

UNIVERSITY OF MADRAS
B.Sc. DEGREE PROGRAMME IN PHYSICS
 SYLLABUS WITH EFFECT FROM 2023-2024

COURSE	SECOND SEMESTER – CORE THEORY 2		
COURSE TITLE	HEAT, THERMODYNAMICS and STATISTICAL PHYSICS		
CREDITS	4	Course Code	137C2A
COURSE OBJECTIVES	The course focuses to understand a basic in conversion of temperature in Celsius, Kelvin and Fahrenheit scales. Practical exhibition and explanation of transmission of heat in good and bad conductor. Relate the laws of thermodynamics, entropy in everyday life and explore the knowledge of statistical mechanics and its relation		
UNITS	COURSE DETAILS		
UNIT-I	<p>CALORIMETRY: specific heat capacity – specific heat capacity of gases C_p and C_v – Meyer’s relation – Joly’s method for determination of C_v – Regnault’s method for determination of C_p</p> <p>LOW TEMPERATURE PHYSICS: Joule-Kelvin effect – porous plug experiment – Joule-Thomson effect – Boyle temperature – temperature of inversion – liquefaction of gas by Linde’s Process – adiabatic demagnetisation.</p>		
UNIT-II	<p>THERMODYNAMICS-I: zeroth law and first law of thermodynamics – P-V diagram – heat engine – efficiency of heat engine – Carnot’s engine, construction, working and efficiency of petrol engine and diesel engines – comparison of engines.</p>		
UNIT-III	<p>THERMODYNAMICS-II: second law of thermodynamics – entropy of an ideal gas – entropy change in reversible and irreversible processes – T-S diagram – thermodynamical scale of temperature – Maxwell’s thermodynamical relations – Clausius-Clapeyron’s equation (first latent heat equation) – third law of thermodynamics – unattainability of absolute zero – heat death.</p>		
UNIT-IV	<p>HEAT TRANSFER: modes of heat transfer: conduction, convection and radiation.</p> <p><i>Conduction:</i> thermal conductivity – determination of thermal conductivity of a good conductor by Forbe’s method – determination of thermal conductivity of a bad conductor by Lee’s disc method.</p> <p><i>Radiation:</i> black body radiation (Ferry’s method) – distribution of</p>		

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	energy in black body radiation – Wien’s law and Rayleigh Jean’s law –Planck’s law of radiation – Stefan’s law – deduction of Newton’s law of cooling from Stefan’s law.
UNIT-V	STATISTICALMECHANICS: definition of phase-space – micro and macro states – ensembles –different types of ensembles – classical and quantum Statistics – Maxwell-Boltzmann statistics – expression for distribution function – Bose-Einstein statistics – expression for distribution function – Fermi-Dirac statistics – expression for distribution function – comparison of three statistics.
UNIT-VI	PROFESSIONAL COMPONENTS: expert lectures –seminars — webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	<ol style="list-style-type: none"> 1. BrijlalandN. Subramaniam, 2000, Heat and Thermodynamics, S.Chandand Co. 2. NarayanamoorthyandKrishnaRao, 1969,Heat,Triveni Publishers, Chennai. 3. V.R.KhannaandR.S.Bedi, 1998 1st Edition, Text book of Sound, Kedharnaath Publish and Co, Meerut 4. Brijlal and N. Subramanyam, 2001, Waves and Oscillations,Vikas Publishing House, New Delhi. 5. Ghosh, 1996, Text Book of Sound, S.ChandandCo. 6. R.MurugeshanandKiruthigaSivaprasath, Thermal Physics, S.Chandand Co.
REFERENCE BOOKS	<ol style="list-style-type: none"> 1. J.B.Rajamand C.L.Arora, 1976, Heat and Thermodynamics, 8th edition, S.Chandand Co. Ltd. 2. D.S.Mathur, Heat and Thermodynamics, Sultan Chand and Sons. 3. Gupta, Kumar, Sharma, 2013, Statistical Mechanics, 26th Edition, S. Chand and Co. 4. Resnick, HallidayandWalker,2010, Fundamentals of Physics, 6th Edition. 5. Sears, Zemansky, Hugh D. Young,Roger A. Freedman, 2021 University Physics with Modern Physics 15th Edition, Pearson.
WEB RESOURCES	<ol style="list-style-type: none"> 1. https://youtu.be/M_5KYncYNyc 2. https://www.youtube.com/watch?v=4M72kQulGKkandvl=en 3. Lecture 1: Thermodynamics Part 1 Video Lectures Statistical Mechanics I: Statistical Mechanics of Particles Physics MIT OpenCourseWare 4. http://www.freebookcentre.net/Physics/Physics-Books-Online.html

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METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	100	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	CO1	Acquires knowledge on how to distinguish between temperature and heat. Introduce him/her to the field of thermometry and explain practical measurements of high temperature as well as low temperature physics. Student identifies the relationship between heat capacity, specific heat capacity. The study of Low temperature Physics sets the basis for the students to understand cryogenics, superconductivity, superfluidity and Condensed Matter Physics
	CO2	Derive the efficiency of Carnot's engine. Discuss the implications of the laws of Thermodynamics in diesel and petrol engines
	CO3	Able to analyze performance of thermodynamic systems viz efficiency by problems. Gets an insight into thermodynamic properties like enthalpy, entropy
	CO4	Study the process of thermal conductivity and apply it to good and bad conductors. Quantify different parameters related to heat, relate them with various physical parameters and analyse them
	CO5	Interpret classical statistics concepts such as phase space, ensemble, Maxwell-Boltzmann distribution law. Develop the statistical interpretation of Bose-Einstein and Fermi-Dirac . Apply to quantum particles such as photon and electron

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes (CO) for each course with program outcomes (PO) in the 3-point scale of STRONG (S), MEDIUM (M) and LOW (L).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	S	M	S	S	S	M	M	S	M