STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

COURSE FILE
(2023-24)
ODD

NAME OF THE FACULTY:DR. L. MARY NOVENA

SUBJECT:PH3151 / ENGINEERING PHYSICS

STELLA MARY'S COLLEGE OF ENGINEERING

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai And Accredited By NAAC)
Aruthenganvilai, Kallukatti Junction Azhikal Post, Kanyakumari District-629202, Tamil Nadu.

DEPARTMENT OF PHYSICS

COURSE FILE

PH3151:ENGINEERING PHYSICS

COURSE DETAILS

YEAR	:	I
SEMESTER	:	I
ACADEMIC YEAR	:	2023-2024(ODD)
PROGRAMME	:	B.E/ENGINEERING FOR PHYSICS

STELLA MARY'S COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai and Accredited by NAAC)
Aruthengankvilai, Kallukatti Junction Azhikal Post, Kanyakumari District-629202, Tamil Nadu.

DEPARTMENT OF SCIENCE & HUMANITIES

COURSE FILE INDEX

ACADEMIC YEAR : 2023 - 24 (Odd/Even)

Name of the Faculty : Dr. L. MARY NOVENA
Course Code/Course Name : PH3151 / ENGINEERING PHYSICS

S.No.	Course Content	Head of Course Content
1.	Faculty details	*Section 1* **PREPARATORY REQUISITES FOR COURSE HANDLING**
2.	Course details	
3.	Institution Vision and mission	
4.	POs, PSOs	
5.	Course Objectives & Course Outcomes	
6.	CO-PO Mapping	
7.	Student Name List	
8.	List of slow learners and fast learners with action plan	
9.	Time table	
10.	Syllabus	
11.	Curricular Gap Identification	
12.	Course Coordinator &Module Coordinator Meeting -Agenda	
13.	Course Coordinator &Module Coordinator Meeting - Minutes	
14.	Course plan	*Section 2* **PLANNING STATEMENT**
15.	Course material (Units 1 to 5)	*Section 3* **STUDENT SUPPORT MATERIALS**
16.	Content beyond syllabus (Material and Mapping)	
17.	Two Marks question with answer	
18.	Student support materials Question Bank	
19.	Internal Exam I, Internal Exam II & Model Exam question paper with Blooms taxonomy	
20.	Internal Exam I, Internal Exam II & Model Exam answer key	
21.	Sample answer sheet for all exams	
22.	Rewrap test question papers with sample answer scripts	

23.	Assignments with questions	
24.	Course attainment 1. Direct 2. Indirect 3. Overall CO Attainment	
25.	University question papers	
26.	ICT &E-Learning content 1. PPT 2. Google classroom 3. Flipped Classroom	*Section 4* **ICT &E-LEARNING CONTENT**
27.	Advanced Teaching Learning methodologies used 1. Participative Learning (Seminar/Quiz) 2. Project based learning ((Research lab/Field /Mini projects) 3. Model based learning 4. Experiential learning 5. Peer Group learning 6.Mind map 7.Any other idea	*Section 5* **ADVANCED TEACHING LEARNING METHODOLOGIES IMPLEMENTED**
28.	GATE Materials	*Section 6* **MCQs**
29.	Faculty participation in Seminar/Workshop/FDP related to course	*Section 7* **RELATED ACTIVITIES**
30.	Arrangement of Guest Lecture / Workshop / Seminars for the course / IV/IPT/Value Added/Certificate Courses	
31.	NPTEL Registration of course handling faculty / guided student	*Section 8* **NPTEL REGISTRATION**
32.	Log book with complete entry and signatures	*Section 9* **COURSE LOG BOOK**
33.	CD with soft copy of the course content	*Section 10* **CD**

Course Coordinator

Programme Coordinator

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

COURSE DETAILS

STELLA MARYS COLLEGE OF ENGINEERINGSTELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District - 629202

Name of the Faculty: DR.L. MARY NOVENA

Department : S&H [PHYSICS]

Course Code : PH3151

Course Name : ENGINEERING PHYSICS

Class : S1/S&H

Academic Year : 2023-2024

Semester : ODD

Regulation : 2021

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthengavillai, Kallukatti Junction, Azhikal Post, Kanyakumari District-629202

SCHEME OF STUDY AND EXAMINATION

S. No.	COURSE DETAILS	
1.	Regulation	2021
2.	Semester	I
3.	Course Code	PH3151
4.	Course Name	ENGINEERING PHYSICS
5.	Lecture hours/week	9
6.	Duration of examination	3 Hours
7.	Internal Marks	40 marks
8.	University Examination Marks	60 marks
9.	Maximum Marks	100 marks
10.	Maximum Marks for Pass	45 marks
11.	Credit	3

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DEPARTMENT OF SCIENCE AND HUMANITIES

Academic Year: 2021-2022(ODD)

Year/ Semester	Course Code /Name	Course Coordinator	Module Coordinator	Programme Coordinator
1/1	PH3151 / ENGINEERING PHYSICS	DR.L. Mary Novena (Assistant Professsor /S&H)	(Assistant Professsor /S&H)	Mr. S. Ravikumar (Assistant Professor Professsor&Head/S&H)
Signature				

STELLA MARYS COLLEGE OF ENGINEERING

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COURSE DETAIL FORM

(1) Course Code	PH 3151
(2) Course Title	Engineering Physics
(3) Number of units	5
(4) Course Type	Science and Humanities
(5)Pre-requisite	Higher Secondary Physics (+1 & +2)
(6) Course Synopsis	This course gives adequate knowledge on the basics of mechanics and its applications. This course provides knowledge on the waves and concepts of optical devices and their applications in fibre optics. Also, acquiresknowledge on the concepts of electromagnetic waves and their applications in cell phone reception. It provides knowledge on concepts of quantum theory and its applications in tunneling microscopes, make understand the importance of quantum physics.
(7) List of experiments	**BS3171 PHYSICS AND CHEMISTRY LABORATORY** • Determination of Rigidity Modulus-Torsion pendulum • Determination of Young's modulus by non-uniform bending method • Determination of velocity of sound and compressibility of *liquid-Ultrasonic interferometer* • Determination of Planck's constant using photocell • Determination of thickness of a thin wire-Air wedge method • Determination of Numerical aperture, acceptance angle and width of the groove using laser • Determination of the wavelength of the laser using grating
(8) Learning Approach	Lecture: 3 Tutorial: 0 Practical: 0 Credit: 3

(9) First time course offered	(Semester and academic session): No S1/Branch-MECH/2021-2022/ODD

(10)Course articulation matrix:

Course Outcome(CO)		Program Outcome (PO)												Program Specific Outcome (PSO)		
Course code / CO No.	CO Statement	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
PH3151/1	1. **Recall** the knowledge on basics about motion of the rigid bodies and their centre of mass.	2	2	2	1	2	3	1	1	2	1	2	-	3	1	-
PH3151/2	2.**Recognize** the knowledge on concepts of electromagnetic waves and their properties	2	2	2	2	1	2	2	1	3	1	2	-	2	1	1
PH3151/3	3. **Recognize** the knowledge on concepts of optical devices & their applications in fibre optics	3	3	3	3	2	3	2	1	3	2	3	-	1	1	1
PH3151/4	4. **Understand** the importance of quantum Physics.	1	1	1	2	1	2	2	1	2	2	2	-	2	1	1
PH3151/5	5. **Apply** the concepts of quantum theory & applications in tunneling microscopes.	3	3	1	3	3	2	3	2	2	2	3	-	2	1	1

*Blooms level:
C1-Remembering, C2-Understanding, C3-Applying, C4-Analysing, C5-Evaluating, C6-Creating

(11) Course Planning Statement

1. No. of Units : 5
2. No. of periods allotted /Unit: 9
3. No. of Tutorial Periods allotted: NIL

Details of Period allotment	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5

Unit	No. of periods required to handle	No. of periods handled (cumulative)	Course content	Delivery mode	No. of Tutorial hours (if needed)	Assessments (Periodical Tests/Quiz/ Assignments)

Periods allotted per unit	9	9	9	9	9
No. of Periods allotted for Tutorial classes	-	-	-	-	-

1. PROPERTIES OF MATTER	1	1	Elasticity -Stress-strain diagram & its uses	Black Board	-	Periodical Tests/ Assignments
	2	3	factors affecting elastic modulus & tensile strength - torsional stress & deformations	ppt	-	
	1	4	twisting couple	Black Board	-	
	1	5	torsion pendulum: theory &experiment	Experimental	-	
	1	6	bending of beams - bending moment	Black Board	-	
	1	7	cantilever: theory and experiment	Black Board	-	
	1	8	uniform & non-uniform bending: theory and experiment	Experimental	-	
	1	9	I-shaped girders - stress due to bending in beams.	Black Board	-	
	1	10	**Construction of bridges using I &Tshaped girder.**	ppt		
2. WAVES AND FIBER OPTICS	2	2	Oscillatory motion – forced and damped oscillations: differential equation & its solution	Black Board	-	Periodical Tests/ Assignments
	1	3	plane progressive waves – wave equation.	Black Board	-	
	1	4	Lasers : population of energy levels, Einstein's A and B coefficients -derivation	Black board	-	
	2	6	resonant cavity,optical amplification(qualitative) Semiconductor lasers: homo & hetero junction	Black Board	-	
	1	7	Fiber optics: principle, numerical aperture and acceptance angle	Black Board	-	
	1	8	types of optical fibres (material, refractive index, mode)	ppt	-	
	1	9	losses associated with optical fibers	interactive	-	
	1	10	**Applications of Laser and Fiber optics**	Flipped videos		
3. THERMAL PHYSICS	2	2	expansion joints, bimetallic strips,thermal conduction, convection and radiation	Black Board	-	Periodical Tests/ Assignments
	1	3	heat conductions in solids – thermal conductivity	Black Board	-	
	2	5	Forbe's and Lee's disc method: theory and experiment	Black Board	-	
	1	6	conduction through compound media (series and parallel)	Black Board	-	
	3	9	thermal insulation - applications:heat exchangers, refrigerators, ovens & solar water heaters.	ppt	-	
	1	10	**Advantages and applications of solar energy.**	flipped videos		
4.	1	1	Black body radiation – Planck's theory (derivation)	Black Board	-	Periodical Tes

	1	2	wave particle duality – electron diffraction	ppt	-	
	2	4	Compton effect: theory and experimental verification	Black Board	-	
	1	5	concept of wave function and its physical significance	Black Board	-	
	2	7	Schrodinger's wave equation – time independent and time dependent equations	Black Board	-	
	1	8	particle in a one-dimensional rigid box – tunnelling (qualitative)	Black Board	-	
	1	9	Scanning tunnelling microscope.	Black Board & Interactive	-	
	1	10	**Types of microscope and its uses.**			
5. CRYSTAL PHYSICS	1	1	Single crystalline, polycrystalline and amorphous materials - single crystals: unit cell	Black Board	-	Periodical Tests/ Assignments
	1	2	crystal systems, Bravais lattices, directions &planes in a crystal	Black Board & ppt	-	
	1	3	Miller indices – inter-planar distances	Black Board	-	
	1	4	coordination number and packing factor for SC, BCC, FCC structures	Black Board	-	
	1	5	HCP structure	Black Board & flipped		
	1	6	Diamond structure	Black Board		
	1	7	crystal imperfections: point defects, line defects	Black Board & Interactive	-	
	1	8	Burger vectors, stacking faults - role of imperfections in plastic deformation	Black Board	-	
	1	9	Growth of single crystals: solution and melt growth techniques.	Black Board & Interactive	-	
	1	10	**Applications of crystal in various field.**			

Note: <u>**Delivery Mode**</u>**- 1. Participative Learning-** Interaction between Staff and Student during lecture(Seminar/Quiz etc..)
2. Flipped Class room – Discussion on Content circulated through Google Classroom
3. Experiential Learning- Lab or Field based demonstrative learning
4. Model /Project based learning- *Demonstration done using models/Projects*

(12) Evaluation Contribution	Internal Assessment tests (50%)

	Model Exam (35%) Assignments (15%)		
(13) Number of students			
(14) Text Books	1. Kasap, S.O. —Principles of Electronic Materials and Devicesl, McGraw-Hill Education, 2007. 2. Umesh K Mishra & Jasprit Singh, —Semiconductor Device Physics and Designl, Springer, 2008. 3. Wahab, M.A. —Solid State Physics: Structure and Properties of Materialsl. Narosa Publishing House, 2009.		
(15) List of references (List the main texts/references first)	1. Garcia, N. & Damask, A. —Physics for Computer Science Studentsl. Springer-Verlag, 2012. 2. Hanson, G.W. —Fundamentals of Nanoelectronicsl. Pearson Education, 2009		
(16) Signatures and approvals	(i) Course Coordinator Name: Dr. L. Mary Novena Date: 30/8/20	(ii) Module Coordinator Name:Mrs. G.Uthaya Date:	(iii) Programme Coordinator Name:Mr. Ravikumar Date:
	(iv) Principal Name: Dr. S. Suresh Premil Kumar Date:		

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Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

FACULTY DETAILS

STELLA MARY'S COLLEGE OF ENGINEERING

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Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District- 629 202

Course File Document

Academic Year :	2023-2024 Odd
Course Title :	PH3151 Engineering Physics
Staff Name :	Mary Novena L (1275)
Start Date :	25 September 2023
End Date :	04 January 2024

Students Name List

S.No	Roll No	Reg. No	Name
1	null	null	vaikundamani R
2	null	null	VALAN MASLINO A
3	23RUME001	null	ABISHEK M
4	23RUME002	null	AGASH G
5	23RUME003	null	AHILAN A
6	23RUME004	null	AKASH A
7	23RUME005	null	AKASH G
8	23RUME006	null	AKASH K
9	23RUME007	null	AKSHAY S
10	23RUME008	null	ALBIN X
11	23RUME009	null	ANISH V
12	23RUME010	null	ANISH VEL MURUGAN
13	23RUME011	null	ANTO SIBINSON A
14	23RUME012	null	Ari krishnan S R
15	23RUME013	null	ARSATH BADHUSHA S
16	23RUME014	null	ARUL REMO P
17	23RUME015	null	ARUN KUMAR S
18	23RUME016	null	BABINESH S
19	23RUME017	null	DHARSITH S L
20	23RUME018	null	DHIVYAA DHARSAN R S
21	23RUME019	null	GOKUL S
22	23RUME020	null	JAWAHAR J S
23	23RUME021	null	JEBIN Y
24	23RUME022	null	JENIL K M
25	23RUME023	null	JOBIN BENNET C B
26	23RUME024	null	JOHN BISHER A
27	23RUME025	null	JOHN FRANCO J
28	23RUME026	null	JOHNDLY ROCH G
29	23RUME028	null	KANNAN H
30	23RUME029	null	MARUTHAPPA M
31	23RUME030	null	MATHIN M
32	23RUME031	null	MOHAMMED RAIHAN M
33	23RUME032	null	MUGESHKUMAR S
34	23RUME034	null	NIBIN J
35	23RUME036	null	NITHIN U
36	23RUME037	null	NITHISH H
37	23RUME039	null	PAUL JAMES P S
38	23RUME040	null	REXCILIN JINO R
39	23RUME041	null	RISMI V J
40	23RUME042	null	RIXSHOL SIJIN M
41	23RUME044	null	SANTHOSH S
42	23RUME045	null	SHAHIL R
43	23RUME046	null	SIVA KEERTHIKA R

44	23RUME047	null	SIVANATHAN V
45	23RUME048	null	SREE DHARSHAN K S
46	23RUME049	null	SUBILESH S
47	23RUME050	null	TARUN RAJ M
48	23RUME051	null	THANGA POOJA S
49	23RUME052	null	THASHBIN K K

Course Syllabus

PH3151	Engineering Physics	3 0 0 3

Course Objectives:

- To make the students effectively achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- To understand the behavior of particles through the concept of quantum physics
- To motivate the students towards the application of quantum physics in quantitative and qualitative aspects

Course Outcomes:

- Recall the knowledge on basics about motion of the rigid bodies and their centre of mass
- Recognize the knowledge on concepts of electromagnetic waves and their properties
- Recognize the knowledge on concepts of optical devices & their applications in fibre optics
- Understand the importance of quantum Physics.
- Apply the concepts of quantum theory & applications in tunneling microscopes.

Programme Outcomes:

#	PO
a	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b	Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
c	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change
m	Use data management techniques and algorithmic thinking for Software Design and Development practices
n	Develop reliable IT solutions based on the expertise in Distributed Applications Development, Web Designing and Networking for various societal needs and entrepreneurial practices ethically:Matrix algorithm can efficiently manipulate the data, however one like.
o	Manage multidisciplinary environments effectively through their interpersonal and analytical skills and be responsible members and leaders of the society: Matrices are useful in any big data task

Articulation Matrix (CO PO Mapping):

#	CO	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
1	Recall the knowledge on basics about motion of the rigid bodies and their centre of mass	M	M	M	M	M	M	L	L	M	L	M		L	L	L
2	Recognize the knowledge on concepts of electromagnetic waves and their properties	M	M	M	H	M	H	L	L	M	L	M	-	M	M	L
3	Recognize the knowledge on concepts of optical devices & their applications in fibre optics	H	H	M	H	H	H	L	L	H	M	M	-	M	H	M
4	Understand the importance of quantum Physics.	M	M	M	H	M	M	M	M	H	H	H		H	M	M
5	Apply the concepts of quantum theory & applications in tunneling microscopes.	H	H	H	H	M	M	M	M	M	M	M		M	M	

Course Content:

UNIT 1 **9 Hours**

MECHANICS

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.

UNIT 2 **9 Hours**

ELECTROMAGNETIC WAVES

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium- vacuum interface for normal incidence.

UNIT 3 **9 Hours**

OSCILLATIONS, OPTICS AND LASERS

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer – Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT 4 **9 Hours**

BASIC QUANTUM MECHANICS

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT 5 **9 Hours**

APPLIED QUANTUM MECHANICS

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

References:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.
4. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
5. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
6. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.

Course Topics

S.No	Unit	Topic	Hours	Mode
1	MECHANICS	Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies	1	Conventional
2	MECHANICS	rotational kinetic energy and moment of inertia - theorems of M .I –	1	Conventional
3	MECHANICS	moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies	1	Conventional
4	MECHANICS	conservation of angular momentum – rotational energy state of a rigid diatomic molecule	1	Conventional
5	MECHANICS	yroscope - torsional pendulum	1	ICT
6	MECHANICS	double pendulum	1	Conventional
7	MECHANICS	Introduction to nonlinear oscillations	1	Conventional
8	ELECTROMAGNETIC WAVES	The Maxwell's equations - wave equation;	1	Conventional
9	ELECTROMAGNETIC WAVES	Plane electromagnetic waves in vacuum, Conditions on the wave field	1	Conventional
10	ELECTROMAGNETIC WAVES	properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter	2	Conventional
11	ELECTROMAGNETIC WAVES	polarization	1	Conventional
12	ELECTROMAGNETIC WAVES	Producing electromagnetic waves	2	Conventional
13	ELECTROMAGNETIC WAVES	Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure	2	Conventional
14	ELECTROMAGNETIC WAVES	Cell-phone reception.	1	ICT
15	ELECTROMAGNETIC WAVES	Reflection and transmission of electromagnetic waves from a non-conducting medium	1	Conventional
16	ELECTROMAGNETIC WAVES	vacuum interface for normal incidence.	1	Conventional
17	OSCILLATIONS, OPTICS AND LASERS	Simple harmonic motion - resonance	1	Conventional
18	OSCILLATIONS, OPTICS AND LASERS	analogy between electrical and mechanical oscillating systems - waves on a string	1	Conventional
19	OSCILLATIONS, OPTICS AND LASERS	sound waves - Doppler effect	1	Conventional
20	OSCILLATIONS, OPTICS AND LASERS	Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer	2	Conventional
21	OSCILLATIONS, OPTICS AND LASERS	Theory of air wedge and experiment. Theory of laser	1	ICT
22	OSCILLATIONS, OPTICS AND LASERS	characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion	2	Conventional
23	OSCILLATIONS, OPTICS AND LASERS	Nd-YAG laser, CO2 laser, semiconductor laser	2	ICT

24	OSCILLATIONS, OPTICS AND LASERS	Basic applications of lasers in industry.	1	ICT
25	BASIC QUANTUM MECHANICS	Photons and light waves	1	Conventional
26	BASIC QUANTUM MECHANICS	Electrons and matter waves –Compton effect	2	Conventional
27	BASIC QUANTUM MECHANICS	The Schrodinger equation (Time dependent and time independent forms)	1	Conventional
28	BASIC QUANTUM MECHANICS	meaning of wave function - Normalization –Free particle	1	Conventional
29	BASIC QUANTUM MECHANICS	particle in a infinite potential well: 1D,2D and 3D Boxes	1	Conventional
30	BASIC QUANTUM MECHANICS	Normalization, probabilities and the correspondence principle	2	Conventional
31	MECHANICS	motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies:	1	Conventional
32	MECHANICS	Rotational kinematics – rotational kinetic energy and moment of inertia	1	Conventional
33	APPLIED QUANTUM MECHANICS	The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)-	1	Conventional
34	APPLIED QUANTUM MECHANICS	Tunneling microscope - Resonant diode	1	ICT
35	APPLIED QUANTUM MECHANICS	Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model	1	Conventional
36	APPLIED QUANTUM MECHANICS	origin of energy bands.	1	Conventional

Course Delivery Plan

S.No	Unit	Topic	Date	Hour
1	MECHANICS	motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies:	25-09-23	10.55AM-11.45AM
2	MECHANICS	Rotational kinematics – rotational kinetic energy and moment of inertia	26-09-23	3.40PM-4.20PM
3	MECHANICS	Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies	27-09-23	9.00AM-9.55AM
4	MECHANICS	rotational kinetic energy and moment of inertia - theorems of M .I –	03-10-23	9.55AM-10.45AM
5	MECHANICS	rotational kinetic energy and moment of inertia - theorems of M .I –	04-10-23	10.55AM-11.45AM
6	MECHANICS	moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies	05-10-23	1.15PM-2.00PM
7	MECHANICS	moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies	06-10-23	10.55AM-11.45AM
8	MECHANICS	conservation of angular momentum – rotational energy state of a rigid diatomic molecule	09-10-23	3.40PM-4.20PM
9	MECHANICS	yroscope - torsional pendulum	10-10-23	9.00AM-9.55AM
10	MECHANICS	double pendulum	11-10-23	9.55AM-10.45AM
11	MECHANICS	double pendulum	12-10-23	10.55AM-11.45AM
12	MECHANICS	Introduction to nonlinear oscillations	13-10-23	1.15PM-2.00PM
13	ELECTROMAGNETIC WAVES	The Maxwell's equations - wave equation;	16-10-23	10.55AM-11.45AM
14	ELECTROMAGNETIC WAVES	Plane electromagnetic waves in vacuum, Conditions on the wave field	17-10-23	3.40PM-4.20PM
15	ELECTROMAGNETIC WAVES	properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter	18-10-23	9.00AM-9.55AM
16	ELECTROMAGNETIC WAVES	properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter	19-10-23	9.55AM-10.45AM
17	ELECTROMAGNETIC WAVES	polarization	20-10-23	10.55AM-11.45AM
18	ELECTROMAGNETIC WAVES	Producing electromagnetic waves	25-10-23	1.15PM-2.00PM
19	ELECTROMAGNETIC WAVES	Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure	26-10-23	10.55AM-11.45AM
20	ELECTROMAGNETIC WAVES	Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure	27-10-23	3.40PM-4.20PM
21	ELECTROMAGNETIC WAVES	Cell-phone reception.	30-10-23	9.00AM-9.55AM

22	ELECTROMAGNETIC WAVES	Reflection and transmission of electromagnetic waves from a non-conducting medium	31-10-23	9.55AM-10.45AM
23	ELECTROMAGNETIC WAVES	vacuum interface for normal incidence.	02-11-23	10.55AM-11.45AM
24	OSCILLATIONS, OPTICS AND LASERS	Simple harmonic motion - resonance	03-11-23	1.15PM-2.00PM
25	OSCILLATIONS, OPTICS AND LASERS	analogy between electrical and mechanical oscillating systems - waves on a string	06-11-23	10.55AM-11.45AM
26	OSCILLATIONS, OPTICS AND LASERS	sound waves - Doppler effect	07-11-23	3.40PM-4.20PM
27	OSCILLATIONS, OPTICS AND LASERS	Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer	08-11-23	9.00AM-9.55AM
28	OSCILLATIONS, OPTICS AND LASERS	Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer	09-11-23	9.55AM-10.45AM
29	OSCILLATIONS, OPTICS AND LASERS	Theory of air wedge and experiment. Theory of laser	10-11-23	11.45AM-12.35PM
30	OSCILLATIONS, OPTICS AND LASERS	characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion	14-11-23	10.55AM-11.45AM
31	OSCILLATIONS, OPTICS AND LASERS	Nd-YAG laser, CO2 laser, semiconductor laser	15-11-23	1.15PM-2.00PM
32	OSCILLATIONS, OPTICS AND LASERS	Nd-YAG laser, CO2 laser, semiconductor laser	16-11-23	10.55AM-11.45AM
33	OSCILLATIONS, OPTICS AND LASERS	Nd-YAG laser, CO2 laser, semiconductor laser	17-11-23	3.40PM-4.20PM
34	OSCILLATIONS, OPTICS AND LASERS	Basic applications of lasers in industry.	18-11-23	11.45AM-12.35PM
35	BASIC QUANTUM MECHANICS	Photons and light waves	20-11-23	9.00AM-9.55AM
36	BASIC QUANTUM MECHANICS	Electrons and matter waves –Compton effect	21-11-23	9.55AM-10.45AM
37	BASIC QUANTUM MECHANICS	Electrons and matter waves –Compton effect	22-11-23	10.55AM-11.45AM
38	BASIC QUANTUM MECHANICS	The Schrodinger equation (Time dependent and time independent forms)	23-11-23	1.15PM-2.00PM
39	BASIC QUANTUM MECHANICS	meaning of wave function - Normalization –Free particle	24-11-23	10.55AM-11.45AM
40	BASIC QUANTUM MECHANICS	particle in a infinite potential well: 1D,2D and 3D Boxes	25-11-23	11.45AM-12.35PM
41	BASIC QUANTUM MECHANICS	particle in a infinite potential well: 1D,2D and 3D Boxes	27-11-23	3.40PM-4.20PM
42	BASIC QUANTUM MECHANICS	Normalization, probabilities and the correspondence principle	28-11-23	9.00AM-9.55AM
43	APPLIED QUANTUM MECHANICS	The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)-	29-11-23	9.55AM-10.45AM
44	APPLIED QUANTUM MECHANICS	The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)-	30-11-23	10.55AM-11.45AM
45	APPLIED QUANTUM MECHANICS	Tunneling microscope - Resonant diode	01-12-23	1.15PM-2.00PM
46	APPLIED QUANTUM MECHANICS	Tunneling microscope - Resonant diode	05-12-23	10.55AM-11.45AM

