## **Engineering Physics** SH 102

Theory 4 Year : I I/II Tutorial Part : 1

Practical 2

Course objectives: To provide the concept and knowledge of Physics with the emphasis of

present-day application. The background of Physics corresponding to

Proficiency Certificate Level is assumed.

Chapter Syllabus Miore syllabus			
Chapter	Syllabus	Micro syllabus	
1. Oscillation (6 hrs)	1.1 Physical pendulum	(Prerequisites: Periodic motion, SHM & terminology, Simple pendulum & its time period, uses, rotational motion & I)  1.1 Differential equation of SHM & solution, description, example in daily life, definition of Compound or Physical or Rigid pendulum, derivation of differential	
	1.1.1 Bar pendulum	equation with solution, time period, equivalent length of simple pendulum, problems 1.1.1 Bar Pendulum, study between time period & length of point of suspension from CG, proof of four collinear points having same time period in a bar pendulum, uses for determination of 'g' and 'K'	
	1.1.2 Interchangeability of point of suspension and point of oscillation 1.1.3 Minimum time period in case of physical pendulum	angeability of of suspension oscillation in physical pendulum, proof of interchangeability of point of suspension and point of oscillation and point of oscillation oscillation and point of oscillation of oscillation of time period, problems	
	1.1.4Torsion pendulum  1.1.4 Description, deriv period), Uses for determinate 'I', problems		
	1.2 Damped and Forced Oscillation 1.2.1 Damped harmonic oscillator 1.2.2 Difference between free and damped oscillator 1.2.3 Energy in damped oscillation 1.2.4 Relaxation time	1.2 Concept of free, damped & forced oscillation 1.2.1 Derivation of differential equation, with solution, special cases of damping, condition for oscillation, problems 1.2.2 Differentiate with example, relation for frequency of free & damped oscillation 1.2.3 Expression of Energy in damped oscillation, Energy loss, problems 1.2.4 Definition, graphical representation,	
		Relaxation time $(\tau = \frac{2m}{b})$ , problems	

and resonance  1.2.6 Sharpness of resonance 1.2.7 Quality factor  1.2.6 Definition only, factors affecting sharpness of resonance 1.2.7 Definition, expression (no derivation), band width, problems  (Prerequisites: Sound & its propagation, various sound phenomena, characteristics of sound)  2.1 Introduction 2.1.1 Threshold of hearing and loudness 2.1.2 Reverberation and reverberation time 2.1.3 Absorption 2.1.4 Sabine's Law 2.1.5 Conditions for good acoustics 2.2 Ultrasound 2.1.1 Forduction 2.1.2 The finition, perfect absorber, average absorption coefficient 2.1.4 Sabine's Law 2.1.5 Conditions for good acoustics 2.2 Ultrasound 2.2.1 Production piezoelectric) of ultrasound and its applications 2.2.2 Test of structure and materials 2.2.3 Medical uses  3. Heat and Thermodynamics (8 hrs)  3.1 Quantity of Heat 3.1.1 Calorific value of Foods and Fluels 3.1.2 Bomb Calorimeter 3.1.3 Specific heat of solid: Dulong - Petit law, Einstein's law. 3.2 Nature of Heat 3.2.1 Degree of freedom 3.2.1 Definition only, factors affecting sharpness of resonance with mathematica pyression (no derivation), expression (no derivation), band width, problems 1.2.6 Definition only, factors affecting sharpness of resonance 1.2.7 Definition, expression (no derivation), band width, problems 2.1.1 Throduction to Acoustic phenomena cannet personal cannet propagation, various sound phenomena, characteristics of sound) 2.1 Introduction to Acoustic phenomena cannet personal cannet propagation, various sound phenomena, characteristics of sound) 2.1 Introduction to Acoustic phenomena cannet propagation, various sound phenomena, characteristics of sound) 2.1 Introduction to Acoustic phenomena cannet propagation, various sound phenomena, characteristics of sound) 2.1.1 throduction to Acoustic phenomena cannet propagation, various sound phenomena, characteristics of sound) 2.1.1 throduction to Acoustic phenomena cannet propagation, various sound phenomena, characteristics of sound) 2.1.1 throduction to Acoustic phenomena cannet propagation, various sound		1.2.5 Forced oscillation	1.2.5 Derivation of differential equation	
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atomic molecule)		3.2.1 Degree of freedom	3.2.1 Definition (for mono, di, & tri-	
			atomic molecule)	
3.2.2 Maxwell's law of 3.2.2 Maxwell's Law of equipartition of		3.2.2 Maxwell's law of	3.2.2 Maxwell's Law of equipartition of	
equipartition of Energy, problems		equipartition of	Energy, problems	
energy				

