students should be familiar with Thermal equilibrium, Zeroth law and first law of thermodynamics 4. Students should know the basics mathematics of permutations, combinations, logarithm, and Sterling's approximation				
Course Summary	1. Introduces theory of different optical phenomena. 2. Aims to provide the basic concepts of thermodynamics, the first and the second law of thermodynamics, heat engine, entropy, and the change in entropy during reversible and irreversible processes. 3. Gain the basic knowledge about the fundamentals of Statistcal Mechanics. 4. Provides a platform to observe and analyse different optical phenomena through practical sessions.				

BOOKS FOR STUDY:

1. Optics, Dr. N Subrahmanyam Brijlal, Dr M N Avadhanulu, S Chand and Company Ltd (2020).
2. Heat and Thermodynamics and Statistical Mechanics: Brijlal , Subramaniam, P S Hemne, S. Chand &Co (2021).

BOOKS FOR REFERENCE:

1. Optics, Ajoy Ghatak, McGraw Hill, New Delhi (2020).
2. Heat and Thermodynamics: M. Zemansky, McGraw Hill, New Delhi (2007).
3. Physics, Principles with Applications, Douglas C. Giancoli, Pearson Education Limited, 7th Edition (2016).
4. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan, S Rai Choudhury, McGraw Hill Education (India) Private Limited (2017).
5. Sear and Zemansky's University Physics With Modern Physics, Hugh D Young, Roger A Freedman, Addison -Wesley, 13TH EDITION, 2012.
6. Heat and Thermodynamics: D. S. Mathur, S. Chand & Sons, New Delhi (1995)
7. College Physics 2e, Paul Peter Urone, Roger Hinrichs, Openstax, 2022.
8. Principles Of Physics 10th Edition, Robert Resnick Jearl Walker, David Halliday, Wiley, 2014.
9. Statistical Mechanics, Sathyaprakash, Kedar Nath Ram Nath, Delhi, Edn (2021).
10. Thermal and Statistical Mechanics: S. K. Roy, New Age International- 2001

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**GEOMETRIC OPTICS (Book 1)**	**7**	
	1	Light – Electromagnetic theory and Quantum theory, Dual nature	1	2
	2	Reflection – Laws, Refraction – Laws	2	1
	3	Refractive index, optical path,	1	2
	4	Dispersion	1	2
	5	Fermat's principle, Rectilinear propagation of light	2	1,2

II	**WAVE OPTICS (Book 1)**		**15**	
	6	Interference - Principle of superposition.	2	1
	7	Young's double slit experiment, bright and dark fringes, fringe width	2	2
	8	Interference in thin films – due to reflected light, Colours in thin films, Applications.	2	2
	9	Newtons rings	2	2
	10	Diffraction - Fresnel and Fraunhofer Diffraction	1	2
	11	Diffraction from a Single slit, Double slit (Qualitative), Plane transmission grating (Qualitative).	3	2
	12	Polarisation – polarised and unpolarised light	1	2
	13	Types of Polarisations	2	2
III	**THERMODYNAMICS (Book 2)**		**9**	
	14	Thermodynamic Systems, Thermodynamic Equilibrium, Work done during volume changes, Internal energy and first law of Thermodynamics	2	1,3
	15	Thermodynamic processes –Quasistatic, Isothermal, Adiabatic, reversible, and irreversible, Cyclic process, Isobaric and Isochoric (Basic ideas)	3	3
	16	Carnot's Ideal Heat engine	2	3
	17	Second law of thermodynamics – Clausius and Kelvin - Planck statements, Refrigerator	2	1,3
IV	**ENTROPY (Book 2)**		**5**	
	18	Change of entropy – Reversible process, irreversible processes and physical concept	2	3
	19	T -S diagram	2	3
	20	Principle of increase of entropy - Heat Death of universe	1	3
V*	**STATISTICAL MECHANICS (Book 2)**		**9**	
	21	Statistical Basis – Probability, Principle of equal A priory	1	1,4

	22	Macrostates and Microstates, Phase space	2	4
	23	Statistical Ensembles – Microcanonical, Canonical, Grand Canonical	2	4
	24	Maxwell - Boltzmann statistics - Energy distribution – Derivation	2	4
	25	Need of Quantum statistics, Maxwell - Boltzmann statistics, Bose - Einstein statistics, Fermi - Dirac statistics – Comparative study only	2	4

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Liquid Lens – optical constants of given lens	5
2	Liquid lens – Refractive Index of given liquid	5
3	Spectrometer – A, D and n of a solid prism	5
4	Spectrometer – Dispersive power and Cauchy's constants	5
5	Spectrometer – Grating normal Incidence	5
6	Spectrometer – Hollow Prism Refractive Index of given liquid	5
7	Spectrometer – i-d Curve	5
8	Newton's Rings – Reflected system	5
9	To determine angular spread of He-Ne laser using plane diffraction grating	5
Part B* – At least One Experiment to be performed		
10	Air wedge – Diameter of a wire	5
11	To determine the wavelength of a laser source using diffraction of a single slit	5
12	To determine the wavelength of a laser source using diffraction of double slits	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the fundamental laws of Optics, Thermodynamics and Statistical Mechanics.	U	PSO – 1,2
CO-2	Illustrate the basic principles and describe the applications of geometric optics, wave optics, and polarization	U, Ap	PSO –1,2
CO-3	Identify the basic concepts in thermodynamics and entropy, enabling them to evaluate physical processes and systems governed by these principles.	U, Ap, E	PSO – 1,2
CO-4	Define phase space, microstate, macrostate, ensemble and describe different statistical distributions	U, Ap	PSO – 1,2
CO-5	Inculcate experimental skills and apply optical principles to analyse and interpret experimental data through laboratory experiments	U, Ap, An	PSO – 1,2,7

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

Name of the Course: OPTICS AND THERMODYNAMICS

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

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explain the fundamental laws of Optics, Thermodynamics and Statistical Mechanics.	PO 1,2,3,4,5,6,7 ,8 / PSO – 1,2	U	F, C	L	-
CO-2	Illustrate the basic principles and describe the applications of geometric optics, wave optics, and polarization	PO 1,2,3,4,5,6,7 ,8/ PSO – 1,2	U, Ap	F, C	L	-

CO-3	Identify the basic concepts in thermodynamics and entropy, enabling them to evaluate physical processes and systems governed by these principles.	PO 1,2,3,4,5,6,7 ,8/ PSO – 1, 2	U, Ap, E	F, C	L	-
CO-4	Define phase space, microstate, macrostate, ensemble and describe different statistical distributions	PO 1,2,3,4,5,6,7 ,8/ PSO – 1, 2	U, Ap	F, C	L	-
CO-5	Inculcate experimental skills and apply optical principles to analyse and interpret experimental data through laboratory experiments	PO 1,2,3,4,5,6,7 ,8 /PSO – 1,2,7	U, Ap, An	C, P	-	P

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

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	3	-	-	-	-	-	3	3	1	2	-	1	-	1
CO-2	3	3	-	-	-	-	-	3	3	2	2	1	2	-	1
CO-3	3	3	-	-	-	-	-	3	2	2	1	1	2	-	1
CO-4	3	3	-	-	-	-	-	2	1	2	1	1	1	-	1
CO-5	3	3	-	-	-	-	3	3	3	3	2	2	3	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	✓	-	-	-
CO-5	-	-	✓	-