47	APPLIED QUANTUM MECHANICS	Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model	06-12-23	3.40PM-4.20PM
48	APPLIED QUANTUM MECHANICS	Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model	07-12-23	9.00AM-9.55AM
49	APPLIED QUANTUM MECHANICS	origin of energy bands.	08-12-23	9.55AM-10.45AM
50	MECHANICS	yroscope - torsional pendulum	11-12-23	10.55AM-11.45AM
51	MECHANICS	moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies	12-12-23	1.15PM-2.00PM
52	MECHANICS	Rotational kinematics – rotational kinetic energy and moment of inertia	13-12-23	10.55AM-11.45AM
53	ELECTROMAGNETIC WAVES	Cell-phone reception.	14-12-23	3.40PM-4.20PM
54	ELECTROMAGNETIC WAVES	The Maxwell's equations - wave equation;	15-12-23	9.00AM-9.55AM
55	ELECTROMAGNETIC WAVES	Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure	19-12-23	9.55AM-10.45AM
56	OSCILLATIONS, OPTICS AND LASERS	Nd-YAG laser, CO2 laser, semiconductor laser	20-12-23	10.55AM-11.45AM
57	OSCILLATIONS, OPTICS AND LASERS	analogy between electrical and mechanical oscillating systems - waves on a string	21-12-23	1.15PM-2.00PM
58	OSCILLATIONS, OPTICS AND LASERS	characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion	22-12-23	10.55AM-11.45AM
59	BASIC QUANTUM MECHANICS	The Schrodinger equation (Time dependent and time independent forms)	27-12-23	3.40PM-4.20PM
60	BASIC QUANTUM MECHANICS	particle in a infinite potential well: 1D,2D and 3D Boxes	28-12-23	9.00AM-9.55AM
61	BASIC QUANTUM MECHANICS	meaning of wave function - Normalization –Free particle	29-12-23	9.55AM-10.45AM
62	APPLIED QUANTUM MECHANICS	The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)-	02-01-24	10.55AM-11.45AM
63	APPLIED QUANTUM MECHANICS	Tunneling microscope - Resonant diode	03-01-24	1.15PM-2.00PM
64	APPLIED QUANTUM MECHANICS	Tunneling microscope - Resonant diode	04-01-24	10.55AM-11.45AM

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

VISION & MISSION

VISION

To be a beacon of academic excellence, empowering future innovators with technical mastery to harness technology for positive global change.

MISSION

M1	To Cultivate a vibrant learning environment where students delve into the frontiers of **technical knowledge**, hone their **problem-solving skills**, and embrace **innovation** to transform ideas into solutions that address **global challenges**.
M2	To bridge the gap between technical brilliance and **real-world impact** by forging **strong industry partnerships**, fostering **cutting-edge research**, and nurturing **entrepreneurial drive** in our students, empowering them to build a better future through technology.
M3	To ignite the spark of **intellectual curiosity** within every student, equip them with the **tools and knowledge** to become pioneers in their chosen fields, and guide them towards **ethical and responsible** use of technology for the **betterment of humanity**.

MAPPING VISION WITH MISSION

1. **Cultivating Learning Excellence:**

Aligned with Vision: Empowering future innovators with technical mastery.

How: Creating a vibrant learning environment, fostering problem-solving skills, and encouraging innovation.

2. **Connecting Brilliance to Impact:**

Aligned with Vision: Harnessing technology for positive global change.

How: Forging industry partnerships, driving advanced research, and nurturing an entrepreneurial drive for societal impact.

3. **Igniting Intellectual Curiosity:**

Aligned with Vision: Being a beacon of academic excellence.

How: Sparking curiosity, providing tools for pioneering achievements, and emphasizing ethical technology use for global betterment.

INSTITUTE OBJECTIVES

1. To ensure the continual maintenance of elevated academic standards across all programs.
2. To provide students with the technical skills necessary for global innovation.
3. To cultivate an environment that promotes active learning and innovation.
4. To motivate students to transform their ideas into practical solutions.
5. To Form robust partnerships with industries to offer students real-world exposure.
6. To cultivate an entrepreneurial mind-set among students, fostering innovative thinking.
7. To Spark and nurture curiosity to encourage continuous learning among students.
8. To equip students with the tools and skills necessary to become effective leaders.
9. To emphasize ethical considerations in the development and application of technology.
10. To cultivate a culture of collaboration and a shared commitment to making a positive impact globally.

CORE VALUES

"Making every student of Stella Mary's, a good citizen of the nation, by offering a good practice of advanced technologies, helping the teaching and learning community to do their exploration and experimentation in an ethical manner under an environment of academic transparency and honesty, thereby, achieving a sustainable nation-wide development of technology".

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

POS, PSOS

STELLA MARYS COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District– 629 202,
Tamil Nadu

Department of Mechanical Engineering

Program Outcomes (POs)

1. **Engineering knowledge:**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/development of solutions:**Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:**Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or

leader in diverse teams, and in multidisciplinary settings.

10. **Communication:**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:**Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change

Program specific Outcomes (PSOs)
1. Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems. 2. Apply the knowledge acquired to investigate research-oriented problems in mechanical engineering with due consideration for environmental and social impacts. 3. Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

Program Educational Objectives (PEOs)

PEO1: Effectuating success in careers by exploring with the design, digital and computational analysis of engineering systems, experimentation and testing, smart manufacturing, technical services, and research

PEO2: Amalgamating effectively with stakeholders to update and improve their core competencies and abilities to ethically compete in the ever-changing multicultural global enterprise

PEO3: To encourage multi-disciplinary research and development to foster advanced technology, and to nurture innovation and entrepreneurship in order to compete successfully in the global economy.

PEO4: To globally share and apply technical knowledge to create new opportunities that proactively advances our society through team efforts and to solve various challenging technical, environmental and societal problems

PEO5: To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

COURSE OBJECTIVES

&

OUTCOMES [Parent file]

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

CO – PO MAPPING

COURSE NAME: ENGINEERING PHYSICS (PH3151) **DEPARTMENT: MECH**

Course Outcome(CO)		Program Outcome (PO)												Program Specific Outcome (PSO)		
Course code / CO No.	CO Statement	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
PH3151/1	**Recall** the knowledge on basics about motion of the rigid bodies and their centre of mass	2	2	2	2	2	2	1	1	2	1	2	-	2	1	1
PH3151/2	**Recognize** the knowledge on concepts of electromagnetic waves and their properties	2	2	2	3	2	3	1	1	2	1	2	-	2	2	1
PH3151/3	**Recognize** the knowledge on concepts of optical devices & their applications in fibre optics	3	3	2	3	3	3	1	1	3	2	2	-	2	3	2
PH3151/4	**Understand** the importance of quantum Physics.	2	2	2	3	2	2	2	2	3	3	3	-	3	2	2
PH3151/5	**Apply** the concepts of quantum theory & applications in tunneling microscopes.	3	3	3	3	2	2	2	2	2	2	2	-	2	2	-

COURSE CORDINATOR

MODULE COORDINATOR

HOD

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

STUDENT NAME LIST

STELLA MARY'S COLLEGE OF ENGINEERING

(Approved By AICTE, New Delhi and Affiliated To Anna University ChennaiAnd Accredited By NAAC)

Aruthenganvilai, Azhikal Post, Kanyakumari District-629 202

DEPARTMENT OF MECHANICAL ENGINEERING

STUDENT NAME LIST (2023-2024) ODD

Subject Name/Code: PH3151/ENGINEERINGPHYSICS SEM/YEAR:I/I

SL.NO	REGISTER NO	NAME
1	963523114001	ABISHEK M
2	963523114002	AGASH G
3	963523114003	AHILAN A
4	963523114004	AKASH A
5	963523114005	AKASH G
6	963523114006	AKASH K
7	963523114007	AKSHAY S
8	963523114008	ALBIN X
9	963523114009	ANISH V
10	963523114010	ANISH V
11	963523114011	ANTO SIBINSON A
12	963523114013	ARIKRISHNAN S R
13	963523114014	ARSATH BADHUSHA S
14	963523114015	ARUL REMO P
15	963523114016	ARUN KUMAR S
16	963523114017	BABINESH S
17	963523114018	DHARSITH S L
18	963523114019	DHIVYAA DHARSAN R S
19	963523114020	GOKUL S
20	963523114021	JAWAHAR J S
21	963523114022	JEBIN Y
22	963523114023	JENIL K M
23	963523114024	JOBIN BENNET C B
24	963523114025	JOHN BISHER A
25	963523114026	JOHNDLY ROCH G
26	963523114027	JOHN FRANCO J
27	963523114029	KANNAN H
28	963523114030	MARUTHAPPA M
29	963523114031	MATHIN M
30	963523114032	MOHAMMED RAIHAN M
31	963523114033	MUGESHKUMAR S
32	963523114035	NIBIN J
33	963523114037	NITHIN U
34	963523114039	NITHISH K N
35	963523114040	PAUL JAMES P S

36	963523114041	REXCILIN JINO R
37	963523114042	RISMI V J
38	963523114043	RIXSHOL SIJIN M
39	963523114045	SANTHOSH S
40	963523114046	SHAHIL R
41	963523114047	SIVA KEERTHIKA R
42	963523114048	SIVANATHAN V
43	963523114049	SREE DHARSAN K S
44	963523114050	SUBILESH S
45	963523114051	TARUN RAJ M
46	963523114052	THANGA POOJA S
47	963523114053	THASHBIN KK

FACULTY IN-CHARGE **HOD** **PRINCIPAL**

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

SLOW LEARNERS

&

ADVANCED LEARNERS

LIST OF SLOW AND FAST LEARNERS

SLOW LEARNERS AND ADVANCED LEARNERS – ACTION PLAN

The students were segregated into slow learners and advanced learners based on their marks obtained in +2. The action plan is framed accordingly and is to be discussed with the module coordinator.

SLOW LEARNERS

Sl.No	Reg No	Name of the Student
1	963521114001	Abishek.M
2	963521114002	Agash.G
3	963521114003	Ahilan.A
4	963521114008	Albin.X
5	963521114009	Anish.V
6	963521114010	Anish.V
7	963521114011	Anto Sibinson.A
8	963521114013	ArsathBadhusha.S
9	963521114014	Arul Remo.P
10	963521114020	Jawahar.J.S
11	963521114021	Jebin.Y
12	963521114022	Jenil.K.M
13	963521114034	Nibin.J
14	963521114035	Nithin.E
15	963521114036	Nithin.U
16	963521114041	Sajin.C.V
17	963521114042	Santhosh.S
18	963521114043	Shahil.R

ADVANCED LEARNERS

Sl.No	Reg No	Name of the Student
1	963521114004	Akash.A
2	963521114005	Akash.G
3	963521114006	Akash.K
4	963521114007	Akshay.S
5	963521114012	Ari Krishnan.S.R
6	963521114015	Arun Kumar.S
7	963521114016	Babinesh.S
8	963521114017	Dharsith.S.L
9	963521114018	DhivyaaDharsan.R.S
10	963521114019	Gokul.S
11	963521114023	Jobin Bennet.C.B
12	963521114024	John Bisher.A
13	963521114025	John Franco.J
14	963521114026	JohndlyRoch.G
15	963521114027	Joselin.S
16	963521114028	Kannan.H
17	963521114029	Maruthappa.M
18	963521114030	Mathin.M
19	963521114031	Mohammed Raihan.M
20	963521114032	Mugeshkumar.S
21	963521114033	Murugeswaran.M
22	963521114037	Nithish.K.N
23	963521114038	Paul James.P.S
24	963521114039	RexcilinJino.R
25	963521114040	RixsholSijin.M
26	963521114044	Siva Keerthika.R
27	963521114045	Sivanathan.V
28	963521114046	Sree Dharshan.K.S
29	963521114047	Subilesh.S
30	963521114048	Tarun Raj.M
31	963521114049	Thanga Pooja.S
32	963521114050	Thashbin.K

STELLA MARY'S COLLEGE OF ENGINEERING
Aruthengavillai, Kallukatti Junction, Azhikal Post, Kanyakumari District-629202

DEPARTMENT OF MECHANICAL ENGINEERING

Academic Year: 2023-2024(ODD)

AFTER IAT-I

SLOW LEARNERS LIST

S.No.	Name of the Student	Action plan executed till now
1	Ahilan.A	1. Attendance to class was monitored and warned if frequently absent. 2. Learning support material (2marks/8 marks/13 marks questions) for exam point of view preparation was given. 3. Remedial coaching was conducted for failures that ended up with retest for improving their internal marks. 4. Informed parents about their performance in IAT
2	Albin.X	
3	Anish.V	
4	Anto Sibinson.A	
5	ArsathBadhusha.S	
6	Arul Remo.P	
7	Jawahar.J.S	
8	Jebin.Y	
9	Jenil.K.M	
10	Nibin.J	
11	Nithin.E	
12	Sajin.C.V	
13	Shahil.R	

ADVANCED LEARNERS LIST

S.No.	Name of the Student	Action plan executed till now
1	Abishek.M	1. Attendance to class was monitored regularly. 2. It was decided to collect aptitude/gate questions pertaining to specified topics and solve them in the coaching session allotted after semester examinations. Interested students were asked to solve them in weekend holidays.
2	Agash.G	
3	Santhosh.S	
4	Nithin.U	
5	Anish. V	
6	Akash.A	
7	Akash.G	
8	Akash.K	
9	Akshay.S	
10	Ari Krishnan.S.R	
11	Arun Kumar.S	
12	Babinesh.S	
13	Dharsith.S.L	
14	DhivyaaDharsan.R.S	
15	Gokul.S	
16	Jobin Bennet.C.B	
17	John Bisher.A	
18	John Franco.J	
19	JohndlyRoch.G	
20	Joselin.S	
21	Kannan.H	

22	Maruthappa.M	
23	Mathin.M	
24	Mohammed Raihan.M	
25	Mugeshkumar.S	
26	Murugeswaran.M	
27	Nithish.K.N	
28	Paul James.P.S	
29	RexcilinJino.R	
30	RixsholSijin.M	
31	Siva Keerthika.R	
32	Sivanathan.V	
33	Sree Dharshan.K.S	
34	Subilesh.S	
36	Tarun Raj.M	
37	Thanga Pooja.S	
38	Thashbin.K	

Course Coordinator **HOD**

DEPARTMENT OF MECHANICAL ENGINEERING

Academic Year: 2023-2024(ODD)

AFTER IAT-II

SLOW LEARNERS LIST

SLOW LEARNERS			Action Plan executed
S.No.	Register Number	Name of the Student	
1.	963521114001	Ahilan.A	1.Students were strictly monitored and warned not to take leave when they have exams. 2. Important questions from 2marks and 16 marks questions was given to the students to get pass mark in the coming examinations. 3. Special coaching was conducted for failures and conducted retest for improving their internal marks. 4. For tutorial and coaching classes peer group learning under advanced learners were imparted. 5. Informed parents about their performance in IAT 2.
2.	963521114003	Albin.X	
3.	963521114005	Anish.V	
4.	963521114015	Anto Sibinson.A	
5.	963521114016	ArsathBadhusha.S	
6.	963521114017	Arul Remo.P	
7.	963521114021	Jawahar.J.S	
8.	963521114030	Jebin.Y	
9.	963521114032	Jenil.K.M	
10.	963521114033	Nibin.J	
11.	963521114039	Nithin.E	
12.	963521114040	Sajin.C.V	
13.	963521114010	Anish.V	

ADVANCED LEARNERS LIST

ADVANCED LEARNERS			Action plan executed till now
S.No.	Register Number	Name of the Student	
1.	963521114001	Abishek.M	1. Attendance of the students was monitored regularly and have taken necessary action. 2. Important questions from 2marks and 16 marks questions was given to the students to get pass mark in the coming examinations. 3.Students were encouraged to share their knowledge through participative mode of learning to slow learners during tutorial and coaching sessions.
2.	963521114005	Agash.G	
3.	963521114042	Santhosh.S	
4.	963521114036	Nithin.U	
5.	963521114010	Anish. V	
6.	963521114004	Akash.A	
7.	963521114005	Akash.G	
8.	963521114006	Akash.K	
9.	963521114007	Akshay.S	
10.	963521114012	Ari Krishnan.S.R	
11.	963521114015	Arun Kumar.S	
12.	963521114016	Babinesh.S	
13.	963521114017	Dharsith.S.L	
14.	963521114018	DhivyaaDharsan.R.S	
15.	963521114019	Gokul.S	
16.	963521114023	Jobin Bennet.C.B	
17.	963521114024	John Bisher.A	
18.	963521114025	John Franco.J	
19.	963521114026	JohndlyRoch.G	
20.	963521114027	Joselin.S	
21.	963521114028	Kannan.H	
22.	963521114029	Maruthappa.M	

23.	963521114030	Mathin.M	
24.	963521114031	Mohammed Raihan.M	
25.	963521114032	Mugeshkumar.S	
26.	963521114033	Murugeswaran.M	
27.	963521114037	Nithish.K.N	
28.	963521114038	Paul James.P.S	
29.	963521114039	RexcilinJino.R	
30.	963521114040	RixsholSijin.M	
31.	963521114044	Siva Keerthika.R	
32.	963521114045	Sivanathan.V	
33.	963521114046	Sree Dharshan.K.S	
34.	963521114047	Subilesh.S	
35.	963521114048	Tarun Raj.M	
36.	963521114049	Thanga Pooja.S	
37.	963521114050	Thashbin.K	
38.	963521114022	Shahil.R	

Course Coordinator

HOD

Aruthengavillai, Kallukatti Junction, Azhikal Post, Kanyakumari District-629202

DEPARTMENT OF MECHANICAL ENGINEERING

Academic Year: 2023-2024(EVEN)

AFTER IAT-III

SLOW LEARNERS LIST

SLOW LEARNERS			Action Plan executed
S.No.	Register Number	Name of the Student	
1.	963521114001	Ahilan.A	1.Students were strictly monitored and warned not to take leave when they have exams. 2. Important questions from 2marks and 16 marks questions was given to the students to get pass mark in the coming examinations. 3. Special coaching was conducted for failures and conducted retest for improving their internal marks. 4. For tutorial and coaching classes peer group learning under advanced learners were imparted. 5. Informed parents about their performance in model exam.
2.	963521114003	Albin.X	
3.	963521114005	Anish.V	
4.	963521114015	Anto Sibinson.A	
5.	963521114016	ArsathBadhusha.S	
6.	963521114017	Arul Remo.P	
7.	963521114021	Jawahar.J.S	
8.	963521114030	Jebin.Y	
9.	963521114032	Jenil.K.M	
10.	963521114033	Nibin.J	
11.	963521114039	Nithin.E	
12.	963521114040	Sajin.C.V	
13.	963521114010	Anish.V	
14.			
15.			
16.			

ADVANCED LEARNERS			Action plan executed till now
S.No.	Register Number	Name of the Student	
1.	963521114001	Abishek.M	1. Attendance to class was monitored regularly. 2.It was decided to collect aptitude questions pertaining to specified topics and solve them in the coaching session allotted after semester examinations. Interested students were asked to solve them in weekend holidays.
2.	963521114005	Agash.G	
3.	963521114042	Santhosh.S	
4.	963521114036	Nithin.U	
5.	963521114010	Anish. V	
6.	963521114004	Akash.A	
7.	963521114005	Akash.G	
8.	963521114006	Akash.K	
9.	963521114007	Akshay.S	
10.	963521114012	Ari Krishnan.S.R	
11.	963521114015	Arun Kumar.S	
12.	963521114016	Babinesh.S	
13.	963521114017	Dharsith.S.L	
14.	963521114018	DhivyaaDharsan.R.S	
15.	963521114019	Gokul.S	
16.	963521114023	Jobin Bennet.C.B	
17.	963521114024	John Bisher.A	
18.	963521114025	John Franco.J	
19.	963521114026	JohndlyRoch.G	
20.	963521114027	Joselin.S	
21.	963521114028	Kannan.H	
22.	963521114029	Maruthappa.M	

STELLA MARYS COLLEGE OF ENGINEERINGSTELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District - 629202

Name of the Faculty: DR.L. MARY NOVENA

Department : S&H [PHYSICS]

Course Code : PH3151

Course Name : ENGINEERING PHYSICS

Class : S1/S&H

Academic Year : 2023-2024

Semester : ODD

Regulation : 2021

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthengavillai, Kallukatti Junction, Azhikal Post, Kanyakumari District-629202

SCHEME OF STUDY AND EXAMINATION

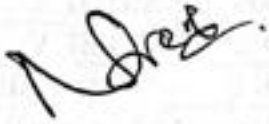
S. No.	COURSE DETAILS	
1.	Regulation	2021
2.	Semester	I
3.	Course Code	PH3151
4.	Course Name	ENGINEERING PHYSICS
5.	Lecture hours/week	9
6.	Duration of examination	3 Hours
7.	Internal Marks	40 marks
8.	University Examination Marks	60 marks
9.	Maximum Marks	100 marks
10.	Maximum Marks for Pass	45 marks
11.	Credit	3

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthengavillai, Kallukatti Junction, Azhikal Post, Kanyakumari District-629202

DEPARTMENT OF SCIENCE AND HUMANITIES

Academic Year: 2021-2022(ODD)

Year/ Semester	Course Code /Name	Course Coordinator	Module Coordinator	Programme Coordinator
1/1	PH3151 / ENGINEERING PHYSICS	DR.L. Mary Novena (Assistant Professsor /S&H)	Mrs. G.Uthaya (Assistant Professsor /S&H)	Mr. S. Ravikumar (Assistant Professor Professsor&Head/S&H)
Signature				

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District– 629 202, Tamil Nadu

Student Name List

SL.NO	REGISTER NO	NAME
1	963523114001	ABISHEK M
2	963523114002	AGASH G
3	963523114003	AHILAN A
4	963523114004	AKASH A
5	963523114005	AKASH G
6	963523114006	AKASH K
7	963523114007	AKSHAY S
8	963523114008	ALBIN X
9	963523114009	ANISH V
10	963523114010	ANISH V
11	963523114011	ANTO SIBINSON A
12	963523114013	ARIKRISHNAN S R
13	963523114014	ARSATH BADHUSHA S
14	963523114015	ARUL REMO P
15	963523114016	ARUN KUMAR S
16	963523114017	BABINESH S
17	963523114018	DHARSITH S L
18	963523114019	DHIVYAA DHARSAN R S
19	963523114020	GOKUL S
20	963523114021	JAWAHAR J S
21	963523114022	JEBIN Y
22	963523114023	JENIL K M
23	963523114024	JOBIN BENNET C B
24	963523114025	JOHN BISHER A
25	963523114026	JOHNDLY ROCH G
26	963523114027	JOHN FRANCO J
27	963523114029	KANNAN H
28	963523114030	MARUTHAPPA M
29	963523114031	MATHIN M
30	963523114032	MOHAMMED RAIHAN M
31	963523114033	MUGESHKUMAR S
32	963523114035	NIBIN J
33	963523114037	NITHIN U
34	963523114039	NITHISH K N
35	963523114040	PAUL JAMES P S
36	963523114041	REXCILIN JINO R
37	963523114042	RISMI V J
38	963523114043	RIXSHOL SIJIN M
39	963523114045	SANTHOSH S

40	963523114046	SHAHIL R
41	963523114047	SIVA KEERTHIKA R
42	963523114048	SIVANATHAN V
43	963523114049	SREE DHARSAN K S
44	963523114050	SUBILESH S
45	963523114051	TARUN RAJ M
46	963523114052	THANGA POOJA S
47	963523114053	THASHBIN K K

Course Coordinator

HOD

SLOW LEARNERS AND ADVANCED LEARNERS – ACTION PLAN

The students were segregated into slow learners and advanced learners based on their marks obtained in +2. The action plan is framed accordingly and is to be discussed with the module coordinator.