<ul> <li>3.2.3 Atomicity of gases</li> <li>3.2.4 Vander-Waal's equation of rea gases</li> <li>3.2.5 Critical constants</li> </ul>	3.2.3Atomicity of mono, di & tri-atomic Gases 3.2.4Vander-Waal's Equation of Real Gas (i) correction for pressure and (ii) correction for volume 3.2.5 Vander-Waal's critical constants $V_C = 3b,  T_C = \frac{8a}{27Rb},  P_C = \frac{a}{27b^2},$ problems
3.3 Thermodynamics 3.3.1 Laws of thermodynamics 3.3.2 Clapeyron latent heat equation 3.3.3 Entropy and Thirdlaw of thermodynamics 3.3.4 Negative energy 3.3.5 Maxwell's thermodynamic relations	thermodynamics (review only)  3.3.2 Derivation using thermo dynamical relation, applications, problems  3.3.3 Entropy with physical concept, equation of change in entropy, third law of thermodynamics statement, numerical  3.3.4 concept of negative energy  3.3.5 Internal energy change  dU = TdS - PdV  Enthalpy change  dH = TdS + VdP  Helmholtz function change  dF = - SdT - PdV  Gibb's function change  dG = - SdT + VdP  Derivation of Clapeyron's latent heat equation from Maxwell's thermodynamic relations and show that for a perfect gas
3.3.6 Gibb's free energy and phase transitions	$\left(\frac{\partial V}{T}\right)^{-1}$
3.4 Heat & mass Transfer 3.4.1 Fourier's law o thermal conductivity 3.4.2 Use of thermal conductivity in building sciences 3.4.3 Thermal resistance 3.4.4 Types of convection 3.4.5 Law of diffusion	3.4.1 Definition and Fourier's law of thermal conductivity (derivation), problems 3.4.2 Application of thermal conduction in building science

	3.4.6 Relation between Stefan's law and Newton's law of Cooling 3.4.7 Pyrheliometer and Pyrometer	$D\nabla^2 C - v \cdot \nabla C - \frac{\partial C}{\partial t} + R = 0$ (Three cases explanation also) 3.4.6 Derivation of Newton's Law of Cooling from Stefan's law of black body r 3.4.7 Pyrheliometer, Radiation Pyrometer (Construction & working principle)
4. Optics (17 hrs)	4.1 Geometrical optics	(Prerequisites: Thin Lens formula, Images in lens, Lens Maker's formula, combination of lenses in contact, chromatic aberration in a lens, achromatism, Interference, condition for constructive & destructive interference, Young's double slit expt. & fringe width, basic concept of diffraction & polarization)
	<ul><li>4.1.1 Lens separation</li><li>4.1.2 Chromatism in lens combination</li></ul>	4.1.1 Derivation of equivalent focal length of combination of two lenses separated at a distance, principal points & planes, numerical 4.1.2 Application of Chromatic aberration in a lens for derivation of condition of achromatism of two lenses separated at a distance (Calculus method only), for describing circle of least confusion & derivation of its diameter, problems
	4.2 Interference 4.2.1 Interference in thin films (reflected and transmitted light)  4.2.2 Fringes produced by a wedge-shaped thin film	4.2.1 Derivation for path difference between two consecutive light radiations in thin film due to reflected & transmitted radiations and application for interference dark and bright fringes, numerical 4.2.2. Description with figure, derivation for fringe width, numerical
	4.2.3 Newton's rings (both reflected and transmitted case)	4.2.3 Description with experimental arrangement, application of interference fringes produced by a wedge-shaped thin film, derivation for radius of dark and bright rings, numerical
	4.2.4 Determination of wavelength of light and refractive index of liquid by using Newton's rings  4.3 Diffraction	4.2.4 Application of derivation for diameter of dark and bright Newton's rings for determination of wavelength of light used & refractive index of a liquid, numerical
	4.3.1 Introduction: Fresnel and Fraunhoffer's diffraction	4.3.1 Definition, Difference between Fresnel and Fraunhoffer's diffraction