SLOW LEARNERS			
S.No.	Register Number	Name of the Student	Action Plan Framed
1.	963523114001	ABISHEK M	
2.	963523114002	AGASH G	
3.	963523114003	AHILAN A	
4.	963523114011	ANTO SIBINSON A	
5.	963523114013	ARIKRISHNAN S R	
6.	963523114014	ARSATH BADHUSHA S	
7.	963523114015	ARUL REMO P	
8.	963523114022	JEBIN Y	
9.	963523114023	JENIL K M	
10.	963523114025	JOHN BISHER A	
11.	963523114045	SANTHOSH S	
12.	963523114046	SHAHIL R	

ADVANCED LEARNERS			
S.No.	Register Number	Name of the Student	Action Plan Framed
	963523114004	AKASH A	1. To monitor the regularity in attending class. 2. To give learning support in terms of important 2marksand 16marks questions. 3. To give assignments on important topics/topics of their own interest pertaining to the unit. 4. To encourage them to share their knowledge through participative mode of learning. 5. To encourage them to involve in peer group learning to become more confident in the concepts learnt.
1.	963523114005	AKASH G	
2.	963523114006	AKASH K	
3.	963523114007	AKSHAY S	
4.	963523114008	ALBIN X	
5.	963523114009	ANISH V	
6.	963523114010	ANISH V	
7.	963523114016	ARUN KUMAR S	
8.	963523114017	BABINESH S	
9.	963523114018	DHARSITH S L	
10.	963523114019	DHIVYAA DHARSAN R S	
11.	963523114020	GOKUL S	
12.	963523114021	JAWAHAR J S	
13.	963523114022	JEBIN Y	
14.	963523114023	JENIL K M	
15.	963523114024	JOBIN BENNET C B	
16.	963523114025	JOHN BISHER A	
17.	963523114026	JOHNDLY ROCH G	
18.	963523114027	JOHN FRANCO J	
19.	963523114029	KANNAN H	
20.	963523114030	MARUTHAPPA M	
21.	963523114031	MATHIN M	
22.	963523114032	MOHAMMED RAIHAN M	
23.	963523114033	MUGESHKUMAR S	

24.	963523114035	NIBIN J	
25.	963523114037	NITHIN U	
26.	963523114039	NITHISH K N	
27.	963523114040	PAUL JAMES P S	
28.	963523114041	REXCILIN JINO R	
29.	963523114042	RISMI V J	
30.	963523114043	RIXSHOL SIJIN M	
31.	963523114045	SANTHOSH S	
32.	963523114046	SHAHIL R	
33.	963523114047	SIVA KEERTHIKA R	
34.	963523114048	SIVANATHAN V	
35.	963523114049	SREE DHARSAN K S	
36.	963523114050	SUBILESH S	
37.	963523114051	TARUN RAJ M	
38.	963523114052	THANGA POOJA S	
39.	963523114053	THASHBIN K K	

Course Coordinator

Hod

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthengavillai, Kallukatti Junction, Azhikal Post, Kanyakumari District-629202

DEPARTMENT OF SCIENCE AND HUMANITIES

Academic Year: 2021-2022 (ODD)

YEAR/SEMESTER: I/1

COURSE CODE: PH3151

COURSE NAME: ENGINEEERING PHYSICS

RESULT ANALYSIS (AFTER IAT1)

Date: 8/4/23

SLOW LEARNERS			MARKS		HH (18+18)	HA	%	IM
S.No.	Register Number	Name of the Student	IAT1	IAT1 (R)				
1.	963523114001	ABISHEK M	8	21	29	24	83	75
2.	963523114002	AGASH G	5	57	29	29	100	70
3.	963523114003	AHILAN A	0	30	29	29	100	75
4.	963523114011	ANTO SIBINSON A	22	52	29	24	83	75
5.	963523114013	ARIKRISHNAN S R	12	53	29	25	86	70
6.	963523114014	ARSATH BADHUSHA S	AB	51	29	27	93	80
7.	963523114015	ARUL REMO P	2	52	29	29	100	70
8.	963523114022	JEBIN Y	32	50	29	25	86	75
9.	963523114023	JENIL K M	50	—	29	25	86	75
10.	963523114025	JOHN BISHER A	33	-	29	26	90	75
11.	963523114045	SANTHOSH S	3	42	29	28	97	75
12.	963523114046	SHAHIL R	5	43	29	24	83	75
13.	963523114027	JOHN FRANCO J	6	—	29	26	90	80
14.	963523114041	REXCILIN JINO R	0	-	29	29	100	80

ADVANCED LEARNERS			MARKS		HH (18+18)	HA	%	IM
S.No.	Register Number	Name of the Student	IAT 1	IAT1 (R)				
1.	963523114004	AKASH A	53	-	29	29	100	80
2.	963523114005	AKASH G	53	-	29	29	100	80
3.	963523114006	AKASH K	51	-	29	29	100	80
4.	963523114007	AKSHAY S	52	-	29	25	86	85
5.	963523114008	ALBIN X	50	-	29	24	83	80
6.	963523114009	ANISH V	50	-	29	29	100	85
7.	963523114010	ANISH V	50	-	29	29	100	80
8.	963523114016	ARUN KUMAR S	63	-	29	29	100	80
9.	963523114017	BABINESH S	60	-	29	25	86	85
10.	963523114018	DHARSITH S L	57	-	29	24	83	80
11.	963523114019	DHIVYAA DHARSAN R S	52	-	29	27	93	80
12.	963523114020	GOKUL S	83	-	29	29	100	85
13.	963523114021	JAWAHAR J S	50	-	29	25	86	80
14.	963523114022	JEBIN Y	56	-	29	24	83	85
15.	963523114023	JENIL K M	50	-	29	24	83	80
16.	963523114024	JOBIN BENNET C B	80	-	29	29	100	85
17.	963523114025	JOHN BISHER A	57	-	29	24	83	80
18.	963523114026	JOHNDLY ROCH G	60	-	29	24	83	80
19.	963523114029	KANNAN H	65	-	29	27	93	85
20.	963523114030	MARUTHAPPA M	85	-	29	29	100	80
21.	963523114031	MATHIN M	80	-	29	24	83	80

22.	963523114032	MOHAMMED RAIHAN M	60	-	29	29	100	80
23.	963523114033	MUGESHKUMAR S	65	-	29	29	100	80
24.	963523114035	NIBIN J	60	-	29	24	83	85
25.	963523114037	NITHIN U	60	-	29	24	83	80
26.	963523114039	NITHISH K N	57	-	29	29	100	85
27.	963523114040	PAUL JAMES P S	65	-	29	29	100	75
28.	963523114041	REXCILIN JINO R	60	-	29	29	100	70
29.	963523114042	RISMI V J	54	-	29	29	100	80
30.	963523114043	RIXSHOL SIJIN M	AB	-	29	24	83	85
31.	963523114045	SANTHOSH S	50	-	29	29	100	85
32.	963523114047	SIVA KEERTHIKA R	60	-	29	29	100	80
33.	963523114048	SIVANATHAN V	58	-	29	24	83	75
34.	963523114049	SREE DHARSAN K S	52	-	29	29	100	80
35.	963523114050	SUBILESH S	53	-	29	29	100	85
36.	963523114051	TARUN RAJ M	50	-	29	29	100	80
37.	963523114052	THANGA POOJA S	53	-	29	29	100	85
38.	963523114053	THASHBIN K K	53	-	29	29	100	80

IAT(R) - IAT Retest; HH-Hours handled; HA-Hours Attended; IM-Internal Marks awarded

Course Coordinator

HoD

STELLA MARY'S COLLEGE OF ENGINEERING

SAruthengavillai, Kallukatti Junction, Azhikal Post, Kanyakumari District-629202

DEPARTMENT OF SCIENCE AND HUMANITIES

Academic Year: 2021-2022(ODD)

ACTION PLAN EXECUTION STATUS (AFTER IAT 1)

SLOW LEARNERS			Action plan executed till now
S.No.	Register Number	Name of the Student	
1.	963523114001	ABISHEK M	1.Students were strictly monitored and warned not to take leave when they have exams. 2. Important questions from 2marks and 16 marks questions was given to the students to get pass mark in the coming examinations. 4. PPT classes were made to make classroom teaching interactive. 5. For tutorial and coaching classes peer group learning under advanced learners were imparted. 6. Class tests were conducted. 7. Informed parents about their performance in IAT 1.
2.	963523114002	AGASH G	
3.	963523114003	AHILAN A	
4.	963523114011	ANTO SIBINSON A	
5.	963523114013	ARIKRISHNAN S R	
6.	963523114014	ARSATH BADHUSHA S	
7.	963523114015	ARUL REMO P	
8.	963523114022	JEBIN Y	
9.	963523114023	JENIL K M	
10.	963523114025	JOHN BISHER A	
11.	963523114045	SANTHOSH S	
12.	963523114046	SHAHIL R	
13.	963523114027	JOHN FRANCO J	
14.	963523114041	REXCILIN JINO R	

ADVANCED LEARNERS			Action plan executed till now
S.No.	Register Number	Name of the Student	
1.	963523114004	AKASH A	1. Attendance of the students was monitored regularly and have taken necessary action. 2. Important questions from 2marks and 16 marks questions was given to the students to get pass mark in the coming examinations. 3.Students were encouraged to share their knowledge through participative mode of learning to slow learners during tutorial and coaching sessions.
2.	963523114005	AKASH G	
3.	963523114006	AKASH K	
4.	963523114007	AKSHAY S	
5.	963523114008	ALBIN X	
6.	963523114009	ANISH V	
7.	963523114010	ANISH V	
8.	963523114016	ARUN KUMAR S	
9.	963523114017	BABINESH S	
10.	963523114018	DHARSITH S L	
11.	963523114019	DHIVYAA DHARSAN R S	
12.	963523114020	GOKUL S	
13.	963523114021	JAWAHAR J S	
14.	963523114022	JEBIN Y	
15.	963523114023	JENIL K M	
16.	963523114024	JOBIN BENNET C B	
17.	963523114025	JOHN BISHER A	
18.	963523114026	JOHNDLY ROCH G	
19.	963523114029	KANNAN H	
20.	963523114030	MARUTHAPPA M	
21.	963523114031	MATHIN M	

22.	963523114032	MOHAMMED RAIHAN M	
23.	963523114033	MUGESHKUMAR S	
24.	963523114035	NIBIN J	
25.	963523114037	NITHIN U	
26.	963523114039	NITHISH K N	
27.	963523114040	PAUL JAMES P S	
28.	963523114041	REXCILIN JINO R	
29.	963523114042	RISMI V J	
30.	963523114043	RIXSHOL SIJIN M	
31.	963523114045	SANTHOSH S	
32.	963523114047	SIVA KEERTHIKA R	
33.	963523114048	SIVANATHAN V	
34.	963523114049	SREE DHARSAN K S	
35.	963523114050	SUBILESH S	
36.	963523114051	TARUN RAJ M	
37.	963523114052	THANGA POOJA S	
38.	963523114053	THASHBIN K K	

Course Coordinator

HoD

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthengavillai, Kallukatti Junction, Azhikal Post, Kanyakumari District-629202

DEPARTMENT OF SCIENCE AND HUMANITIES

Academic Year: 2023-2024 (ODD)

ACTION PLAN EXECUTION STATUS (AFTER IAT 2)

SLOW LEARNERS			
S.No.	Register Number	Name of the Student	
1.	963523114001	ABISHEK M	1.Students were strictly monitored and warned not to take leave when they have exams. 2. Important questions from 2marks and 16 marks questions was given to the students to get pass mark in the coming examinations. 3. Special coaching was conducted for failures and conducted retest for improving their internal marks. 4. For tutorial and coaching classes peer group learning under advanced learners were imparted. 5. Informed parents about their performance in IAT 2.
2.	963523114002	AGASH G	
3.	963523114003	AHILAN A	
4.	963523114011	ANTO SIBINSON A	
5.	963523114013	ARIKRISHNAN S R	
6.	963523114014	ARSATH BADHUSHA S	
7.	963523114015	ARUL REMO P	
8.	963523114022	JEBIN Y	
9.	963523114023	JENIL K M	
10.	963523114025	JOHN BISHER A	
11.			
12.			
13.			
14.			

ADVANCED LEARNERS			Action plan executed till now
S.No.	Register Number	Name of the Student	
1.	963523114045	SANTHOSH S	1. Attendance of the students was monitored regularly and have taken necessary action. 2. Important questions from 2marks and 16 marks questions was given to the students to get pass mark in the coming examinations. 3.Students were encouraged to share their knowledge through participative mode of learning to slow learners during tutorial and coaching sessions.
2.	963523114046	SHAHIL R	
3.	963523114027	JOHN FRANCO J	
4.	963523114041	REXCILIN JINO R	
5.	963523114004	AKASH A	
6.	963523114005	AKASH G	
7.	963523114006	AKASH K	
8.	963523114007	AKSHAY S	
9.	963523114008	ALBIN X	
10.	963523114009	ANISH V	
11.	963523114010	ANISH V	
12.	963523114016	ARUN KUMAR S	
13.	963523114017	BABINESH S	
14.	963523114018	DHARSITH S L	
15.	963523114019	DHIVYAA DHARSAN R S	
16.	963523114020	GOKUL S	
17.	963523114021	JAWAHAR J S	
18.	963523114022	JEBIN Y	
19.	963523114023	JENIL K M	
20.	963523114024	JOBIN BENNET C B	

21.	963523114025	JOHN BISHER A	
22.	963523114026	JOHNDLY ROCH G	
23.	963523114029	KANNAN H	
24.	963523114030	MARUTHAPPA M	
25.	963523114031	MATHIN M	
26.	963523114032	MOHAMMED RAIHAN M	
27.	963523114033	MUGESHKUMA R S	
28.	963523114035	NIBIN J	
29.	963523114037	NITHIN U	
30.	963523114039	NITHISH K N	
31.	963523114040	PAUL JAMES P S	
32.	963523114041	REXCILIN JINO R	
33.	963523114042	RISMI V J	
34.	963523114043	RIXSHOL SIJIN M	
35.	963523114045	SANTHOSH S	
36.	963523114047	SIVA KEERTHIKA R	
37.	963523114048	SIVANATHAN V	
38.	963523114049	SREE DHARSAN K S	
39.	963523114050	SUBILESH S	
40.	963523114051	TARUN RAJ M	

41.	963523114052	THANGA POOJA S	
42.	963523114053	THASHBIN K K	

Course Coordinator

HoD

These students were asked to focus more on the support materials given and make a clear and easy pass in the university exams. Others put as slow learners and medium learners were trained in the most important questions in university point of view and asked to try to make a pass in the university exams.

SLOW LEARNERS		
S.No.	Register Number	Name of the Student
1.	963523114001	ABISHEK M
2.	963523114002	AGASH G
3.	963523114003	AHILAN A
4.	963523114011	ANTO SIBINSON A
5.	963523114013	ARIKRISHNAN S R
6.	963523114014	ARSATH BADHUSHA S
7.	963523114015	ARUL REMO P
8.	963523114022	JEBIN Y
9.	963523114023	JENIL K M
10.	963523114045	SANTHOSH S
11.	963523114046	SHAHIL R
12.	963523114043	RIXSHOL SIJIN M
13.	963523114025	JOHN BISHER A

Expected category of students who would pass in the university exam

S.No.	Register Number	Name of the Student
1.	963523114027	JOHN FRANCO J
2.	963523114041	REXCILIN JINO R
3.	963523114004	AKASH A
4.	963523114005	AKASH G
5.	963523114006	AKASH K
6.	963523114007	AKSHAY S
7.	963523114008	ALBIN X
8.	963523114009	ANISH V
9.	963523114010	ANISH V
10.	963523114016	ARUN KUMAR S
11.	963523114017	BABINESH S
12.	963523114018	DHARSITH S L
13.	963523114019	DHIVYAA DHARSAN R S
14.	963523114020	GOKUL S
15.	963523114021	JAWAHAR J S
16.	963523114022	JEBIN Y
17.	963523114023	JENIL K M
18.	963523114024	JOBIN BENNET C B
19.	963523114025	JOHN BISHER A
20.	963523114026	JOHNDLY ROCH G
21.	963523114029	KANNAN H
22.	963523114030	MARUTHAPPA M
23.	963523114031	MATHIN M

24.	963523114032	MOHAMMED RAIHAN M
25.	963523114033	MUGESHKUMAR S
26.	963523114035	NIBIN J
27.	963523114037	NITHIN U
28.	963523114039	NITHISH K N
29.	963523114040	PAUL JAMES P S
30.	963523114041	REXCILIN JINO R
31.	963523114042	RISMI V J
32.	963523114045	SANTHOSH S
33.	963523114047	SIVA KEERTHIKA R
34.	963523114048	SIVANATHAN V
35.	963523114049	SREE DHARSAN K S
36.	963523114050	SUBILESH S
37.	963523114051	TARUN RAJ M
38.	963523114052	THANGA POOJA S
39.	963523114053	THASHBIN K K

Course Coordinator

HoD

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

TIME TABLE

STELLA MARY'S COLLEGE OF ENGINEERING
Aruthenganvilai, Kallukatti Junction, Azhikal Post
Kanyakumari District - 629 202
DEPARTMENT OF SCIENCE AND HUMANITIE

2023 – 2024
Odd/SI

Time Table for First Year B.E. – 2023 – 2024 (Semester I)

BE Mech

W.E.F: 21/ 09 /2022

DAY ORDER	1 9.00 am – 9.50am	2 9.50 am – 10.40 am	3 10.40 am – 11.30 am	11.30 am – 11.40 am	4 11.40 am – 12.30pm	5 12.30 pm – 1.15 pm	1.15 pm – 2.00 pm	6 2.00 pm – 2.45 pm	7 2.45 pm – 3.30 pm	3. 30 pm – 3.40 pm	8 3.40 pm – 4.20 pm
I	MA 3151	CY 3151	GE 3151		PH 3151	PH 3151		GE 3171 / Python Lab			
II	HS 3151	GE 3151	CY 3151		PH 3151	HS 3151		GE3172 / English Lab		*Interval*	CFI
III	PH 3151	CY 3151	Library		MA 3151	GE 3151		MA 3151	CC		CC
IV	GE 3151	MA 3151	HS 3151	*Interval*	GE 3151	CY 3151	*LUNCH BREAK*	BS 3171 / Physics & Chemistry Laboratory			
V	CY 3151	HS 3151	GE 3151		MA 3151	GE3152		PH 3151	GE3152	*Interval*	NSS/ Sports
VI	GE3152	MA 3151	MA 3151		PH 3151	HS 3151		CY 3151	GE3152		Mentoring
Saturday	MA 3151	MA 3151	GE 3151		CY 3151	PH 3151		HS 3151			

Course & Faculty Details

Sl NO	Subject Code	Subject	No. of periods	Name of the Staff	Abbreviation
1	HS3152	Professional English - I	5+1	Mr. S. Sherin	SS
2	MA3151	Matrices and Calculus	7+2	Mr. S. Prince Felix	SPF
3	PH3151	Engineering Physics	6+1	Dr. L. Mary Novena	LMN
4	CY3151	Engineering Chemistry	6+1	Dr. M. Benjamin	MB
5	GE3151	Problem Solving &Python Programming	6+1	Mrs. S. V. Breethy	SVB
6	GE3152	Heritage of Tamils	4	Mrs. D. Angelin Jeba	DAJ
7	BS3171	Physics & Chemistry Laboratory	4	Dr. L. Mary Novena /Dr. M. Benjamin	LMN /MB
8	GE3171	Problem Solving&Python Programming Laboratory	4	Mrs. S. V. Breethy	SVB
9	GE3172	English Laboratory	2	Mr. S. Sherin	SS
10		NSS/Library/Sports/ Mentoring	3	LMN/DAJ/ Mr. K. Bensiger	
11		CFI	1	Dr. PonPartheeban& Team	

Class committee chairperson : **Dr. S. A. Sumi**

Class- incharge : **Dr. L. Mary Novena**

Faculty Adviser (1-15): **Dr. L. Mary Novena,** Faculty Adviser (16-33):**Mrs. Angelin Jeba,** Faculty Adviser (34-52):**Mr. K. Bensiger**

Time Table Incharge **HOD** **Principal**

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

CURRICULAR GAP IDENTIFICATION

STELLA MARY'S COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai and Accredited by NAAC)
Aruthengavilai, Kallukatti Junction Azhikal Post, Kanyakumari District-629202, Tamil Nadu.

ENGINEERING PHYSICS

IDENTIFICATION OF CURRICULAR GAP

REGULATION	**2021**
YEAR	**I**
SEMESTER	**I**
COURSE NAME	**ENGINEERING PHYSICS**
COURSE CODE	**PH3151**
NAME OF THE COURSE INSTRUCTOR	**Dr. L. MARY NOVENA**

COURSE OBJECTIVE

To provide students with the knowledge of variety of important concepts of Physics and their applications in Engineering and Technology

SYLLABUS:

UNITI **CLASSICAL MECHANICS** **5**

Introduction – Newton's Law of Motion– Circular motion – Momentum and impulse – Potential energy and kinetic energy –Angular momentum– Rotations and Translation-Rolling

UNITII **ELECTROMAGNETIC WAVES** **5**

Mathematical Background: Gradient, Divergence, curl (Physical Significance), Irrotational& Solenoidal Field, Gauss Divergence and Stoke's Theorem, Important Vector Identities

UNITIII **OSCILLATIONS, OPTICS &LASER** **3**

Huygen's principle-Interference of light-Diffraction of light-Newton's ring-Laser communication

UNITIV **BASIC QUANTUM PHYSICS** **3**

Need of quantum mechanics –black body radiation-photoelectric effect

UNITV **APPLIED QUANTUM MECHANICS** **3**

X-ray production-Photoelectric effects –.2-slit experiment-quantum dots

TOOL 1: Programme Articulation Matrix

Course Outcome (CO)		Bloom s level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
At the end of the course the student will be able to																	
CO1	Understand the importance of mechanics	5	3	3	2	1	1	1	2	1	2	2	1	1	2	2	2
CO2	Express their knowledge in electromagnetic waves	5	3	3	2	1	2	1	1	1	2	1	1	1	1	1	1
CO3	Demonstrate a strong foundational knowledge in oscillations, optics and lasers	1	3	3	2	2	2	1	2	1	2	1	1	1	2	2	2
CO4	Understand basic fundamental concepts associated with quantum mechanics	5	3	3	1	1	2	1	2	1	2	2	1	2	2	2	2
CO5	Comprehend and apply quantum mechanical principles towards the formation of energy bands	3	3	3	1	1	2	1	2	1	1	2	1	1	1	1	1

Sl. No	POs/PSOs		Curricular Gap	Steps Taken
1	PO1	-	-	-
2	PO2	-		
3	PO3	-		
4	PO4	-		
5	PO5	-		
6	PO6	-		-
7	PO7	2	Environment and sustainability are needed	Basic concepts are given
8	PO8	1	Ethics	Power point presentation are given to apply the principles
9	PO9	2	Individual and team work	Small projects are given
10	PO10	1	Presentation and communication are needed	Soft skill training is imparted to students
11	PO11	1	Project management and finance	Experiments were given through lab
12	PO12	1	Lifelong learning methods are imparted to students	Presentation by students were conducted

11	PO11	1	Project management and finance	Experiments were given through lab
12	PO12	1	Lifelong learning methods are imparted to students	Presentation by students were conducted
13	PSO1	2		Experiential learning was given
14	PSO2	2		Model based learning was given
15	PSO3	2		Students are motivated to do projects and presented by the individual or team

Course Coordinator **Module Coordinator** **Programme Coordinator**

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

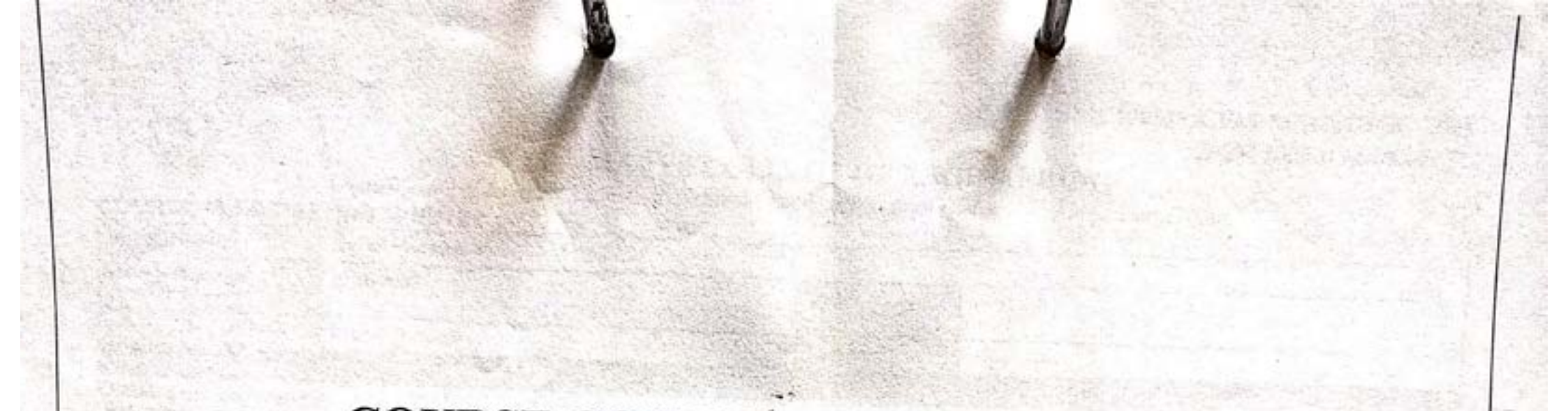
2023 - 2024

COURSE CO-ORDINATOR

&

MODULE CO-ORDINATOR

MEETING MINUTES



COURSE COORDINATOR &MODULE COORDINATOR MEETING - MINUTES

STELLA MARYS COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District– 629 202, Tamil Nadu

COURSE PLAN MEETING MINUTES

Meeting Name:	Course Plan Meeting		
Date of Meeting: (MM/DD/YYYY)	15-10-2023	**Time:**	10-11 AM
Minutes Prepared By:	Course Instructor	**Location:**	*Physics Lab*

1. Meeting Objective

Effective curriculum delivery

To discuss about academic year 2021-2022 (odd) course plan , course file initiation.

Name	Department	E-mail	Phone
G. Uthaya	Physics	uthayaelangopranov@gmail com	8870848034

3. AGENDA ITEM	4. OUTCOMES / DECISIONS	5. ACTIONS TO BE TAKEN, COMMUNICATIONS REQUIRED	6. Date & Time of completion
1.SYLABUS ANALYSIS	i) The Anna university syllabus has been discussed. ii) The departmental calendar has been referred.		
2.TEACHIHNG METHODOLOGY	1. i) It is decided to follow the standard text book by Dr. G. Senthil Kumar"VR Publishers Pvt.Ltd." ii) It is decided to use ICT tools like PPT , flipped videos and animation videos related to topics		
3. SYLLABUS COVERAGE	Syllabus coverage should be in accordance with the course plan and has to be recorded in the personal log .		
4.ACTION PLAN FOR FAST LEARNERS AND SLOW LEARNERS	i) Remedial coaching is planned for slow learners and special coaching is planned for fast learners.		
5.APPROVAL OF COURSE DETAIL FORM	i) The prepared course Detail form consisting the course plan, course articulation matrix has been approved.		
6.COURSE FILE	i) Course file has to be properly maintained with syllabus, time table, course detail form, previous year question papers, evidence for special coaching, assessment and model question papers with keys, evidence for ICT tools usage, experiential, model based, participative learning.		

Summary of Review Outputs

- The matters discussed will be implemented and will be monitored by the program coordinator concerned in coordination with the Principal

7. Next Meeting (if applicable)					
Date: (MM/DD/YYYY)	Will be informed later	**Time:**	-	**Location:**	-
Objective:	-				

S.No.	Name	Designation	Department
1.	Mrs. G. Uthaya	Course Coordinator/ Assissant.Prof	S&H
2.	Dr. L. Mary Novena	Module Coordinator/ Assissant. Prof	S&H
3.	Mr. S. RaviKumar	Program Coordinator/ Assissant. Prof	S&H

Signature: .....
Course Coordinator

Signature: .....
Module Coordinator

Signature: .....
Program Coordinator

Signature: .....
Principal

SMCE/S&H/MC-PL-01/MGAA
2023- 2024 (Odd/Even)

STELLA MARYS COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District– 629 202, Tamil Nadu

COURSE PLAN MEETING AGENDA (12/10/2023)

Meeting Name:	***Course Coordinator with Module CoordinatorMeeting***		
Date of Meeting: (DD/ MM /YYYY)	15/10/2023	**Time:**	10.00-11 PM
Meeting Chair:	Mr. S. Ravikumar	**Location:**	*Physics Lab.*
Meeting Facilitator:	Dr. L. Mary Novena		
Meeting Minute Taker:	Mrs. G Uthaya	**Meeting Documenter:**	Mrs. G Uthaya

1. Meeting Objective

To nominate the course coordinator 1and module coordinator for the academic year 2021 -2022 (Odd)

2. Attendees

Name	Department	E-mail	Phone
Mr. Ravikumar/(Programme coordinator)	HOD/S&H	raviyear@gmail.com	9597820124
Dr. L. Mary Novena/(Module Coordinator)	AP/ S&H	pinkyjustin4@gmail.com	9715266206
Mrs. G Uthaya/(course coordinator)	AP/ S&H	uthayaelangopranov@gmail.com	9489282287

3. Meeting Agenda

Topic	Time
1. SYLLABUS ANALYSIS	
2. TEACHING METHODOLOGY	
3. ACTION PLAN FOR FAST LEARNERS AND SLOW LEARNERS	
4. APPROVAL OF COURSE DETAIL FORM	
5. COURSE FILE	

Signature: .....

HEAD OF THE DEPARTMENT

Signature: .....

PRINCIPAL

COURSE COORDINATOR &MODULE COORDINATOR MEETING -AGENDA

SMCE/S&H/MC-PL-01/MGMS
2022-2023 EVEN

STELLA MARY'S COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai)
Aruthenganvilai, Kallukatti Junction Azhikal Post, Kanyakumari District-629202, Tamil Nadu.

DEPARTMENT OF SCIENCE AND HUMANITIES

Date: 12-10-2023

Minutes of the Module Coordinator meeting of ~~physics~~ Physics was held on the 15th of October 2023, at 10:00 AM, in the Physics lab of the S&H Department.

1.01 Appraisal of role as a Module coordinator

The roles of a module coordinator as appraised in the PAB conducted on 05.10.2023 were recollected. It was informed that .....number of courses have been mapped under this stream till now.

1.02. Detailed orientation to write course outcomes

The need for writing the Course Objectives and Course Outcomes was appraised. Course outcomes were insisted to be written using the action words as per Blooms Taxonomy. Course Outcomes should be able to describe what the students are expected to know, and what they would be able to do at the end of each course related to the skills, knowledge and behaviour that students would acquire as they progress through the course.

The course outcomes written by the course coordinators were verified and suggestions to improve/correct were given.

1.03 Detailed orientation on framing Course Articulation matrix

After framing the Course outcomes, it was told that the course outcomes have to be mapped with the POs listed by NBA. The methodology to map the COs with POs was taught with respect to the three correlation levels (1-low,2-medium,3-high).Similar mapping was asked to be done with respect to the PSOs after its framing.

It was told that, the altogether mapping of all the fifteen programme outcomes would form the course articulation matrix.

The course articulation matrices for the courses handled till now was asked to be submitted for verification before 19.10.2023.

1.04 Detailed orientation on CO and PO attainments and tools used to evaluate

After framing the Course outcomes, it was told that the attainment of the COs and POs has to be assessed by means of direct and indirect assessment tools.

It was explained that the Direct methods of assessment are those based on the direct examination or observation of students'

knowledge or skills against measurable performance indicators. It was told that the indirect methods of assessment are based on finding out opinions or some self-reports. Rubrics were asked to be framed for indirect assessment.

It was instructed that the direct tools for assessment of COs and POs would be Internal Assessment tests, Model examinations, Assignments, Laboratory assessments and Project assessments.

It was also instructed that the indirect tools for assessment of COs and POs would be Course Exit Survey and Programme Exit Survey respectively.

The levels of attainment (low-1, medium-2 and high-3) are attained based on the bench mark score that is fixed. It was told that based on the accomplishment of the University results the bench mark score has to be fixed. The minimum fixed value must not be less than 50%.

The course coordinators were asked to make the Attainment calculations for all these assessments so that based on all these the continuous improvement plan can be framed for all course at the end.

The CO attainment and the PO attainment for all the course handled till now was asked to be submitted before 19.10.2023

1.05. Detailed orientation on Curricular Gap identification and bridging

It was instructed to the course coordinators that based on the CO- PO mapping the curricular gap identification has to be done and has to be addressed by means of Content beyond the syllabus.

It could be addressed to the students through various means like workshops, hands on training programmes, value added courses, certification courses etc. It was informed that this has to be done for all the courses from the next academic year.

Mrs. L. Mary Novena thanked everyone for their presence and the meeting came to an end.

Attendance at the meeting:

Members	Signature
1. Dr. L. Mary Novena, Module Coordinator PH3151-Engineering Physics	
2. Mrs. G.Uthaya PH3151-Engineering Physics	
3. Mrs. Anshy Tom Dhanya PH3151-Engineering Physics	
4. Mrs. Angelin Jeba PH3151-Engineering Physics	

MODULE COORDINATOR **PROGRAMME COORDINATOR**

2022 - 2023 (Even)
2023 - 2024
ODD -

STELLA MARY'S COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai)
Aruthenganvilai, Kallukatti Junction Azhikal Post, Kanyakumari District-629202, Tamil Nadu

DEPARTMENT OF SCIENCE AND HUMANITIES

CIRCULAR

Date: 22-11-2023

The first Module Coordinator meeting of the Physics for the odd semester is scheduled on 25th of November 2023, at 12.30 PM. in the Physics Laboratory.

AGENDA

1. Recap of the previous year's comments for continuous improvement.
2. Fixation of benchmark score.
3. Implementation of the Assessment plan for continuous improvement of the course for this year.
4. Appraisal of curricular gap remedies.

MODULE COORDINATOR

Circulated to

S.No.	Name of the Course Coordinator	Course Code/Name
1.	Dr. L. Mary Novena	PH3151
2.	Mrs. G. Uthaya	PH3151
3.	Mrs. A. Anshy Tom Dhanya	PH3151
4.	Mrs. D. Angelin Jeba	PH3151

2023-2024 ODD

STELLA MARY'S COLLEGE OF ENGINEERING

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Aruthenganvilai, Kallukatti Junction Azhikal Post, Kanyakumari District-629202, Tamil Nadu)

DEPARTMENT OF SCIENCE AND HUMANITIES

CIRCULAR

Date: 07.03.2024

The second Module Coordinator meeting of ~~Chemistry~~ Physics for the odd semester is scheduled on 9th of March 2024, at 12:30 PM, in the physics Laboratory.

AGENDA

1. CO Attainment analysis check – after IAT2.

MODULE COORDINATOR

Circulated to

S.No.	Name of the Course Coordinator	Course Code/Name
1.	Dr. L. Mary Novena	PH3151
2.	Mrs. G. Uthaya	PH3151
3.	Mrs. A. Anshy Tom Dhanya	PH3151
4.	Mrs. D. Angelin Jeba	PH3151

Attendance at the meeting:

Members	Signature
Dr. L. Mary Novena Module Coordinator (PH3151-Engineering Physics)	
Mrs. G. Uthaya Course Coordinator (PH3151- Engineering Physics)	
Mrs. A.Anshy Tom Dhanya Course Coordinator (PH3151- Engineering Physics)	
Mrs. D. Angelin Jeba Course Coordinator (PH3151- Engineering Physics)	

MODULE COORDINATOR

PROGRAMME COORDINATOR

~~2021-2022 ODD~~

STELLA MARY'S COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai)
Aruthenganvilai, Kallukatti Junction Azhikal Post, Kanyakumari District-629202,Tamil Nadu)

DEPARTMENT OF SCIENCE AND HUMANITIES

CIRCULAR

Date: 14-03-2024

The third Module Coordinator meeting of chemistry for the odd semester is scheduled on 15th of March 2024, at 12:30 PM, in the physics lab.

AGENDA

1. CO Attainment analysis check – After Model exam
2. PO attainment analysis check– After Model exam
3. Continuous improvement plan

MODULE COORDINATOR

Circulated to

S.No.	Name of the Course Coordinator	Course Code/Name
1.	Dr. L. Mary Novena	PH3151
2.	Mrs. G. Uthaya	PH3151
3.	Mrs. A. Anshy Tom Bhanya	PH3151
4.	Mrs. D. Angelin Jeba.	PH3151

5	PH3151-Engineering physics CIVIL		-	Target Attained

Attendance at the meeting:

Members	Signature
Dr. L. Mary Novena Module Coordinator (PH3151-Engineering Physics)	
Mrs. Uthaya Course Coordinator (PH3151-Engineering Physics)	

Mrs. Anshy Tom Dhanya. A

Mrs. Angelin Jeba. D

MODULE COORDINATOR

PROGRAMME COORDINATOR

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

CONTENT BEYOND SYLLABUS

STELLA MARY'S COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai and Accredited by NAAC)
Aruthenganvilai, Kallukatti Junction Azhikal Post, Kanyakumari District-629202, Tamil Nadu.

DEPARTMENT OF MECHANICAL ENGINEERING

IDENTIFICATION OF CURRICULAR GAP

REGULATION	2021
YEAR	I
SEMESTER	I
COURSE NAME	ENGINEERING PHYSICS
COURSE CODE	PH3151
NAME OF THE COURSE INSTRUCTOR	Dr. L. MARY NOVENA

COURSE OBJECTIVE

To provide students with the knowledge of variety of important concepts of Physics and their applications in Engineering and Technology

SYLLABUS:

UNITI CLASSICAL MECHANICS 7

Introduction – Newton's Law of Motion– Circular motion – Momentum and impulse – Potential energy and kinetic energy –Angular momentum– Rotations and Translation-Rolling

UNITII ELECTROMAGNETIC WAVES 8

Mathematical Background: Gradient, Divergence, curl (Physical Significance), Irrotational& Solenoidal Field, Gauss Divergence and Stoke's Theorem, Important Vector Identities

UNITIII OSCILLATIONS, OPTICS &LASER 9

Huygen's principle-Interference of light-Diffraction of light-Newton's ring-Basic Application of OFs in Sensing & Communication. Hollow Core Photonic Crystal Fibers

UNITIV BASIC QUANTUM PHYSICS 6

Need of quantum mechanics –Postulates of quantum mechanics- photons – Wave equation- Planck law – Energy quantization -Boltzmann distribution.

UNITV APPLIED QUANTUM MECHANICS 4

X-ray production-Photoelectric effects –.2-slit experiment-quantum dots

.

TOOL 1: Programme Articulation Matrix

Course Outcome (CO)		Blooms level	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
At the end of the course the student will be able to																	
CO1	Understand the importance of mechanics	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	Express their knowledge in electromagnetic waves	5	1	1	1	1	2	1	1	1	1	1	1	1	3	2	2
CO3	Demonstrate a strong foundational knowledge in oscillations, optics and lasers	1	1	1	1	1	1	1	2	1	2	2	2	2	1	1	2
CO4	Understand basic fundamental concepts associated with quantum mechanics	5	2	2	2	1	2	1	1	1	1	1	2	1	2	2	2
CO5	Comprehend and apply quantum mechanical principles towards the formation of energy bands	3	1	1	2	2	1	2	1	1	1	1	2	2	2	2	2

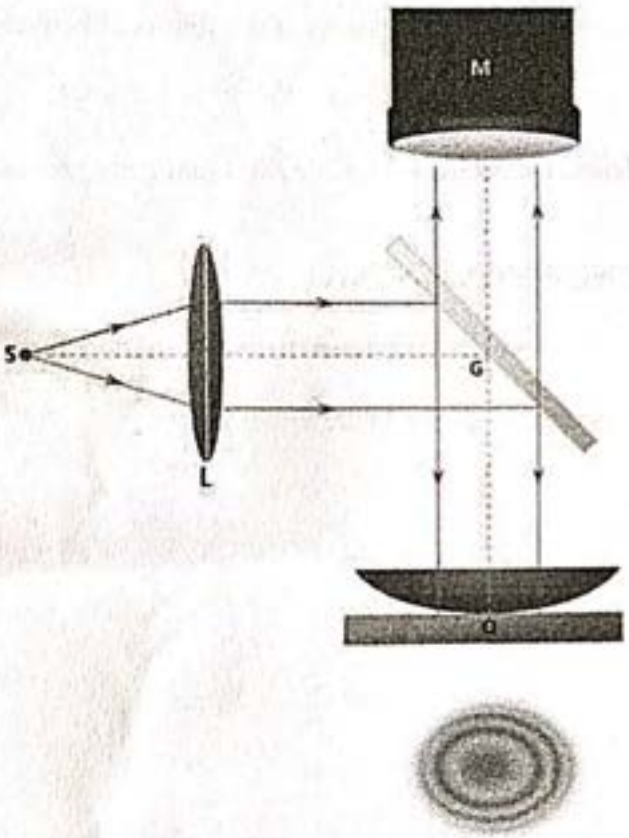
Course Coordinator

Module Coordinator

Programme Coordinator

NEWTON'S RING

When a plano-convex lens with its convex surface is placed on a plane glass plate, an air film of gradually increasing thickness is formed between the lens and the glass plate. The thickness of the air film is almost zero at the point of contact O and gradually increases as one proceeds towards the periphery of the lens. If monochromatic light is allowed to fall normally on the lens, and the film is viewed in reflected light, alternate bright and dark concentric rings are seen around the point of contact. These rings were first discovered by Sir Isaac Newton, hence named as **Newton's Rings**. If it is viewed with the white light then coloured fringes are obtained. The experimental arrangement of the Newton's Ring apparatus is shown in *figure 1*.



S	Monochromatic Source
L	Convex Lens
M	Microscope
G	Glass Plate inclined at an angle of 45°
O	Centre of Plano-convex lens

Fig. 1: Experimental arrangement of the Newton's Ring apparatus

A parallel beam of monochromatic light is reflected towards the lens *L*. Consider a beam of monochromatic light strikes normally on the upper surface of the air film. The beam gets partly reflected and partly refracted. The refracted beam in the air film is also reflected partly at the lower surface of the film. The two reflected rays, i.e. produced at the upper and lower surface of the film, are coherent and interfere constructively or destructively. When the light reflected upwards is observed through microscope *M* which is focused on the glass plate, a pattern of dark and bright concentric rings are observed from the point of contact *O*. These concentric rings are known as *Newton's Rings*.

The path difference between the two successive reflected rays are obtained using wedge shaped interference case as:

$$\Delta = 2\mu t\cos(r+\theta) \pm \lambda/2 \quad (1)$$

For air film, $\mu = 1$ and at normal incidence, $i = r = 0$. Since, θ is very small then $\cos\theta = 1$. Hence, eq. (1) reduces to

$$\Delta = 2t \pm \lambda/2 \quad (2)$$

At the point of contact of the lens and the glass plate (O), the thickness of the film is effectively zero i.e. $t = 0$

$$\Delta = \pm\lambda/2 \quad (3)$$

This is the condition for minimum intensity. Hence, the centre of Newton rings generally appears dark.

DIAMETER OF NEWTON'S RING

Diameter of Bright Rings:

Consider a ring of radius r due to thickness t of air film as shown in the *figure 2.*

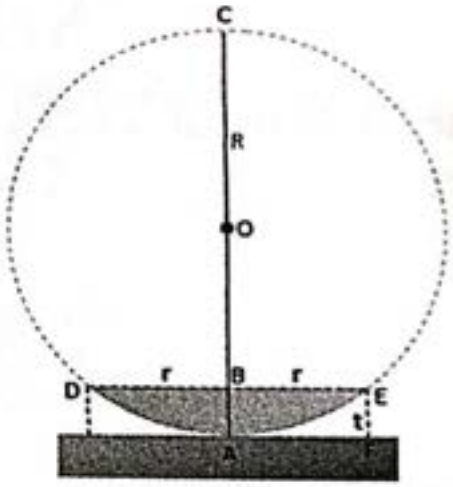


Fig. 2.

According to the geometrical theorem (i.e. property of the circle), the product of intercepts of the intersecting chord is equal to the product of sections of the diameter.

$$\overline{DB} \times \overline{BE} = \overline{AB} \times \overline{BC} \quad (4)$$

$$r \times r = t(2R - t) \quad (5)$$

$$r^2 = 2Rt - t^2 \quad (6)$$

Since t is very small hence t^2 will also be negligible, thus,

$$r^2 = 2Rt \quad (7)$$

$$t = \frac{r^2}{2R} \tag{8}$$

a. ***Condition for a bright ring (constructive interference in thin film)***

$$2\mu t = (2n-1)\frac{\lambda}{2} \qquad \text{where } n=1, 2, 3..... \tag{9}$$

Putting eq. (8) in eq. (9) we get

$$2\mu\left(\frac{r^2}{2R}\right) = (2n-1)\frac{\lambda}{2} \tag{10}$$

Radius of the n^{th} bright ring becomes

$$r_n^2 = (2n-1)\frac{\lambda R}{2\mu} \tag{11}$$

Thus diameter of the n^{th} bright ring is

$$\left(\frac{D_n}{2}\right)^2 = (2n-1)\frac{\lambda R}{2\mu} \tag{12}$$

$$D_n^2 = 2(2n-1)\frac{\lambda R}{\mu} \tag{13}$$

$$D_n = \sqrt{2(2n-1)\frac{\lambda R}{\mu}} \tag{14}$$

If the medium considered is air then $\mu = 1$ and eq. (14) simplifies to

$$D_n = \sqrt{2(2n-1)\lambda R} \tag{15}$$

$$D_n \propto \sqrt{(2n-1)} \qquad \text{where } n = 1, 2, 3..... \tag{16}$$

Thus, ***diameter of the bright rings is proportional to the square root of odd natural numbers.***

b. ***Condition for a dark ring (destructive interference in thin film)***

$$2\mu t = n\lambda \qquad \text{where } n = 0,1, 2, 3..... \tag{17}$$

Putting eq. (8) in eq. (17) we get

$$2\mu\frac{r^2}{2R} = n\lambda \tag{18}$$

Radius of the n^{th} dark ring becomes

$$r_n^2 = \frac{n\lambda R}{\mu} \tag{19}$$

Thus, diameter of the n^{th} dark ring is

$$\left(\frac{D_n}{2}\right)^2 = \frac{n\lambda R}{\mu} \tag{20}$$

$$D_n^2 = \frac{4n\lambda R}{\mu} \tag{21}$$

$$D_n = \sqrt{\frac{4n\lambda R}{\mu}} \qquad \text{where } n = 0, 1, 2, 3..... \tag{22}$$

If the medium considered is air then $\mu = 1$ and eq. (22) simplifies to

$$D_n = \sqrt{4n\lambda R} \tag{23}$$

$$D_n \propto \sqrt{4n\lambda R} \qquad \text{where } n = 0, 1, 2, 3..... \tag{24}$$

Thus ***diameter of the dark rings is proportional to the square root of the natural numbers.***

APPLICATIONS OF NEWTON'S RING

1. Determination of Wavelength of Monochromatic Light (λ)

The diameter of the n^{th} dark ring is given by:

$$D_n^2 = 4n\lambda R \tag{25}$$

Similarly, the diameter of the $(n + p)^{th}$ dark ring is given by:

$$D_n^2 = 4(n+p)\lambda R \tag{26}$$

Subtracting eq. (25) from eq. (26), we get

$$\lambda = \frac{D_{n+p}^2 - D_n^2}{4pR} \tag{27}$$

where, p is an integer.

2. Determination of Refractive Index of the Liquid (μ)

The diameter of the n^{th} dark ring in air film is given by:

$$\left(D_n^2\right)_{air} = 4n\lambda R \tag{28}$$

Similarly, the diameter of n^{th} dark ring in liquid film is given by:

$$\left(D_n^2\right)_{liquid} = \frac{4n\lambda R}{\mu} \tag{29}$$

Therefore, the Refractive Index of the Liquid is obtained as:

$$\mu = \frac{\left(D_n^2\right)_{air}}{\left(D_n^2\right)_{liquid}} \tag{30}$$

WAVE PHENOMENA AND LIGHT

HUYGENS' PRINCIPLE

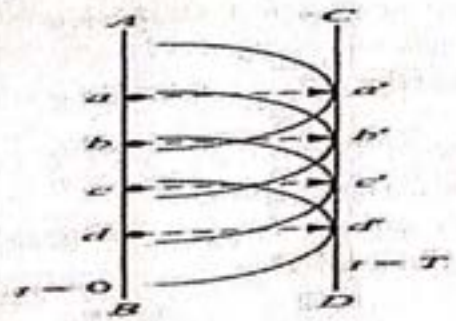
Huygens' postulated that light is a wave, which travels through a hypothetical Medium called ether.

The Huygens'principle states that

Each point on a wavefront becomes a source of secondary disturbance which spreads out in the medium.

- The position of wavefront at any later instant may be obtained by drawing a forward common envelop to all these secondary wavelets at that instant.
- In an isotropic medium, the energy carried by waves is transmitted equally in all directions.
- If the initial shape, position, the direction of motion and the speed of the wavefront is known, its position at a later instant can be ascertained bygeometrical construction.

Propagation of Waves

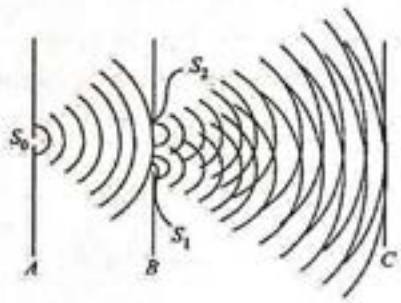


Interference of Light

Interference of light refers to redistribution of energy due to superposition of light waves from two coherent sources.

Young's Double Slit Experiment

- Sunlight was allowed to pass through a pin hole S and then, at some distance away, through two pin holes S1 and S2 equidistant from S and close to each other.
- spherical wavefronts would spread Instruments out from the pin hole S which get divided into two wavefronts by S_1 and S_2 .
- If S is illuminated by a monocromatic source of light, such as sodium, these act as coherent sources and in-phase waves of equal amplitude from these sources superpose as they move beyond S_1S_2



Constructive Interference

the superposition principle that some points on the screen C will have maximum displacement (or amplitude) because the crests due to one set of waves coincide with the crests due to another set of waves.