4.3.2	Fraunhoffer's	4.3.2 Explanation with figure to obtain
sl	liffraction at single lit	diffraction maxima and minima, derivation for width of central and other maxima in diffraction 4.3.3 Intensity distribution in the
ir p	•	diffraction pattern due to a single slit
4.3.4 M	Aultiple slits, iffraction grating	4.3.4 Explanation of diffraction through multiple slits (not in detail), diffraction grating, derivation for principal maxima in diffraction grating, numerical
ra	X-ray diffraction, X- ays in material esting	4.3.5 Explanation of X-ray diffraction and uses for material testing
44 Po	larization	
4.4.1 In re	troduction: double efraction, Nichol rism (construction nd uses)	4.4.1 calcite Crystal (explanation with figure), optic axis, double refraction, Nichol prism (construction and use as polarizer and analyzer)
(qı wa ell	etardation plate uarter and half ave plates), plane, liptical and circular	4.4.2 Definition, expression for thickness, plane, elliptical and circularly polarized light (theoretical and mathematical explanation), problems
(th ma ex	plarized light neoretical & athematical planation)	
sp	ptical activity, ecific rotation	4.4.3 Optically active substance & optical activity, specific rotation of optical active substance (mathematical expression only)
4.5 La		4.5.4.5.00.11
an	troduction: Laser ad ordinary light, operties of laser	4.5.1 Definition, differences between Laser and ordinary light,
4.5.2 In sp. Sti acc	duced absorption, ontaneous and imulated emission, tive medium, opulation inversion, etastable state	4.5.2 Explanation of various terminology used in Laser
4.5.3 Pu op	imping (types: otical, electrical, emical and heating)	4.5.3 Definition of pumping and its types only
4.5.4 He	e-Ne laser, miconductor Laser	4.5.4 He-Ne laser (Construction & working principle with energy diagram), semiconductor Laser (introduction only)
4.5.5 Us	ses of laser	4.5.5 Uses of laser