- points will appear bright because the intensity of light wave is proportional to the square of the amplitude.
- Superposition of waves at these points leads to what is known as constructive interference

Destructive Interference:

- The points where the crests due to one set of waves coincide with the troughs due to the other set and vice-versa, the totalamplitude is zero.
- It is so because the waves reach these points completely out of phase. Such points appear dark on the screen.
- These points correspond to ***destructive interference.***

Intensity of fringes:

To analyse the interference pattern, we calculate the intensity of the bright and dark fringes in the interference pattern for harmonic waves.

$$I \propto A^2$$
$$\propto 4a^2 \cos^2(\delta/2)$$

Phase Difference and Path Difference

The phase difference can be expressed in terms of the path difference between the waves during their journey from the sources to a point on the observation screen.

$$\frac{d}{D}(x_n)_{bright} = n\lambda$$

$$(x_n)_{bright} = \frac{n\lambda D}{d} \; ; n = 0, 1, 2, \ldots$$

$$\frac{d}{D}(x_n)_{dark} = (n + \frac{1}{2})\lambda$$

$$(x_n)_{dark} = (n + \frac{1}{2})\frac{\lambda D}{d} \; ; n = 0, 1, 2, \ldots$$

Fringe width

the fringe width of an interference pattern remains the same for any two consecutive value of n

$$(x_3)_{bright} = 3\frac{\lambda D}{d}$$

and $$(x_2)_{bright} = 2\frac{\lambda D}{d}$$

Therefore, fringe width, β is given by

$$\beta = (x_3)_{bright} - (x_2)_{bright} = \frac{\lambda D}{d}$$

DIFFRACTION OF LIGHT

Bending of light around the edges of an obstacle is known as diffraction.

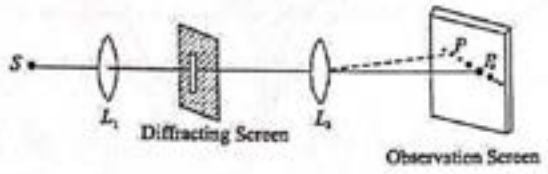
To observe diffraction, either of the following conditions must be satisfied:

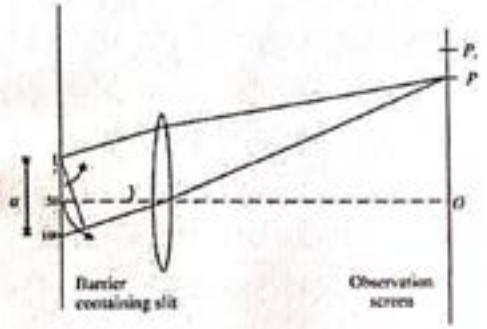
a) The size of the obstacle or the aperture should be of the order of the wavelength of the incident wave.

The separation between the obstacle or aperture and the screen should be considerably larger (a few thousand times) than the size of the obstacle or aperture

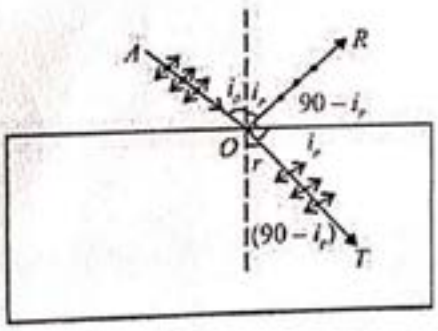
Diffraction at a Single Slit

when the path difference between the extreme waves diffracted by the extreme points in a particular direction is an integral multiple of λ, the resultant diffracted intensity in that direction will be zero.





POLARISATION OF LIGHT



The phenomenon in which vibrations of light get confined in a particular plane containing the direction of propagation is called polarisation of light.

Check Yourself

1. Interference of two light waves can be observed with the help of a
   A. Spectrometer
   B. Photometer
   C. Prism
   D. Michelson experiment
2. The interference of two light wave is constructive if
   A. Two waves are in same phase
   B. Two waves are in opposite phase
   C. Two waves are perpendicular to each other
   D. Two waves are obtained from two different sources
3. Fringe width in the interference pattern will be more, when coherent source are
   A. Close together
   B. Too much apart
   C. Inclined at a certain angle
   D. Inclined at $\pi/4$
4. Colours of thin films result from
   A. Dispersion of light
   B. Interference of light
   C. Absorption of light
   D. Scattering of light
5. When white light is used in Newton rings experiment, then
   A. All fringes are black

B. All fringes are white
C. All fringes are coloured
D. No fringes are observed

Hint to Check Yourself

1D 2A 3A 4B 5C

Stretch Yourself

1. What is a wavefront? What is the direction of a beam of light with respect to the associated wavefront? State the Huygens' principle and explain the propagation of light waves.
2. Describe Young's double slit experiment to produce interference. Deduce an expression for the width of the interference fringes.
3. For a material of refractive index 1.42, calculate the polarising angle for a beam of unpolarised light incident on it.
4. In Young's experimental set-up, the slit separation is 2 mm and the distance between the slits and the observation screen is 100 cm. Calculate the path difference between the waves arriving at a point 5 cm away from the point where the line dividing the slits touches the screen.
5. Distinguish between the polarized and unpolarized lights.

Learning Objectives

By the end of this section, you will be able to:

- Calculate the torques on rotating systems about a fixed axis to find the angular acceleration
- Explain how changes in the moment of inertia of a rotating system affect angular acceleration with a fixed applied torque

In this section, we put together all the pieces learned so far in this chapter to analyze the dynamics of rotating rigid bodies. We have analyzed motion with kinematics and rotational kinetic energy but have not yet connected these ideas with force and/or torque. In this section, we introduce the rotational equivalent to Newton's second law of motion and apply it to rigid bodies with fixed-axis rotation.

Newton's Second Law for Rotation

We have thus far found many counterparts to the translational terms used throughout this text, most recently, torque, the rotational analog to force. This raises the question: Is there an analogous equation to Newton's second law, $\Sigma\vec{\mathbf{F}} = m\vec{\mathbf{a}}$, which involves torque and rotational motion? To investigate this, we start with Newton's second law for a single particle rotating around an axis and executing circular motion. Let's exert a force $\vec{\mathbf{F}}$ on a point mass m that is at a distance r from a pivot point (Figure 10.37). The particle is constrained to move in a circular path with fixed radius and the force is tangent to the circle. We apply Newton's second law to determine the magnitude of the acceleration $a = F/m$ in the direction of $\vec{\mathbf{F}}$. Recall that the magnitude of the tangential acceleration is proportional to the magnitude of the angular acceleration by $a = r\alpha$. Substituting this expression into Newton's second law, we obtain

$$F = mr\alpha.$$

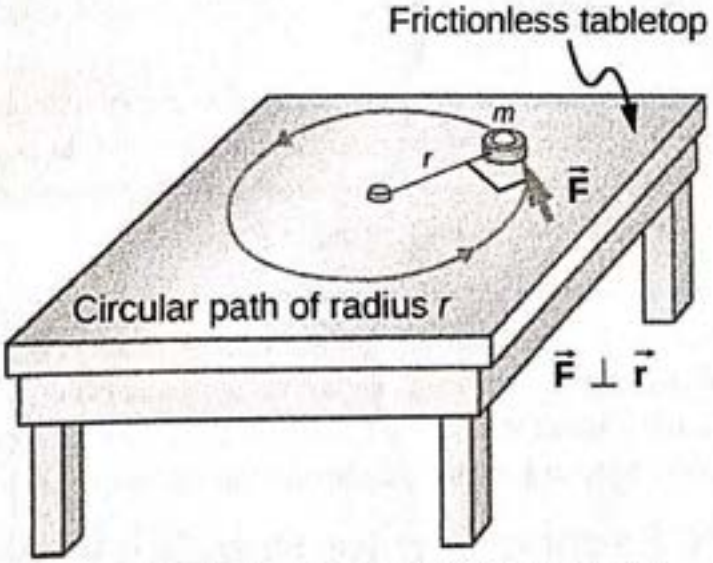


Figure 10.37 An object is supported by a horizontal frictionless table and is attached to a pivot point by a cord that supplies centripetal force. A force $\vec{\mathbf{F}}$ is applied to the object perpendicular to

the radius r, causing it to accelerate about the pivot point. The force is perpendicular to r.

Multiply both sides of this equation by r,

$$rF = mr^2\alpha.$$

Note that the left side of this equation is the torque about the axis of rotation, where r is the lever arm and F is the force, perpendicular to r. Recall that the moment of inertia for a point particle is $I = mr^2$. The torque applied perpendicularly to the point mass in Figure 10.37 is therefore

$$\tau = I\alpha.$$

The torque on the particle is equal to the moment of inertia about the rotation axis times the angular acceleration. We can generalize this equation to a rigid body rotating about a fixed axis.

NEWTON'S SECOND LAW FOR ROTATION

If more than one torque acts on a rigid body about a fixed axis, then the sum of the torques equals the moment of inertia times the angular acceleration:

$$\sum_i \tau_i = I\alpha. \qquad \boxed{10.25}$$

The term $I\alpha$ is a scalar quantity and can be positive or negative (counterclockwise or clockwise) depending upon the sign of the net torque. Remember the convention that counterclockwise angular acceleration is positive. Thus, if a rigid body is rotating clockwise and experiences a positive torque (counterclockwise), the angular acceleration is positive.

Equation 10.25 is **Newton's second law for rotation** and tells us how to relate torque, moment of inertia, and rotational kinematics. This is called the equation for **rotational dynamics**. With this equation, we can solve a whole class of problems involving force and rotation. It makes sense that the relationship for how much force it takes to rotate a body would include the moment of inertia, since that is the quantity that tells us how easy or hard it is to change the rotational motion of an object.

Deriving Newton's Second Law for Rotation in Vector Form

As before, when we found the angular acceleration, we may also find the torque vector. The second law $\Sigma\vec{\mathbf{F}} = m\vec{\mathbf{a}}$ tells us the relationship between net force and how to change the translational motion of an object. We have a vector rotational equivalent of this equation, which can be found by using Equation 10.7 and Figure 10.8. Equation 10.7 relates the angular acceleration to the position and tangential acceleration vectors:

$$\vec{\mathbf{a}} = \vec{\boldsymbol{\alpha}} \times \vec{\mathbf{r}}.$$

We form the cross product of this equation with $\vec{\mathbf{r}}$ and use a cross product identity (note that $\vec{\mathbf{r}} \cdot \vec{\boldsymbol{\alpha}} = 0$):

$$\vec{\mathbf{r}} \times \vec{\mathbf{a}} = \vec{\mathbf{r}} \times (\vec{\boldsymbol{\alpha}} \times \vec{\mathbf{r}}) = \vec{\boldsymbol{\alpha}}(\vec{\mathbf{r}} \cdot \vec{\mathbf{r}}) - \vec{\mathbf{r}}(\vec{\mathbf{r}} \cdot \vec{\boldsymbol{\alpha}}) = \vec{\boldsymbol{\alpha}}(\vec{\mathbf{r}} \cdot \vec{\mathbf{r}}) = \vec{\boldsymbol{\alpha}} r^2.$$

We now form the cross product of Newton's second law with the position vector $\vec{\mathbf{r}}$,

$$\Sigma(\vec{\mathbf{r}} \times \vec{\mathbf{F}}) = \vec{\mathbf{r}} \times (m\vec{\mathbf{a}}) = m\vec{\mathbf{r}} \times \vec{\mathbf{a}} = mr^2\vec{\boldsymbol{\alpha}}.$$

Identifying the first term on the left as the sum of the torques, and mr^2 as the moment of inertia, we arrive at Newton's second law of rotation in vector form:

$$\Sigma\vec{\tau} = I\vec{\alpha}. \qquad \boxed{10.26}$$

This equation is exactly Equation 10.25 but with the torque and angular acceleration as vectors. An important point is that the torque vector is in the same direction as the angular acceleration.

Applying the Rotational Dynamics Equation

Before we apply the rotational dynamics equation to some everyday situations, let's review a general problem-solving strategy for use with this category of problems.

PROBLEM-SOLVING STRATEGY

Rotational Dynamics

1. Examine the situation to determine that torque and mass are involved in the rotation. Draw a careful sketch of the situation.
2. Determine the system of interest.
3. Draw a free-body diagram. That is, draw and label all external forces acting on the system of interest.
4. Identify the pivot point. If the object is in equilibrium, it must be in equilibrium for all possible pivot points—chose the one that simplifies your work the most.
5. Apply $\sum_i \tau_i = I\alpha$, the rotational equivalent of Newton's second law, to solve the problem. Care must be taken to use the correct moment of inertia and to consider the torque about the point of rotation.
6. As always, check the solution to see if it is reasonable.

EXAMPLE 10.16

Calculating the Effect of Mass Distribution on a Merry-Go-Round

Consider the father pushing a playground merry-go-round in Figure 10.38. He exerts a force of 250 N at the edge of the 50.0-kg merry-go-round, which has a 1.50-m radius. Calculate the angular acceleration produced (a) when no one is on the merry-go-round and (b) when an 18.0-kg child sits 1.25 m away from the center. Consider the merry-go-round itself to be a uniform disk with negligible friction.

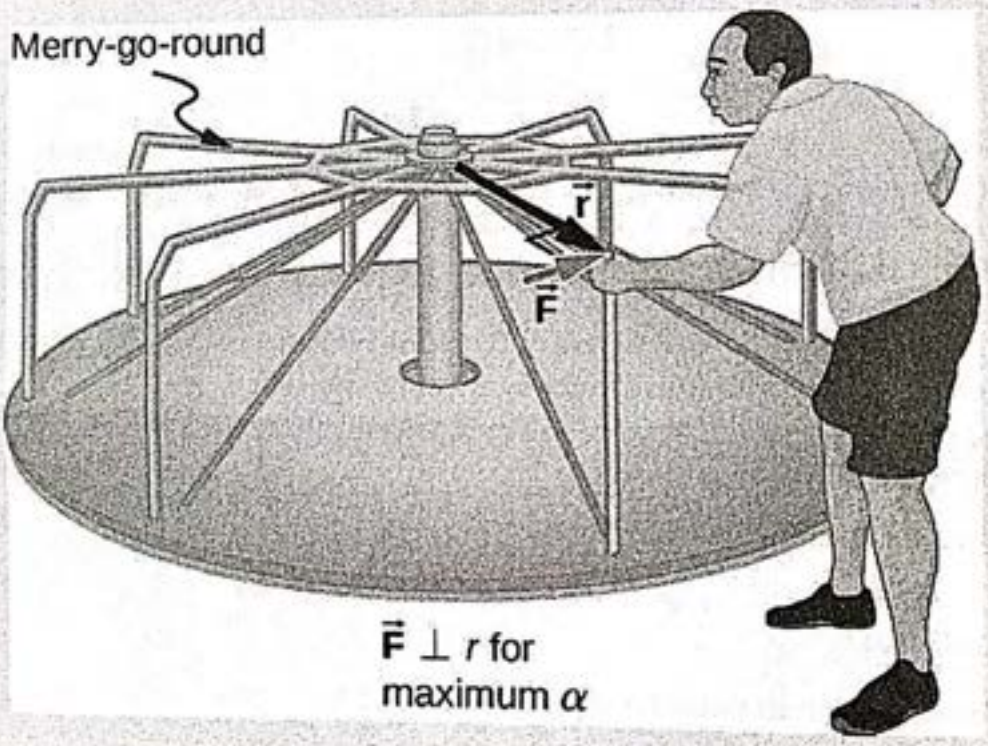


Figure 10.38 A father pushes a playground merry-go-round at its edge and perpendicular to its radius to achieve maximum torque.

Strategy

The net torque is given directly by the expression $\sum_i \tau_i = I\alpha$, To solve for α, we must first calculate the net torque τ (which is the same in both cases) and moment of inertia I (which is greater in the second case).

Solution

a. The moment of inertia of a solid disk about this axis is given in Figure 10.20 to be

$$\frac{1}{2}MR^2.$$

We have $M = 50.0\,\text{kg}$ and $R = 1.50\,\text{m}$, so

$$I = (0.500)(50.0\,\text{kg})(1.50\,\text{m})^2 = 56.25\,\text{kg-m}^2.$$

To find the net torque, we note that the applied force is perpendicular to the radius and friction is negligible, so that

$$\tau = rF\sin\theta = (1.50\,\text{m})(250.0\,\text{N}) = 375.0\,\text{N-m}.$$

Now, after we substitute the known values, we find the angular acceleration to be

$$\alpha = \frac{\tau}{I} = \frac{375.0\,\text{N-m}}{56.25\,\text{kg-m}^2} = 6.67\frac{\text{rad}}{\text{s}^2}.$$

b. We expect the angular acceleration for the system to be less in this part because the moment of inertia is greater when the child is on the merry-go-round. To find the total moment of inertia *I*, we first find the child's moment of inertia I_c by approximating the child as a point mass at a distance of 1.25 m from the axis. Then

$$I_c = mR^2 = (18.0\,\text{kg})(1.25\,\text{m})^2 = 28.13\,\text{kg-m}^2.$$

The total moment of inertia is the sum of the moments of inertia of the merry-go-round and the child (about the same axis):

$$I = 28.13\,\text{kg-m}^2 + 56.25\,\text{kg-m}^2 = 84.38\,\text{kg-m}^2.$$

Substituting known values into the equation for α gives

$$\alpha = \frac{\tau}{I} = \frac{375.0\,\text{N-m}}{84.38\,\text{kg-m}^2} = 4.44\frac{\text{rad}}{\text{s}^2}.$$

Significance

The angular acceleration is less when the child is on the merry-go-round than when the merry-go-round is empty, as expected. The angular accelerations found are quite large, partly due to the fact that friction was considered to be negligible. If, for example, the father kept pushing perpendicularly for 2.00 s, he would give the merry-go-round an angular velocity of 13.3 rad/s when it is empty but only 8.89 rad/s when the child is on it. In terms of revolutions per second, these angular velocities are 2.12 rev/s and 1.41 rev/s, respectively. The father would end up running at about 50 km/h in the first case.

CHECK YOUR UNDERSTANDING 10.7

Basics of Quantum Mechanics
- Classical Point of View -

- In classical (Newtonian) mechanics, the laws are written in terms of PARTICLE TRAJECTORIES.
- **A PARTICLE is an indivisible mass point object that has a variety of properties that can be measured, which we call observables. The observables specify the state of the particle (position and momentum).**
- A SYSTEM is a collection of particles, which interact among themselves via internal forces, and can also interact with the outside world via external forces. The STATE OF A SYSTEM is a collection of the states of the particles that comprise the system.
- **All properties of a particle can be known to infinite precision.**
- **Conclusions:**
  - **TRAJECTORY** → state descriptor of Newtonian physics,
  - **EVOLUTION OF THE STATE** → Use Newton's second law
  - **PRINCIPLE OF CAUSALITY** → Two identical systems with the same initial conditions, subject to the same measurement will yield the same result.

INADEQUACIES OF CLASSICAL MECHANICS

Due to certain limitation of classical mechanics and its wrong assumption this theory could not explain following physical phenomena.

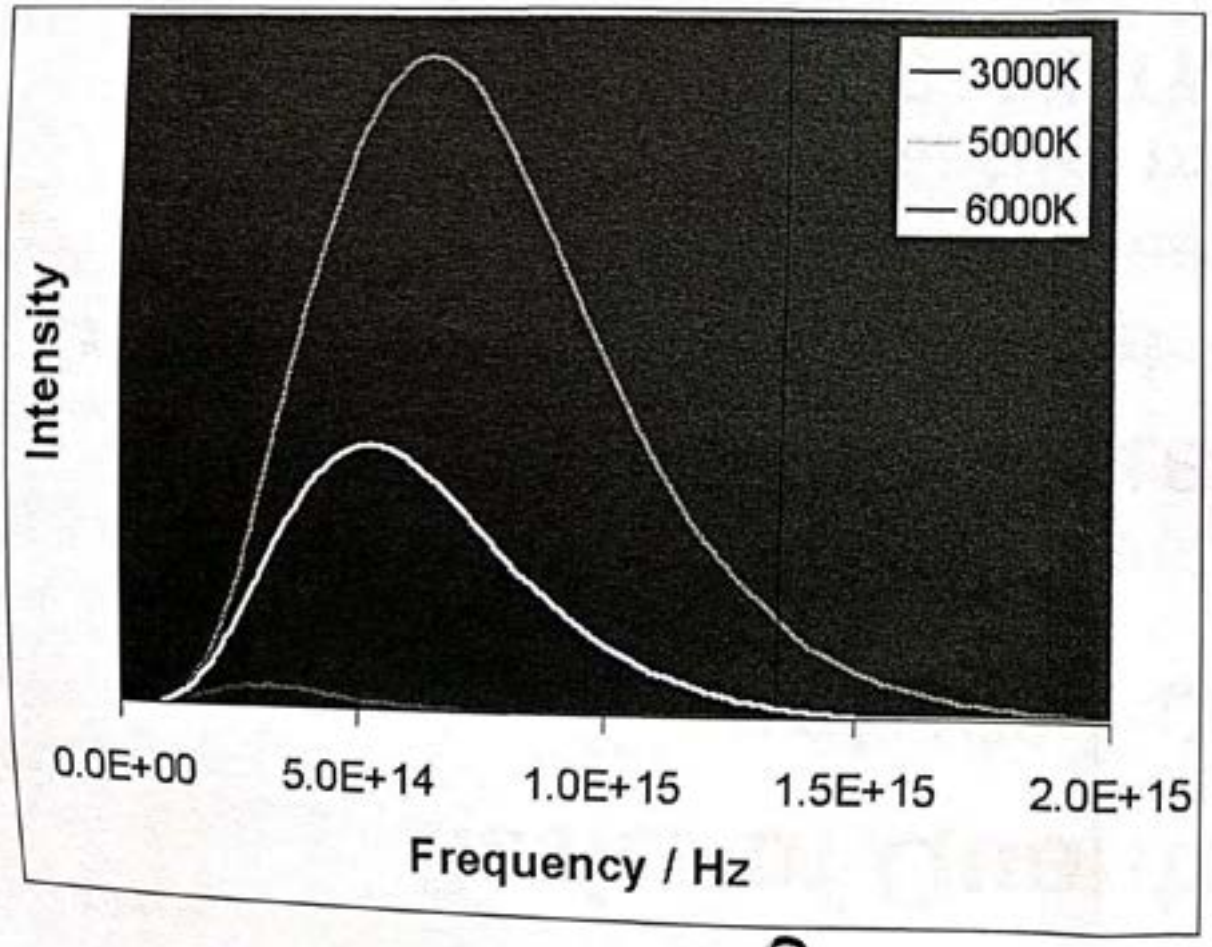
1. It fails to explain the spectrum of black body radiation.
2. It fails to explain the stability of atoms.
3. It fails to explain discrete atomic spectrum
4. It fails not to explain photoelectric effect.
5. It fails to explain the phenomena of pair production
6. It fails to explain the phenomena of Compton scattering.
7. It fails to explain the variation of electric conductivity of solid
8. (super conductivity).
9. It could not explain the phenomena associated with spinning motion of electron.
10. It could not explain Zeeman effect, Stark effect, Raman effect etc
11. It could not explain the phenomena of radioactivity like β-decay and α- decay .

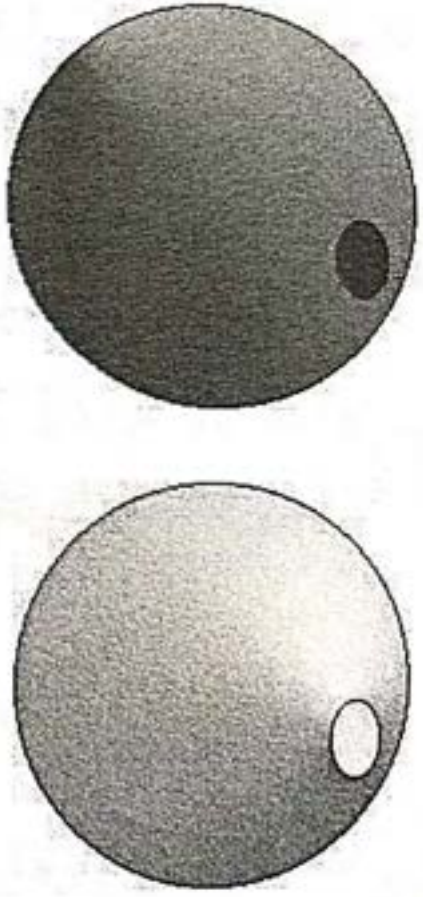
Basics of Quantum Mechanics
- Quantum Point of View -

- Quantum particles can act as both particles and waves ➔ **WAVE-PARTICLE DUALITY**
- Quantum state is a conglomeration of several possible outcomes of measurement of physical properties ➔ **Quantum mechanics uses the language of PROBABILITY theory (random chance)**
- An observer cannot observe a microscopic system without altering some of its properties. Neither one can predict how the state of the system will change.
- **QUANTIZATION** of energy is yet another property of "microscopic" particles.

Black-body Radiation

A black body is a *perfect absorber* of electromagnetic radiation - also a perfect *emitter*

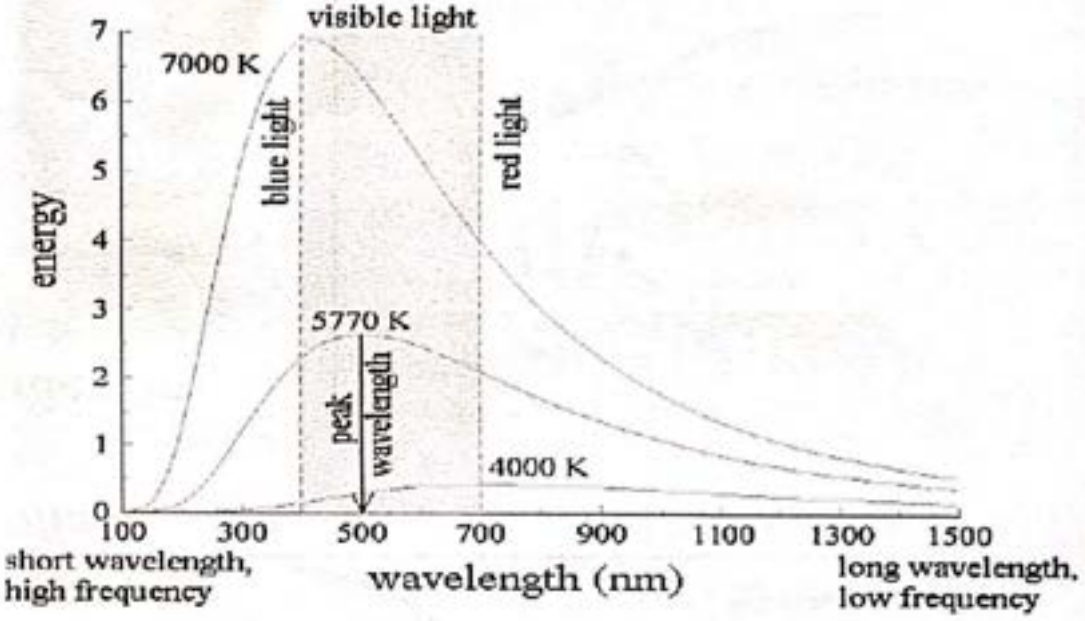




Height increases with T, as in Stefan-Boltzmann equation.

Black Body Radiation

- The energy of blackbody radiation is not shared evenly by all Wavelengths of light.
- The spectrum of blackbody Radiation shows that some wavelengths get more energy than others.
- Three spectra are shown, for three different temperatures.
- Here are some experimental facts about blackbody radiation:

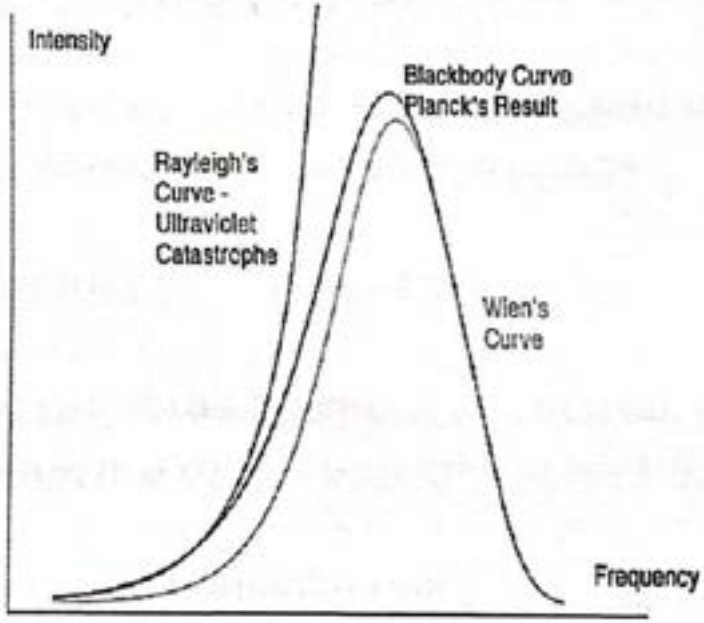


1. The blackbody spectrum depends only on the temperature of the object, it does not depend on the type of material, ie all materials emit the same blackbody spectrum if their temperatures are the same.
2. As the temperature of an object increases, it emits more blackbody energy at all wavelengths.
3. As the temperature of an object increases, the peak wavelength of the blackbody spectrum shifts toward shorter wavelength. For example, blue stars are hotter than red stars.
4. The blackbody spectrum always becomes small at the left-hand side (the short wavelength, high frequency side).

RAYLEIGH'S ENERGY DENSITY DISTRIBUTION

Rayleigh–Jeans formula:

$$u(\nu, T) = \frac{8\pi\nu^2}{c^3} kT.$$

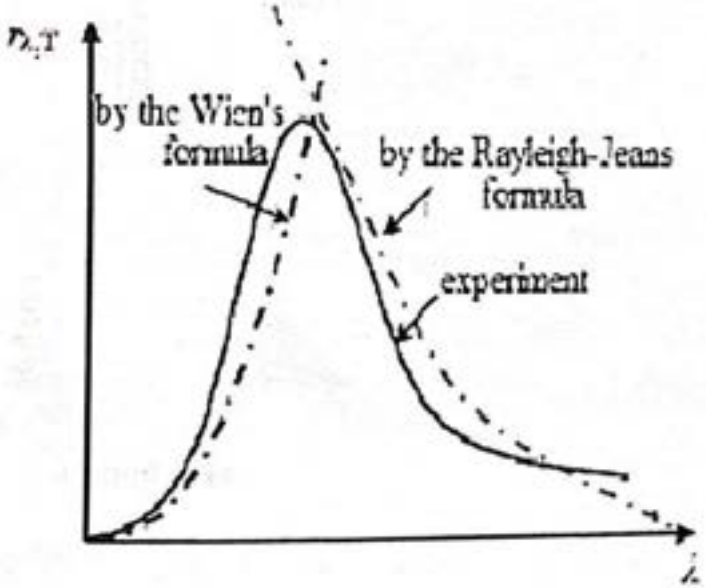


•Illustrates that this law is in complete disagreement with experimental data, except for low frequencies .

• The electromagnetic energy density *u (*ν, T) diverges for high frequencies ν , whereas experimentally it must be finite as shown in adjacent figure.

• The integration of this equation over all frequencies *diverges*, implies that the cavity contains an *infinite* amount of energy.

• This result is absurd. Divergence of this equation for *high* frequencies (i.e., in the *ultraviolet* range) is called the *ultraviolet catastrophe*.



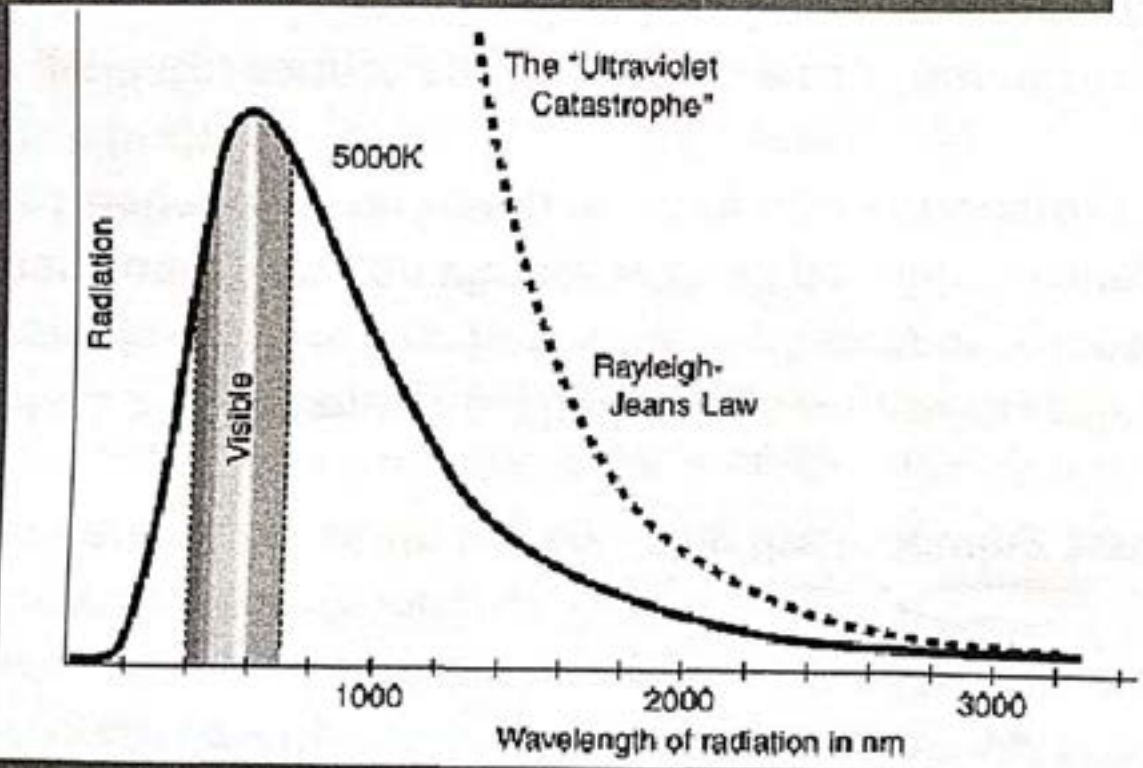
• It is a real catastrophically failure of classical physics indeed!

• It was founded on an erroneous premise:
the energy exchange between radiation and matter is *continuous; any amount of energy can be* Exchanged.

THE 'ULTRAVIOLET CATASTROPHE'

1900 - Rayleigh

Predicted infinite intensity for the UV region



- This was a CLASSICAL prediction, first made in the late 19th century, that an IDEAL BLACK BODY at thermal equilibrium will emit radiation with INFINITE POWER.

- Max Planck resolved this issue by postulating that electromagnetic energy did not follow the classical description, but could only oscillate or be emitted in DISCRETE PACKETS OF ENERGY proportional to the frequency. He called these packets 'QUANTA'.

Note: $h = 6.626x10^{-34} J.s$

$$E = h\upsilon$$

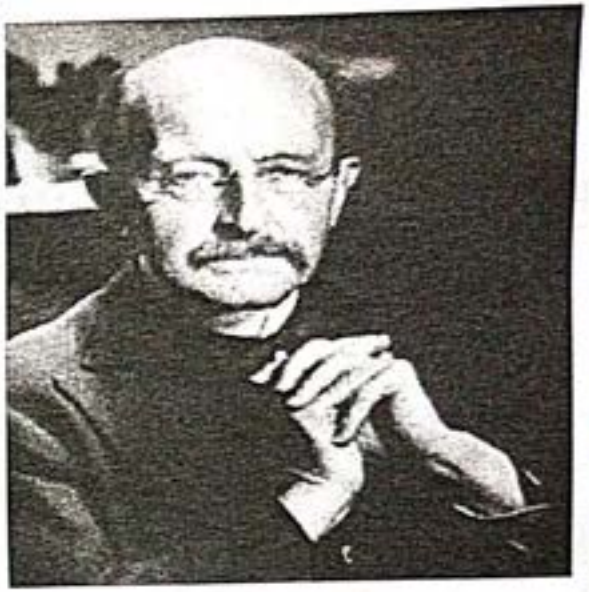
Planck's energy density distribution

- The problem of ultraviolet catastrophe has been resolved by Max Planck.
- An accurate description of blackbody radiation has been put forward accordingly.
- Planck considered that the energy exchange between radiation and matter must be *discrete not continuous.*
- He derived the radiation law by using the following assumptions.

1. *A black body chamber is filled up not only with radiation, but also with simple harmonic oscillators or harmonic oscillators or resonators of molecular dimensions. They can vibrate with all possible frequencies.*
2. The frequency of radiation emitted by an oscillator is the same as the frequency of its vibration.
3. An oscillator cannot emit energy in a continuous manner. It can emit energy in the multiples of a small unit called Quantum (Photon).

- Planck *postulated* that the energy of the radiation (of frequency ν) emitted by the oscillating charges (from the walls of the cavity) must come *only in integer multiples of h* ν *:*
- $E = nh\nu$ (n= 1, 2, 3.....) where *h is a universal constant and hν is the energy of a "quantum" of radiation.*
- $E = nh\nu$ is known as *Planck's quantization rule for energy or Planck's postulate.*

PLANK'S RADIATION LAW



Planck showed that the *correct* thermodynamic relation for the average energy is given by

$$\overline{E} = \frac{\sum_0^\infty nh\nu e^{-nh\nu/kT}\, dE}{\sum_0^\infty e^{-nh\nu/kT}\, dE} = \frac{h\nu}{e^{h\nu/kT} - 1}$$

- So the energy density per unit frequency of the radiation emitted from the hole of a cavity is given by

$$u(\nu, T) = \frac{8\pi\nu^2}{c^3} \frac{h\nu}{e^{h\nu/kT} - 1}$$

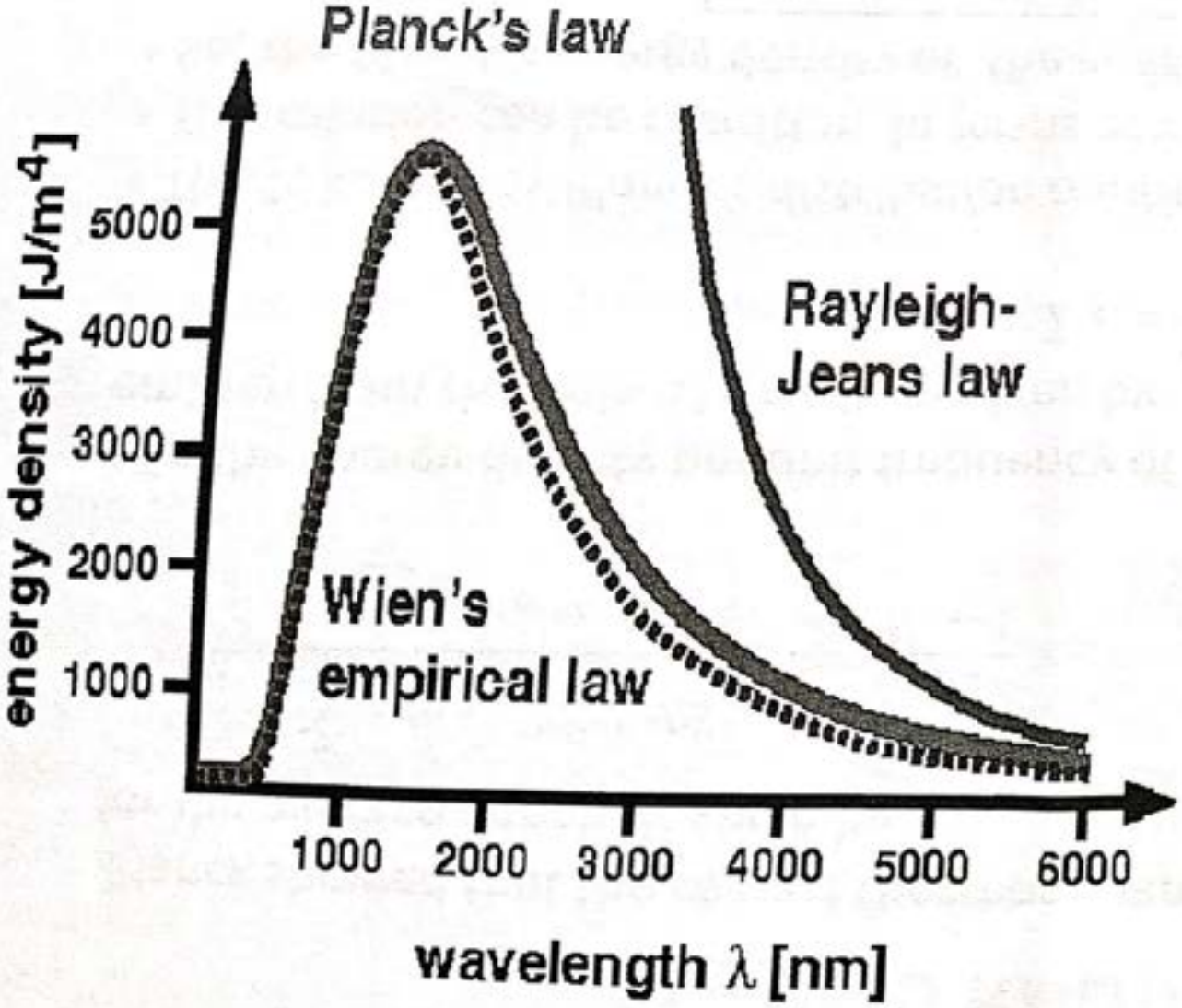
- This is known as *Planck's distribution relation.*
- This relation can be rewritten in terms of wavelength.
- So, the Planck's energy density or the energy density per unit wavelength

$$\tilde{u}(\lambda, T) = \frac{8\pi hc}{\lambda^5} \frac{1}{e^{hc/\lambda kT} - 1}.$$

- The introduction of the constant *h had indeed heralded the end of classical physics and the* dawn of a new era: physics of the microphysical world namely the quantum physics.
- Assuming that the energy of an oscillator is quantized.

$$E_{min} = h\nu$$

$h = 6.626 \times 10^{-34}\ Js^{-1}$ - Planck's constant



Max Planck: 1858-1947

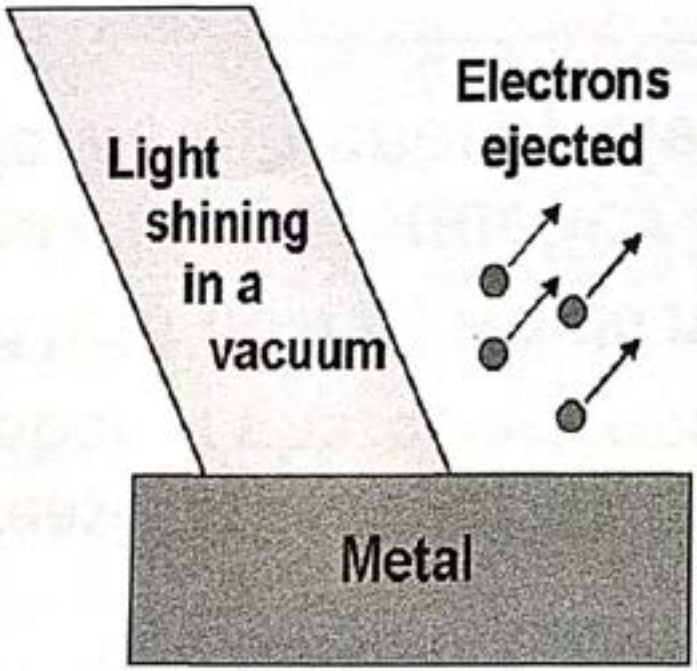
- **The energy in electromagnetic radiation is *quantized.***
- ***Quantum means "how much" in Latin.***
- **Remember this was all being done before anyone had a clue about atomic structure so "atomic oscillators" were an abstract concept.**

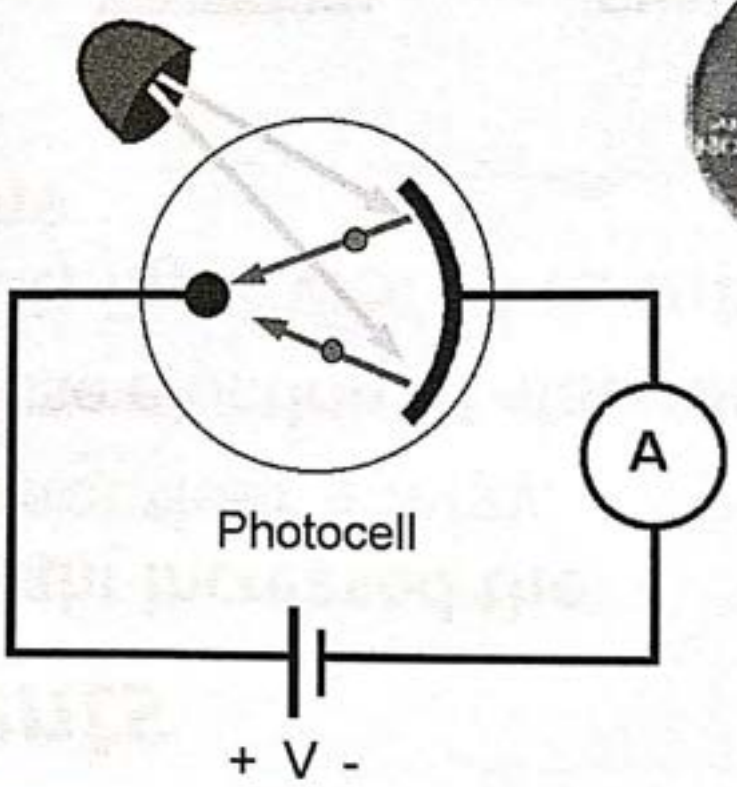
Photoelectric effect

- Noted by Hertz in 1887 ("pre-electron").
- Characterised by Lenard in 1902
- Light shining on surface – electrons ejected
- The photoelectric effect provides a direct confirmation for the energy quantization of light.

Phillip Lénard

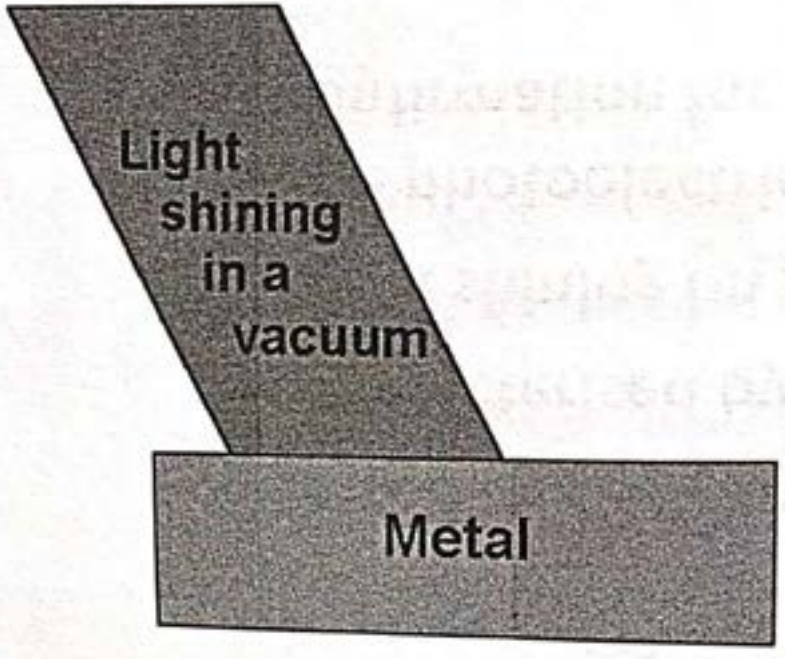
1862-1947

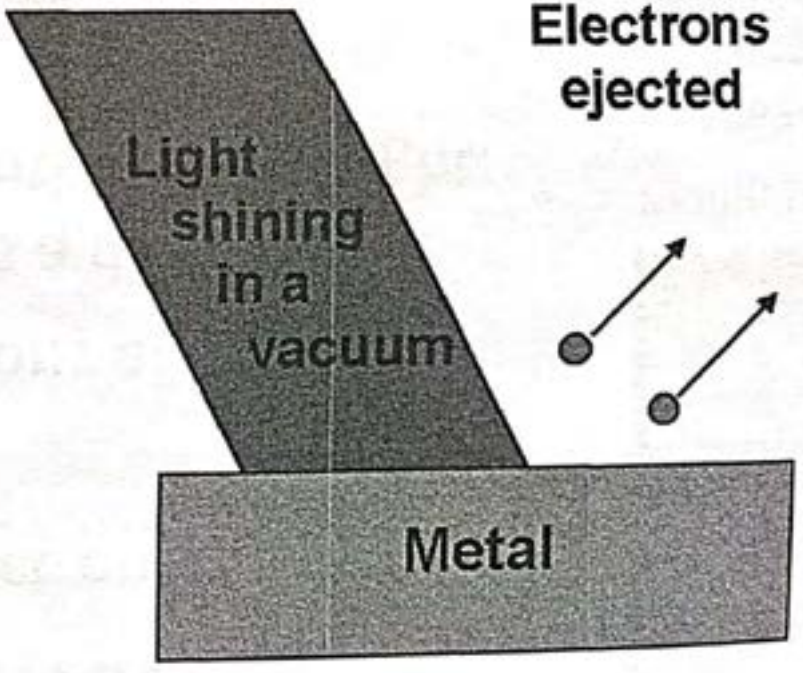


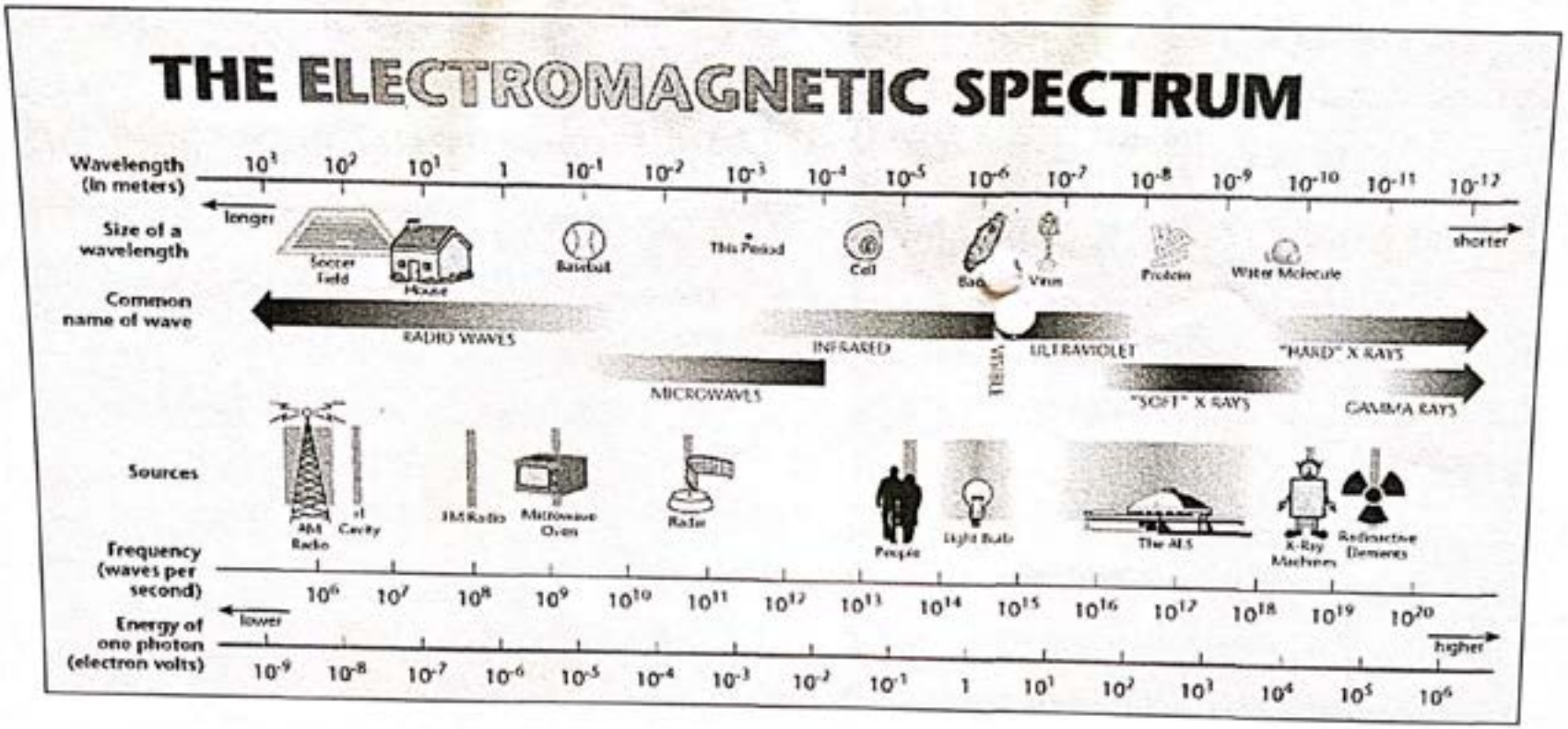


Comments

- Increasing the intensity of the light increased the number of photoelectrons, but not their energy.
- Red light (low v) would not cause ejection of electrons.
- Weak high frequency (violet) light would result in few, high energy electrons