	46 59 0 0	T	
	4.6 Fiber Optics		
	4.6.1 Introduction:	4.6.1 Introduction, Propagation of light	
	Propagation of light	wave due to total internal reflection	
	wave		
	4.6.2 Types of optical	4.6.2 Types of optical fiber	
	fiber: step index and		
	graded index		
	4.6.3 Fiber transmission –	4.6.3 Fiber transmission, single and	
	single & multimode,	multimode, self-focusing, derivation of	
	self- focusing,	acceptance angle and numerical aperture,	
	acceptance angle and	problems	
	numerical aperture		
	4.6.4 Applications	4.6.4 Applications	
	- FF	(Prerequisites: Electric charges &	
		nature, electric field, electric potential	
5.Electrostatics		due to a point charge, capacitor and	
(9 hrs)		capacitance, parallel plate capacitor,	
(7 111 5)		factors affecting capacitance, energy	
	5.1Electric field :	stored in capacitor, dielectric )	
	5.1.1 Electric field due to	5.1.1. Definition, figure, examples,	
		, , , , , , , , , , , , , , , , , , , ,	
	electric dipole (along	mathematical expression, relation between	
	axial and equatorial line)	electric potential & field, comparison	
	5 1 2 Electric dinale in an	(along axial and equatorial line), problems	
	5.1.2 Electric dipole in an	5.1.2 Mathematical expression only and	
	external electric field	problems	
	5.1.3 Electric field due to	5.1.3 Definition, figure, example,	
	linear electric	mathematical expression (along axial	
	quadrupole (along axial	line), problems	
	line)		
	5.1.4 Electric field: a ring of		
	charge, and disc of		
	charge	maximum intensity, problems. Derivation	
		with figure for electric field due to a disc	
		of charge, condition of an infinite sheet	
		(one side of non-conductor), problems	
	5.2 Electric potential		
	5.2.1 Electric potential due	5.2.1 Derivation with figure, special cases,	
	to electric dipole,	problems	
	5.2.2 Electric potential due	5.2.2 Derivation with figure, (along axial	
	to linear electric	line only), problems	
	quadrupole		
	5.2.3 Electric potential due	5.2.3 Mathematical expression only for	
	to continuous charge	electric potential due to continuous charge	
	distribution, ring of	distribution, Derivation with figure for	
	charge and disc of	electric potential due to ring of charge,	
	charge	problems, Derivation with figure for	
		electric potential due to disc of charge,	
		problems	
		Program	

	53 Canacitors	
	<ul><li>5.3 Capacitors</li><li>5.3.1 Cylindrical capacitor</li></ul>	5.3.1 Use of general steps to determine the capacitance of cylindrical capacitor, Energy stored in electric field and energy density in electric field, problems
	5.3.2 Charging and discharging of capacitor	5.3.2 Mathematical expression for instantaneous charge during charging and discharging of capacitor, graphical representation, problems
	5.3.3 Capacitor with dielectrics: dielectrics and Gauss law	5.3.3 Polar and non-polar dielectrics, explanation of effect of dielectric in capacitor, Gauss's law and $(\vec{D} = \varepsilon_0 \vec{E} + \vec{P})$ , Supercapacitor: Construction, properties and application of supercapacitors
	5.3.4 High intensity of electrostatics fields: uses and hazards (xerography, inkjet, precipitation)	5.3.4 Application of high intensity of electrostatics fields and hazards (xerography, inkjet, precipitation)
6.Electromagnetism (5 hrs)		(Prerequisites: Magnetic effect of current, Biot-Savart's law & its application, concept of electromagnetic induction)
	6.1 Electromagnetic	
	induction	
	6.1.1 Faraday's laws	6.1.1 Statement & derivation, Physical
	(12 Indeed:	interpretation of induced electric field
	6.1.2 Induction and energy transformation	6.1.2 Introduction, derivation and
	6.1.3 Induced electric field	interpretation, problems 6.1.3 Definition, mathematical expression
	6.1.4 Self-induction and mutual induction	6.1.4 Concept of Self and Mutual induction, mathematical expression, Self-induction of Solenoid and Toroid, problem
	6.1.5 LR circuit	6.1.5 LR Circuit, growing and decay current with mathematical and graphical explanation, problems
	6.1.6 Energy stored in a magnetic field and energy density	6.1.6 Mathematical expression, problems
	6.1.7 Induced magnetic field: modified Ampere's law and	6.1.7 Mathematical expression, problems
	displacement current <b>6.2 Eddy Current</b>	
	6.2.1 Introduction	6.2.1 Introduction
	6.2.2 Applications: Induction cooker, Electric Guitar, Metal Detector and	6.2.2 Applications of eddy current: Induction cooker, Electric Guitar, Metal detector and Eddy current Breaking (only physical explanation)
	Eddy Current Breaking	physical explanation)