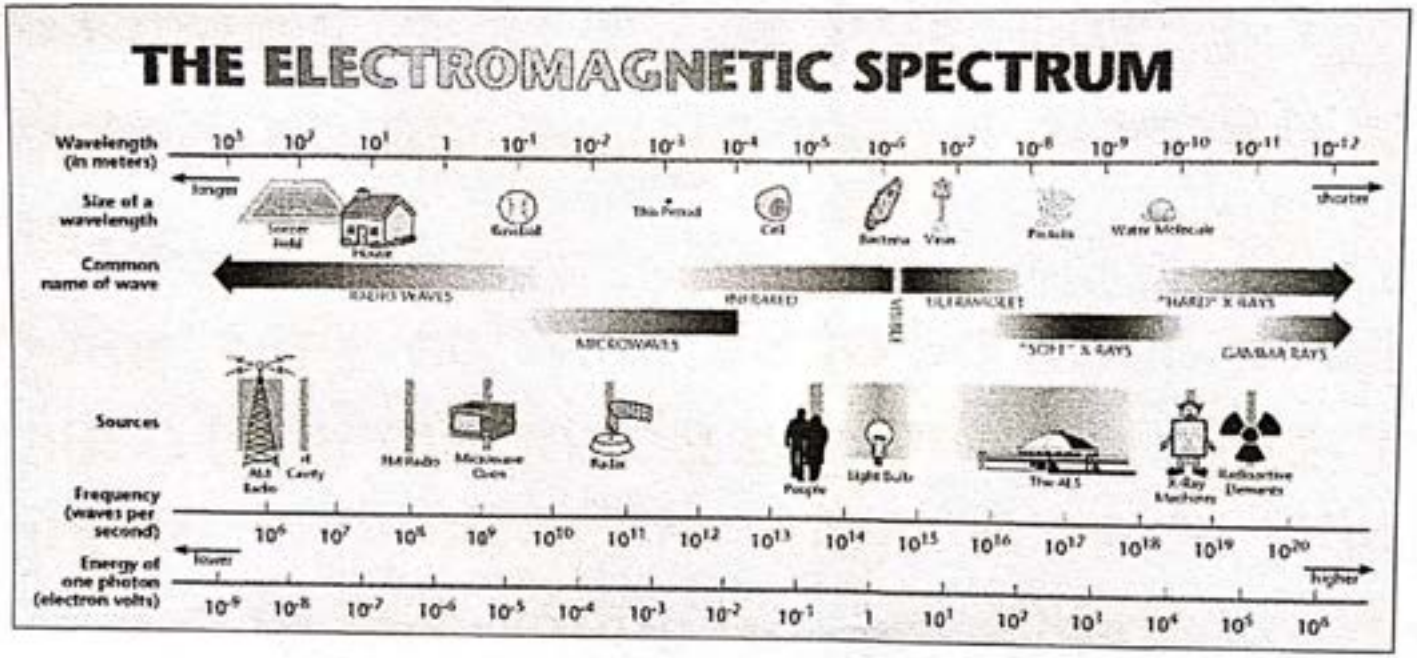




The Electromagnetic Spectrum

The Electromagnetic Spectrum

- The EM spectrum is the ENTIRE range of EM waves in order of increasing frequency and decreasing wavelength.



- As you go from left → right, the wavelengths get smaller and the frequencies get higher. This is an inverse relationship between wave size and frequency. (As one goes up, the other goes down.) This is because the speed of ALL EM waves is the speed of light (300,000 km/s).

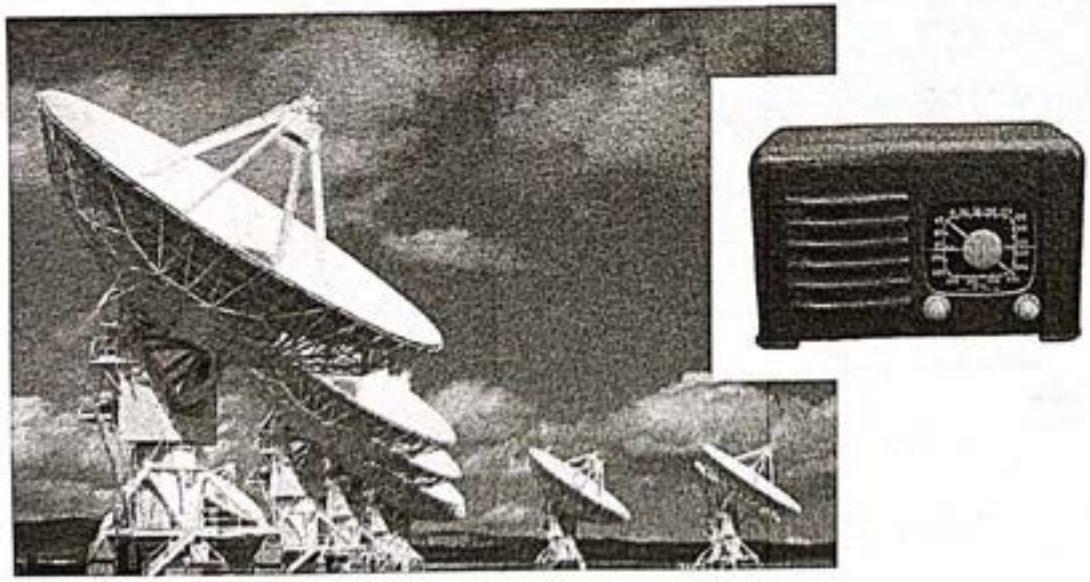
Things to Remember

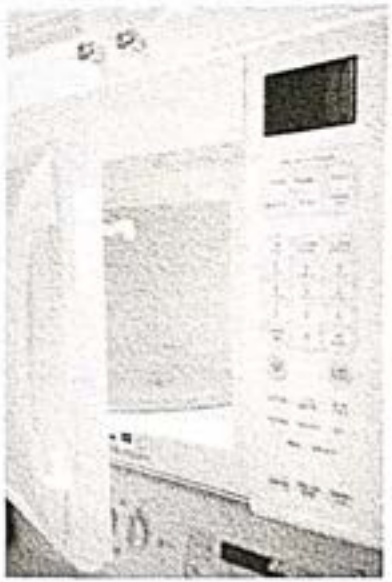
- The higher the frequency, the more energy the wave has.
- EM waves do not require media in which to travel or move.
- EM waves are considered to be transverse waves because they are made of vibrating electric and magnetic fields at right angles to each other, and to the direction the waves are traveling.
- Inverse relationship between wave size and frequency: as wavelengths get smaller, frequencies get higher.

The Waves (in order…)

Radio waves: Have the longest wavelengths and the lowest frequencies; wavelengths range from 1000s of meters to .001 m

- Used in: RADAR, cooking food, satellite transmissions



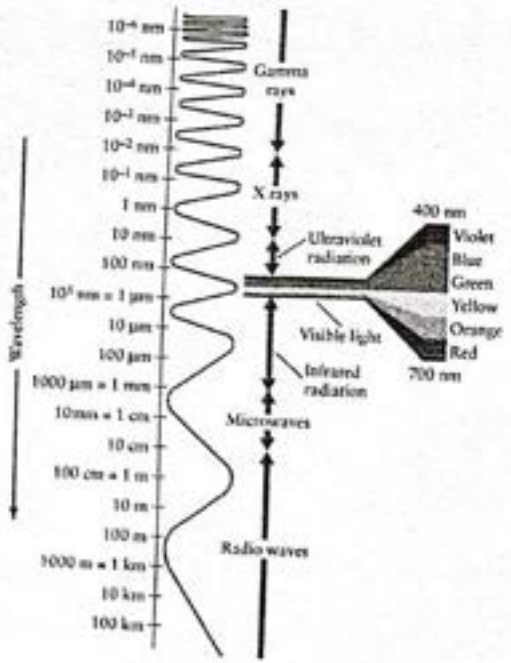


Infrared waves (heat): Have a shorter wavelength, from .001 m to 700 nm, and therefore, a higher frequency.

- Used for finding people in the dark and in TV remote control devices

Visible light: Wavelengths range from 700 nm (red light) to 30 nm (violet light) with frequencies higher than infrared waves.

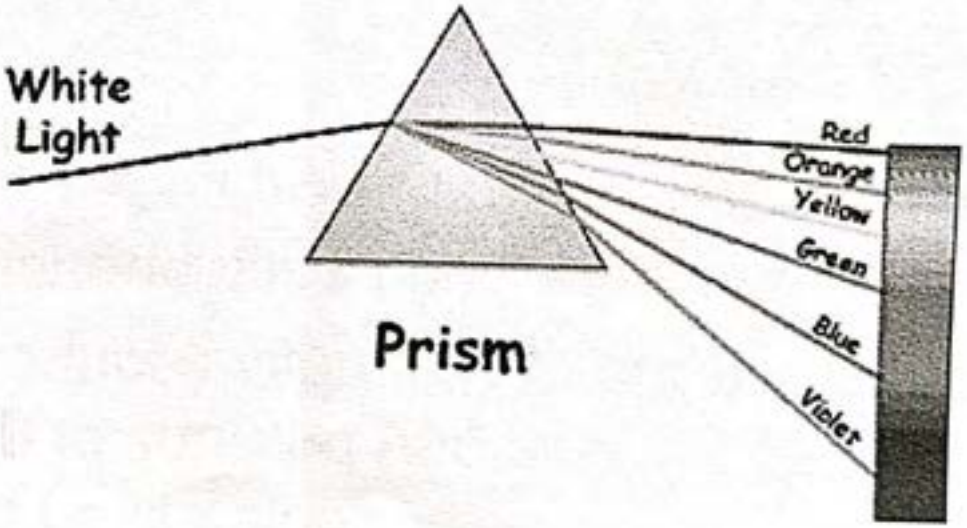
- These are the waves in the EM spectrum that humans can see.
- Visible light waves are a very small part of the EM spectrum!



Visible Light

Remembering the Order

- ROY G. BV
  - red
  - orange
  - yellow
  - green
  - blue
  - violet



Ultraviolet Light: Wavelengths range from 400 nm to 10 nm; the frequency (and therefore the energy) is high enough with UV rays to penetrate living cells and cause them damage.

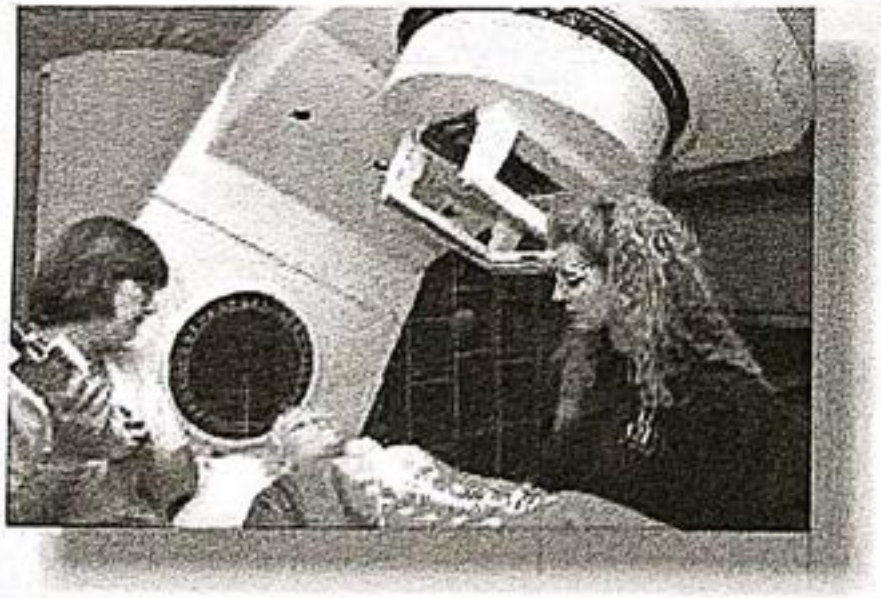
- Although we cannot see UV light, bees, bats, butterflies, some small rodents and birds can.
- UV on our skin produces vitamin D in our bodies. Too much UV can lead to sunburn and skin cancer. UV rays are easily blocked by clothing.
- Used for sterilization because they kill bacteria.

X-Rays: Wavelengths from 10 nm to .001 nm. These rays have enough energy to penetrate deep into tissues and cause damage to cells; are stopped by dense materials, such as bone.

- Used to look at solid structures, such as bones and bridges (for cracks), and for treatment of cancer.

Gamma Rays: Carry the most energy and have the shortest wavelengths, less than one trillionth of a meter (10^{-12}).

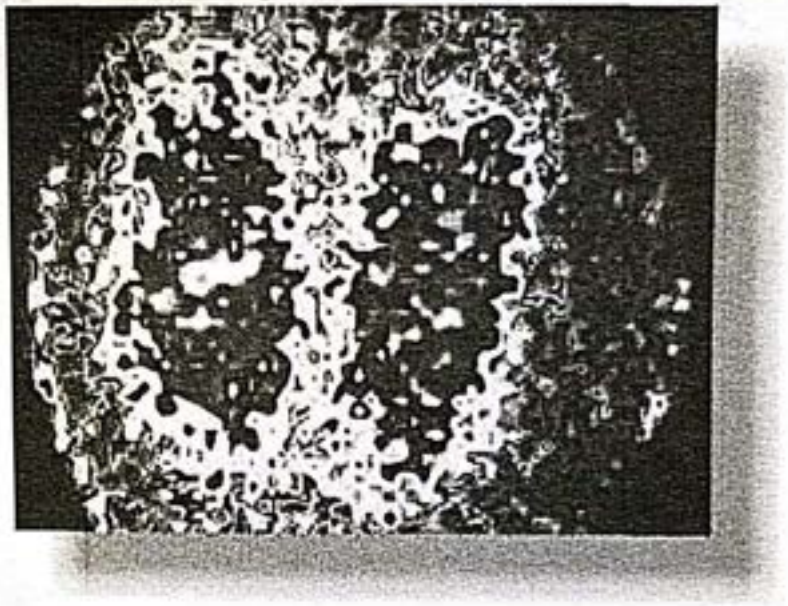
- Gamma rays have enough energy to go through most materials easily; you would need a 3-4 ft thick concrete wall to stop them!



- Gamma rays are released by nuclear reactions in nuclear power plants, by nuclear bombs, and by naturally occurring elements on Earth.
- Sometimes used in the treatment of cancers.

Gamma Rays

- This picture is a "scintigram" ➔
- It shows an asthmatic person's lungs.



- The patient was given a slightly radioactive gas to breath, and the picture was taken using a gamma camera to detect the radiation.
- The colors show the air flow in the lungs.

Image Sources

Micro Worlds, Lawrence Berkeley National Laboratory.
http://www.lbl.gov/MicroWorlds/ALSTool/EMSpec/EMSpec2.html

2004 Microsoft Corporation, One Microsoft Way, Redmond, WA 98052-6399 USA.

NASA http://science-edu.larc.nasa.gov/EDDOCS/Wavelengths_for_Colors.html

NASA http://spaceplace.nasa.gov/blue-sky/

NASA http://missionscience.nasa.gov/ems/11_xrays.html

Andy Darvill, Broadoak Community School, Radioactivity Uses

http://www.northallertoncoll.org.uk/science/Additional%20Physics/Nuclear/Nuclear/Radioactivity/uses.htm

Energy and angular momentum

If we push on an object in the forward direction while the object is moving forward, we do positiv work on the object. The object accelerates, because we are pushing on it. $F = ma$. The object gains kinetic energy. The translational kinetic energy of an object with mass m, whose center of mass is moving with speed v is $K = \frac{1}{2}mv^2$.

Translational kinetic energy = ½ mass * speed^2

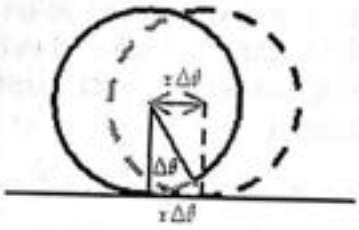
Kinetic energy increases quadratically with speed. When the speed of a car doubles, its energy increases by a factor of four.
A rotating object also has kinetic energy. When an object is rotating about its center of mass, its rotational kinetic energy is $K = \frac{1}{2}I\omega^2$.

Rotational kinetic energy = ½ moment of inertia * (angular speed)^2.

When the angular velocity of a spinning wheel doubles, its kinetic energy increases by a factor of four.
When an object has translational as well as rotational motion, we can look at the motion of the center of mass and the motion about the center of mass separately. The total kinetic energy is the sum of the translational kinetic energy of the center of mass (CM) and the rotational kinetic energy about the CM.

Rolling

Consider a wheel of radius r and mass m rolling on a flat surface in the x-direction.
The displacement Δx and the angular displacement $\Delta\theta$ are related through $\Delta x = r\Delta\theta$.
The magnitudes of the linear velocity and the angular velocity are related through $v_{CM} = r\omega$.
The kinetic energy of the disk is the sum of the kinetic energy of the motion of the center of mass $\frac{1}{2}mv_{CM}^2 = \frac{1}{2}mr^2\omega^2$, and the kinetic energy of the motion about the center of mass, $\frac{1}{2}I\omega^2$.
Thee total kinetic energy is



$$KE_{tot} = \frac{1}{2}mr^2\omega^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}[mr^2 + I]\omega^2 = \frac{1}{2}[m + I/r^2]v^2.$$

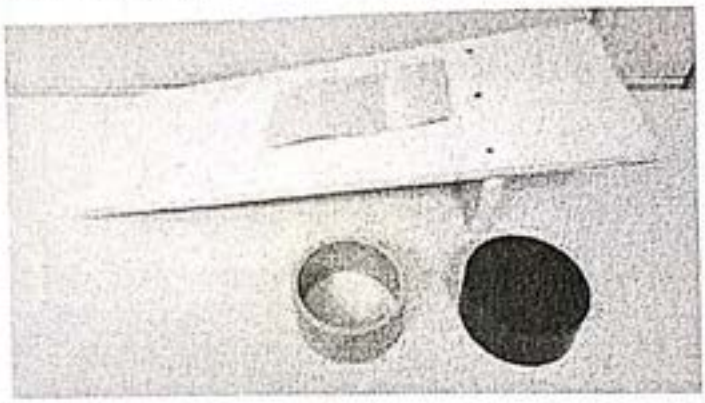
Example:

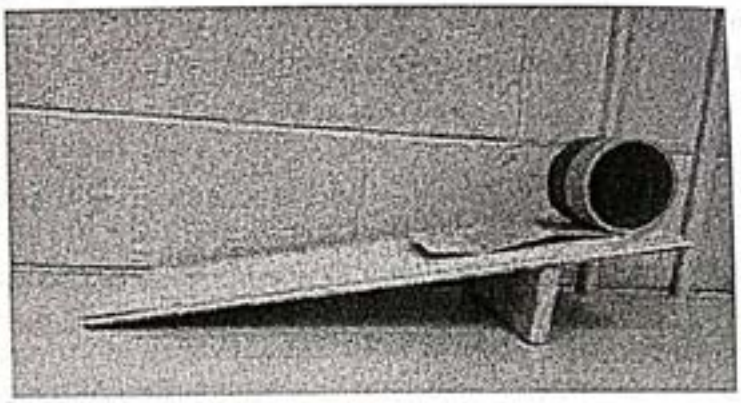
Assume the wheel is a uniform disk. The moment of inertia I of a uniform disk about an axis perpendicular to the plane of the disk through its CM is $\frac{1}{2}mr^2$.
The kinetic energy of the disk therefore is $KE_{tot} = (3/4)mr^2\omega^2$.

The ratio of the translational to the rotational kinetic energy is $E_{trans}/E_{rot} = mr^2/I$.
If two rolling object have the same total kinetic energy, then the object with the smaller moment of inertia has the larger translational kinetic energy and the larger speed.

Problem:

Assume a disk and a ring with the same radius roll down an incline of height h and angle theta. If they both start from rest at t = 0, which one will reach the bottom first?





Solution:

- Reason it out yourself and then watch this video clip. Was your answer correct?

Embedded Question 2

Suppose you are designing a race bicycle and it comes time to work on the wheels. You are told that the wheels need to be of a certain mass but you may design them either as wheels with spokes (like traditional bike wheels) or you may make them as having solid rims all the way through. Which design would you pick given that the racing aspect of the machine is the most important? Please explain!

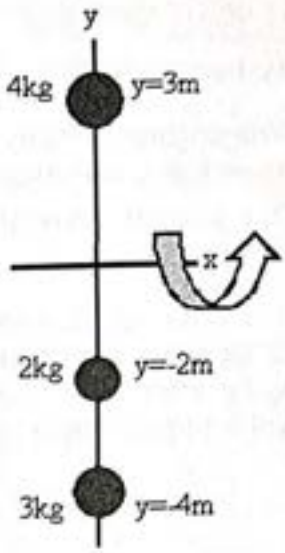
Discuss this with your fellow students in the discussion forum!

Example:

By clicking the button below, you can play or to step through a video clip frame-by-frame. Each step corresponds to a time interval of (1/30) s. In the clip the same torque acts on objects with different moments of inertia. The torque is the product of a weight and a small lever arm. The moment of inertia of the ruler-like object changes because masses are added at larger distances away from the center. When the weight has dropped through the same distance Δy, the same work has been done and the system has the same kinetic energy, since it starts from rest. Neglecting friction $W = \tau\Delta\theta = mg\Delta y = \frac{1}{2}I\omega^2$. However, the system with the larger moment of inertia I has the smaller angular speed ω. (Compare the angles through which the ruler turns per step without attached masses and with masses attached at different locations.)

Begin

Problem:



Three particles are connected by rigid rods of negligible mass lying along the y-axis as shown.
If the system rotates about the x-axis with angular speed of 2 rad/s, find
(a) the moment of inertia about the x-axis and the total rotational kinetic energy evaluated from $\frac{1}{2}I\omega^2$, and
(b) the linear speed of each particle and the total kinetic energy evaluated from $\Sigma\frac{1}{2}m_iv_i^2$.

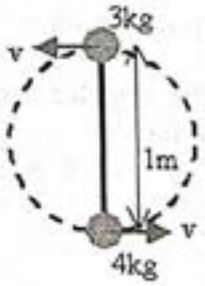
Solution:

- Reasoning:
  The moment of inertia is $I = \Sigma m_i r_i^2$. Here r_i is the perpendicular distance of particle i from the x-axis.
  The linear speed of particle i is $v_i = \omega r_i$.
- Details of the calculation:
  (a) $I = (4\text{ kg})(9\text{ m}^2) + (2\text{ kg})(4\text{ m}^2) + (3\text{ kg})(16\text{ m}^2) = 92\text{ kgm}^2$.
  The rotational kinetic energy is $K = \frac{1}{2}I\omega^2 = 46^*4/s^2 = 184$ J.
  (b) The linear speed of the 4 kg mass is v = 6 m/s, and its kinetic energy is $\frac{1}{2}mv^2 = 72$ J.
  The linear speed of the 2 kg mass is v = 4 m/s, and its kinetic energy is $\frac{1}{2}mv^2 = 16$ J.
  The linear speed of the 3 kg mass is v = 8 m/s, and its kinetic energy is $\frac{1}{2}mv^2 = 96$ J.
  The sum of the kinetic energies of the three particles is 184 J.