	6.2.3 Cyclotron and	6.2.3 Cyclotron (Working principle &	
	Synchrotron	derivation, problems) and Synchrotron	
	Synchrotron	(only physically explanation)	
	7.1 Maxwell's Equations	(only physically explanation)	
7. Electromagnetic	7.1.1Differential and	7.1.1 Mathematical expression, physical	
waves (6 hrs)	integral forms	interpretation	
, , ,	7.1.2 Conversion of	7.1.2 Conversion of Maxwell's equations	
	Maxwell's equations	from integral form to differential form	
	from integral form to	only, differential form to integral form	
	differential form and	(only elaborate and detail conservation not	
	differential form to	necessary)	
	integral form	necessary)	
	7.1.3 Maxwell's equations	7.1.3 Maxwell's equations in free space,	
	in different media	non- conducting and Conducting medium	
	7.2 Applications	non- conducting and conducting medium	
	7.2.1 Wave equations: non	7.2.1 Derivation of wave equations: non	
	conducting and	conducting and conducting medium and	
	conducting medium	free Space	
	and free space	nee space	
	and free space		
	7.2.2 Plane solution of	7.2.2 Derivation of plane solution of wave	
	wave equations,	equations in free space, in conducting &	
	amplitude of	non-conducting (expression only),	
	electromagnetic	amplitude of electromagnetic waves,	
	waves, speed of	speed of electromagnetic waves(free	
	electromagnetic	space), ratio of electric and magnetic fields	
	waves, ratio of electric	(Derivation), problems	
	and magnetic fields	(Berryadion), proorems	
	7.2.3 Continuity equation	7.2.3 Introduction and derivation using	
		Maxwell's equations	
	7.2.4 Energy transfer and	7.2.4 Introduction & derivation to average	
	Poynting vector,	pointing vector, problems, Radiation	
	Radiation pressure	pressure(mathematical expression),	
	1	problems	
	8.1 Quantum Physics		
	8.1.1 Inadequacy of	8.1.1 Inadequacy of classical mechanics,	
0.70	classical mechanics,	explanation & examples of quantum	
8. Photon and	rise of quantum	phenomena, concept of quantization of	
matter waves	mechanics,	energy	
( 6 hrs)	quantization of energy		
	8.1.2 Group velocity and	8.1.2 Definition, explanation and	
	phase velocity,	mathematical relation	
	electron and matter		
	waves		
	8.1.3 de-Broglie	8.1.3 Expression, applications, problems	
	wavelength, its		
	applications		
	8.1.4 Heisenberg	8.1.4 Expression, applications, problems	
	uncertainty principle		
	and its applications		

8.1.5 Wave functions and	8.1.5 Definition, physical significance
its significance	
8.2 Schrodinger wave	
equation	
8.1.2 Time-independent and	8.1.2 Derivation of time-independent and
time-dependent	time-dependent Schrodinger wave
equations	equation (1-D)
8.2.2 Probability	8.2.2 Explanation of normalization and
distribution	probability density
8.2.3 One dimensional	8.2.3 Derivation, Energy eigen value and
infinite potential well,	eigen function, Discrete energy states
Particle in a box	diagram, problems
8.2.4 Barriers Tunneling	8.2.4 Explanation, expression for
effect (reflection and	transmission and reflection coefficient (no
transmission	derivation), problems
coefficient qualitative)	

## Question grid

Unit	Long questions	Short questions	Very Short questions
1. Oscillation	1	1	0
2. Acoustics	1	0	0
3. Heat & Thermodynamics	1	1	1
4. Optics	4	0	1
5. Electrostatics	2	0	1
6. Electromagnetism	1	0	1
7. Electromagnetic Waves	1	1	0
8. Photon & Matter Waves	1	1	0
Total	$12 \times 4 = 48$	$4 \times 2 = 8$	$4 \times 1 = 4$

*Note:* Out of twelve long questions there will be at least five numerical and out of four short questions there will be at least two one step numerical.