Angular momentum about an axis is a measure of an objects rotational motion about this axis. For rotations about a symmetry axis of an object, the angular momentum L is defined as the product of an object's moment of inertia I times its angular velocity ω about the chosen axis.

$$L = I\omega.$$

Problem:



A light rod 1 m in length rotates in the xy plane about a pivot through the rod's center. Two particles of mass 4 kg and 3 kg are connected to its ends. Determine the angular momentum of the system at the instant the speed of each particle is 5 m/s.

Solution:

- Reasoning:
  We assume that the mass and moment of inertia of the rod can be neglected.
  Let the z-axis pass through the center of the rod and point out of the page.
  The moment of inertia of the system about the z-axis is $I = \Sigma m_i r_i^2$, where r_i is the distance of the ith particle from the center of the rod.
- Details of the calculation:
  The moment of inertia of the system about the z-axis is
  $3\text{ kg}^*(0.5\text{ m})^2 + 4\text{ kg}^*(0.5\text{ m})^2 = 1.75\text{ kgm}^2$.

The angular velocity of the system is $\omega = (v/r)k = ((5\ m/s)/(0.5\ m))k = (10/s)k$.
Here k is a unit vector or direction indicator pointing in the z-direction (out of the page).
The angular momentum of the system is $L = I\omega = (17.5\ kgm^2/s)k$.

Angular momentum is a vector. For a single particle its direction is the direction of the angular velocity (given by the right hand rule). The angular momentum of an object is changed by giving it an angular impulse. An angular impulse ΔL is a change in angular momentum. You give an object an angular impulse by letting a torque act on it for a time interval Δt.

$$\Delta L = \tau \Delta t$$
angular impulse = torque * time

If an object has many independently rotating parts, the total angular momentum of the object is the sum of the angular momenta of all its parts.

Problem:

You usually give your closet door a gentle push and it swings closed gently in 5 seconds. But today you are in a rush and exert 3 times the normal torque on it.
(a) If you push on it for the usual time with this increased torque, how will its angular momentum differ from the usual value?
(b) How long will it take the closet door to swing closed after your hurried push?

Solution:

- Reasoning:
  (a) When you push on the door, you exert a torque (force times lever arm) for a certain amount of time, and the door gains angular momentum $L = I\omega$. If you increase the force by a factor of 3 and push for the same amount of time, the angular momentum increases by a factor of three. The moment of inertia of the door does not change, so its angular velocity must increase by a factor of 3.

  (b) angular velocity = angular displacement / time, time = angular displacement / angular velocity
  The time it will take the door to close will decrease by a factor of three.
  time = (5 s)/3 = 1.66 s .

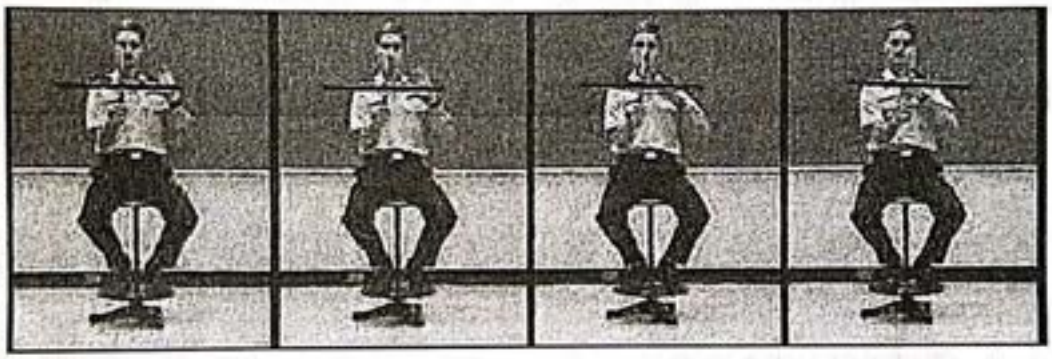
Conservation of angular momentum

The total angular momentum of a a single object is constant if no external torque acts on the object. An object cannot exert a torque on itself. The total angular momentum of two interacting objects is also constant if no external torque acts on the objects. Newton's third law tells us the forces the objects exert on each other are equal in magnitude and opposite in direction. The interaction forces produce torques equal in magnitude and opposite in direction. These torques change the angular momentum of each object by the same amount, but the changes will have opposite directions. When we sum them up to find the change in the total angular momentum, we obtain zero.

If no external torque acts on a system of interacting objects, then their total angular momentum is constant.

In the video clip shown below the total angular momentum of the system points upward. The person is stopping a spinning wheel and the stool starts to spin.

0:00 / 0:07



Some of the first few frames

As the person applies a torque to the wheel, the wheel applies a torque to the person. The magnitudes of the angular momenta of the wheel and of the person change at the same rate, but their sum remains constant.

If an object has nothing external to interact with, it cannot change its angular momentum. However, a flexible object can change its angular position.

Example:

- Falling Cat - Rotation with zero net angular momentum - YouTube,

or

- Slow Motion Flipping Cat Physics | Smarter Every Day 58 - YouTube.

Please watch.

Problem:

A 60 kg woman stands at the rim of a horizontal turntable having a moment of inertia of 500 kg m^2, and a radius of 2 m. The turntable is initially at rest and is free to rotate about a frictionless vertical axis through its center. The woman then starts walking around the rim clockwise (as viewed from above the system) at a constant speed of 1.5 m/s relative to the Earth.
(a) In what direction and with what angular speed does the turntable rotate?
(b) How much work does the women do to set herself and the turntable in motion?

Solution:

- Reasoning:
  The system consists of the woman and the turntable. No external torques act on the system, so the total angular momentum of the system is conserved. It is zero before the woman starts to walk, and it is zero afterwards.
- Details of the calculation:
  (a) When the women walk with angular velocity
  $\omega = -(v/r)\,k = -((1.5\ m/s)/(2\ m))\,k = -(0.75/s)\,k$
  her angular momentum is
  $L = I\omega = (-60\ kg * 4\ m^2 * 0.75/s)k = -(180\ kg\ m^2/s)k.$
  The angular momentum of the turntable will be
  $L = (180\ kg\ m^2/s)k$
  and its angular velocity
  $\omega = (180\ kgm^2/s)k/(500\ kg\ m^2) = (0.36/s)k.$
  The turntable turns counterclockwise.

  (b) The kinetic energy of the women is
  $\frac{1}{2}I\omega^2 = \frac{1}{2}\ 240\ kgm^2 * (0.75\ s)^2 = 67.5\ J.$
  The kinetic energy of the turntable is
  $\frac{1}{2}I\omega^2 = \frac{1}{2}\ 500\ kgm^2 * (0.36\ s)^2 = 32.4\ J.$
  The work done by the women is $W = (67.5 + 32.4)J = 99.9\ J.$

The total angular momentum about any axis in the universe is conserved. The angular momentum of a single object, however, changes when a net torque acts on the object for a finite time interval. Conversely, if no net torque acts on an object, then its angular momentum is constant.

ISSN : 2456-1762
Student Journal of Electrical and Electronics Engineering Issue No. 1, Vol. 1, 2022

LASER BASED COMMUNICATION

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Abstract:

This work presents a point-to-point transmission of voice signal wirelessly through the atmosphere with a LASER diode or infra-red device. Optical communication is gaining popularity because of its high bandwidth, low loss power, high security, low cost, and most importantly no electromagnetic interferences. Laser communication is one of the key areas in Wireless Communications. They are inexpensive, small, low power, and do not require any radio interference studies. The carrier used for the transmission signal is typically generated by a laser diode. Two parallel beams are needed, one for transmission and one for the reception. Wi-Fi is the wireless technology used to connect computers, tablets, smartphones, and other devices to the internet. Wi-Fi is the radio signal sent from a wireless router to a nearby device, which translates the signal into data you can see and use. LiFi is a wireless optical networking technology that uses LEDs for data transmission. In simpler terms, LiFi is considered to be a light-based WiFi that uses light instead of radio waves to transmit information. Using light to transmit data allows LiFi to deliver a couple of advantages such as working in areas susceptible to electromagnetic interference like hospitals and aircraft cabins and working across higher bandwidth while offering higher transmission speeds.

Keywords:

Wireless Communication System, Laser Communication, Audio Amplifier, Transmitter, Receiver and Working

1. INTRODUCTION

A Laser communications system is a wireless network through the atmosphere which carries the information in the light domain rather than the electrical domain in RF communication. Laser communications systems can be implemented in point-to-point communication easily because of their low cost, small hardware, low power, and absence of electromagnetic interference. For two-way communication two parallel beams are required, one for transmission and another one for the reception of a signal. The input which is in the form of voice is initially amplified with a pre-amplifier circuit before further amplified by the second stage amplifier which provides the overall gain of the transmitter. The signal is then fed to a Laser diode through a driver circuit. Laser will convert the electrical signal into light signal and send the signal into free space.

3. WORKING PRINCIPLE

Laser: The acronym LASER (Light amplification by stimulated emission of radiation) is a device that emits a beam of coherent light through an optical amplification process. There are two types of emission as spontaneous emission and stimulated emission. If the atom is in the ground state, with energy E1, the photon may be absorbed so that it is exciting to the upper energy level E2. Subsequently, de-

excitation will occur randomly producing the emission of radiation. This process is spontaneous emission. On the other hand, if the atom is already in the excited state, then the incident photon may stimulate a downward transition with the emission of radiation. Photons emitted in this process are coherent with the stimulating photon i.e both the stimulating and stimulated photons have the same energy, same momentum, and same state of polarization .The input can be in the form of audio from jack input or voice from the condenser mic at the transmitter.

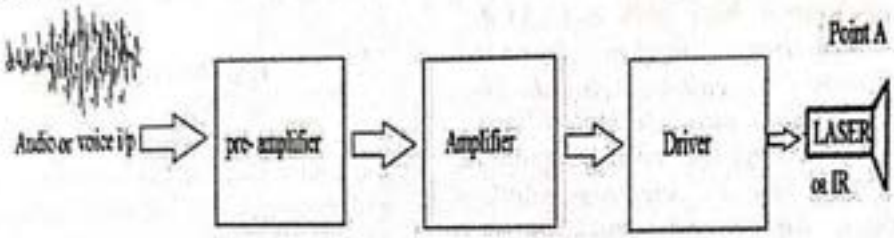


Figure 1. Transmitter section of LASER Communication

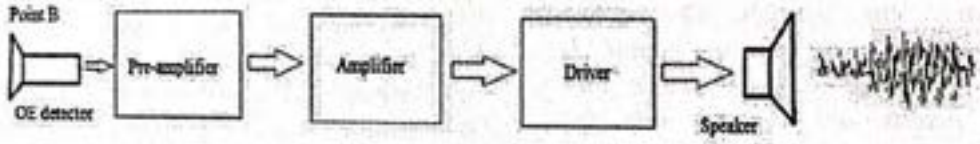
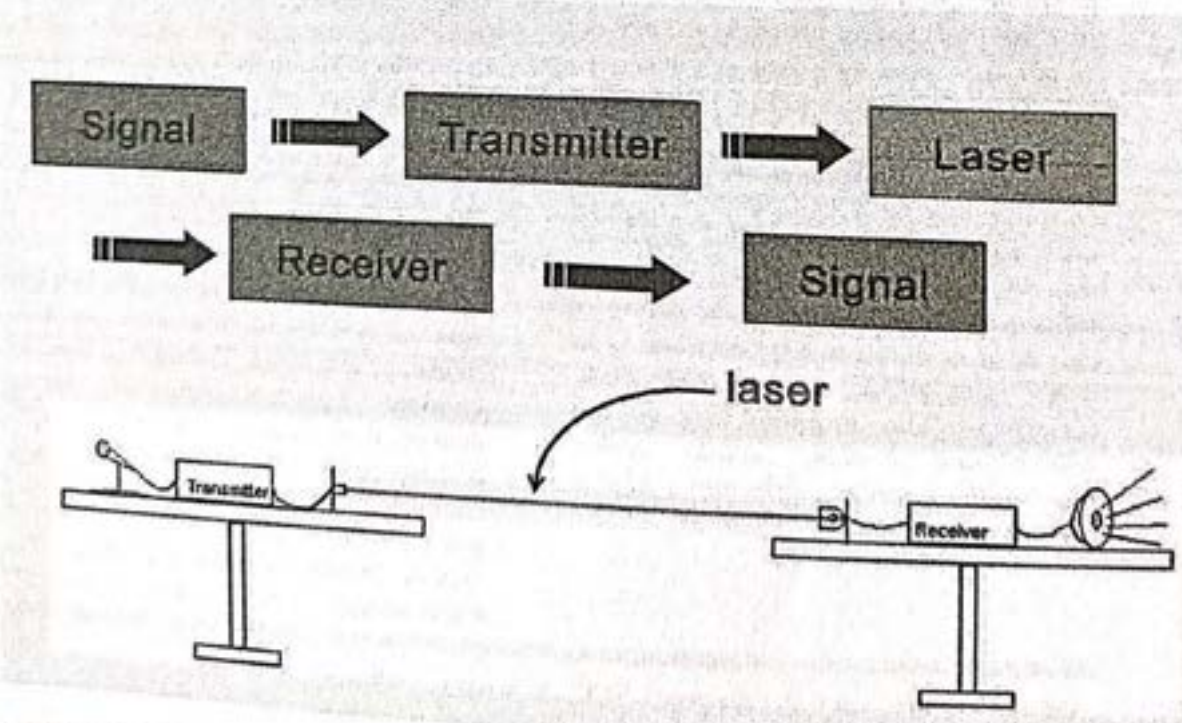


Figure 2. Receiver section of LASER Communication

LASER COMMUNICATION:



ISSN : 2456-1762
Student Journal of Electrical and Electronics Engineering Issue No. 1, Vol. 1, 2022

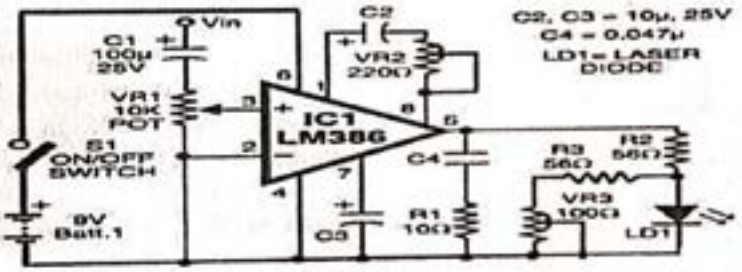
Figure 3. BLOCK DIAGRAM

The low audio signal is initially amplified with a one-stage transistor pre-amplifier circuit before passing through the second stage amplifier which is built with LM 386 providing the overall gain of the transmitter. The amplified signal is then fed to a Laser diode which converts the electrical signal into a light signal and transmits it into free space. The transmitter attains modulation of the Laser signal which acts as a carrier by the modulating signal from condenser mic or audio jack input.

3.1 TRANSMITTER:

Sound or different mode of a signal is amplified and transmitted through laser. By giving the output as sound energy to the input of a laser, which can help to carry the signal from one place to another, the signal travels along with lasers to the receiver end... For example, we can tack a radio station as an example we can transmitter itself generates a radio frequency alternating current, which is applied to the antenna to transmitted signal similar to this we can transmit the signal with laser because lasers have high frequency and high speed is 186000 miles (ca. 299,338 km) per second..

CIRCUIT DIAGRAM - Transmitter



Transmitter Circuit

3.2 RECEIVER

In the receiver end, the transmitted laser reaches the LDR (light dependent resistor) that can again amplify the signal to the audible range in case we are using that transmitting the audio signal we can receive audio signals. For example, we can tack a household radio receiving system as an example Radio wave are received by another antenna attached to a radio receiver. When radio waves strike the receiving antenna they push the electrons in the metal back and forth, creating tiny oscillating currents which are detected by the receiver. Here we are using LDR as the antenna to receive the signal or light from the laser. We are preferring laser for its can travel at high speed and it can travel vacuum so it is used to share information in outer space in minimum delay...even we can use any computer data, ah sharing in same speed using this method.

APPLICATIONS:

- In the Laser communications systems, bandwidth could be distributed in neighbourhoods by putting laser communication systems on top of homes and pointing them towards a common transceiver with a fast link to the Internet.
- With the powerful laser, it would even be possible to communicate using satellites to reflect the signals.

ISSN : 2456-1762
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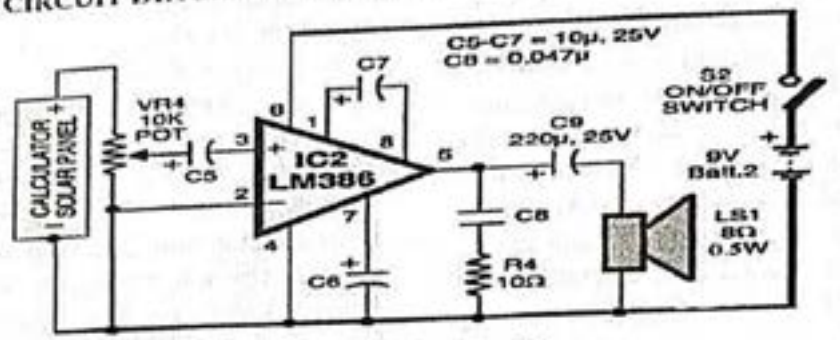
CIRCUIT DIAGRAM - Receiver:



Receiver Circuit

PHOTOGRAPH:

ADVANTAGES:

- ✓ It can provide speed more than 1GBps.So it overtakes the LAN or wireless LAN comprehensively.
- ✓ Laser communications systems can be easily deployed since they are inexpensive, small, low power and do not require any radio interference studies. The carrier used for the transmission signal is typically generated by a laser diode. Two parallel beams are needed, one for transmission and one for reception.
- ✓ Even by a minute fraction of a degree, the laser will miss by thousands of miles. Instead of better and faster pictures, there could be no pictures.

CONCLUSION:

This is new wireless technology to transmit the data or sound signal from one section to another section through the laser beam of the system. This system is safe and without radiation. So it is no harm to living beings. The system can likely transmit data and sound much faster than the other system (like 1GB/s) because this laser communication system became a more popular system than the other system. The paper firstly analysed the components of maritime laser communication systems, the paper made some explanations on the components and functions of the servo system.

RESULT:

Although we could not pin point the exact reason why the reliability of our audio transmission fell drastically at bauds higher than 27.7 kbps, we do suspect that is has something to do with a timing problem involving the time required by the ADC to complete a conversion since the biggest difference between the audio code and the text code is that the audio utilizes the ADC

and transmits continuously. So ultimately the baud limitation did not degrade the quality of the transmitted audio.

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Unit-IV

LASER PHYSICS

Introduction

The word LASER is an acronym for *"Light Amplification by Stimulated Emission of Radiation"*. It is a powerful monochromatic light source of collimated beam in which the light waves are highly coherent. The laser light has many superior features compared to conventional light source. Einstein introduced this concept in 1917. Dr. T.H. Maiman demonstrated the first laser namely the ruby laser in the year 1960.

Characteristics of LASER :

Laser differs from the ordinary light with respect to some properties. They are

- Monochromaticity
- Directionality
- Coherence
- Intensity

1. Monochromaticity :

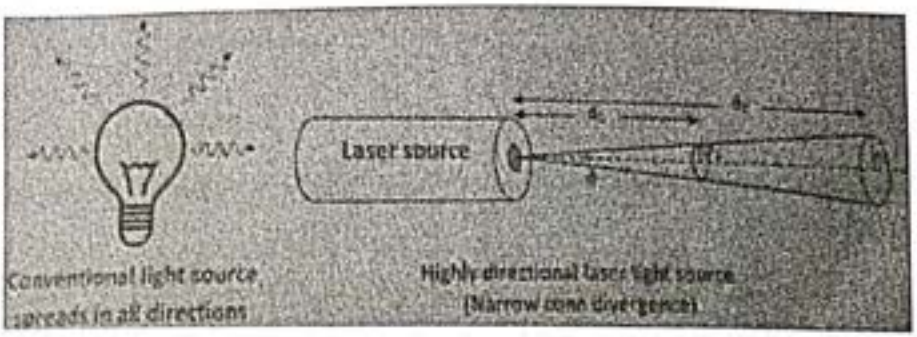
Laser beam is highly monochromatic. It emits single wavelength (one colour) because atoms or molecules are transition between two energy states. Hence it possesses good spectra since range of laser beam wavelength ($\Delta\lambda$) is very narrow. But ordinary light emits combination of wide range of wavelength (colors) because atoms or molecules are transition from several number of excited states to ground state, so it emits different energies, therefore it is polychromatic.

2. Directionality or Divergence :

The light ray coming ordinary light source travels in all directions, but laser light travels in single direction. For example, the light emitted from torch spreads 1km distance, But the laser light spreads a few centimeters distance even it travels longer distance. The ordinary source emits light in all directions and its angular spread is 1 metre/metre. But the laser is highly directional and non-divergent and its angular spread is 1mm/metre.

The angular spread (ϕ) or divergence is given by,

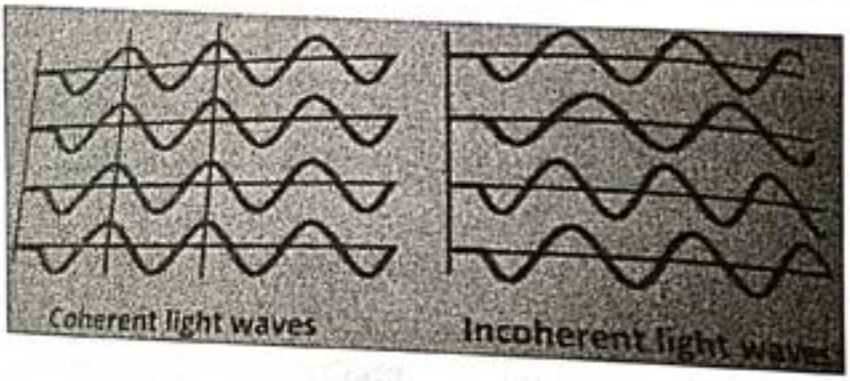
$$\Phi = \frac{r_2 - r_1}{D_2 - D_1} \quad degree$$



where D_1, D_2 are any two distances from the laser source emitted and r_1, r_2 are the radii of the beam spots at a distance D_1 and D_2, respectively.

3. Coherence

A predictable correlation of the amplitude and phase at any one point with other point is called coherence. The light from a source consists of wave pattern. These wave patterns when identical in phase and direction are called coherent. Laser has a high degree of coherence than the ordinary sources. The coherence of laser emission results in an extremely high power of 5×10^6 watt/m^2. A laser beam can be focused to a very small area of about 0.7 μm diameter.



4. Intensity

Laser light is highly intense than the ordinary light. This is because of coherence and directionality of laser. The ordinary light spreads in all directions, so the intensity reaching the target is very less. But in the case of laser, due to high directionality the intensity of laser beam is concentrated in a small region. This concentration of energy gives a high intensity. Since in Laser many number of photons are in phase with each other, the amplitude of the resulting wave becomes na and hence the intensity of laser is proportional to n^2a^2. It is estimated that light from a typical 1mW laser is 10,000 times brighter than the light from the sun at the earth's surface.

Ordinary light versus LASER :

Ordinary light	LASER
Ordinary light are Polychromatic since it consists of radiations of several wavelengths.	Laser light is monochromatic since it consists of only single wavelength.
Ordinary light is divergent because it spreads in all directions	Laser light is non-divergent because it travels in single direction
Intensity of ordinary light is lesser because concentration of photons is lesser	Intensity of Laser light is higher because concentration of photons is higher
Ordinary light is not Coherent	Laser light is highly Coherent
Due to less intensity brightness of ordinary light is low	Due to high intensity brightness of Laser light is high
Examples: Sunlight	Example: Laser light

Ground state and Excited states:

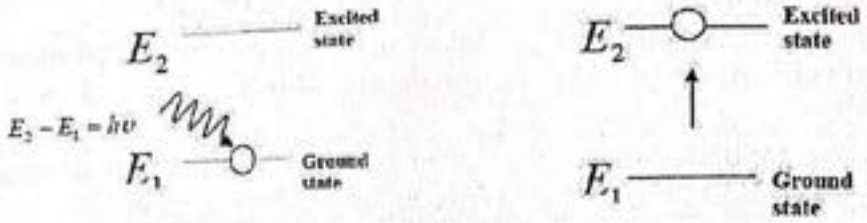
The lowest energy level for an individual atom occurs when its electrons are all in the nearest possible orbits to its nucleus ,this energy level is called the "**Ground state**".

When one or more of an atom's electrons have absorbed energy, they can move to outer orbits, and the atom is then referred to as being excited, and that energy level is called as **"Excited state."** Excited states are generally not stable; as electrons drop from higher-energy to lower-energy levels, they emit the extra energy as light.

Interaction of Radiation with matter

1. Induced Absorption or Stimulated Absorption :

An atom is in the ground state with energy E_1 absorbs a photon of energy $h\nu$ and goes to the excited state with energy E_2 as shown in Fig. This transition is known as stimulated absorption or induced absorption or simply absorption. Here the energy difference is given as $(E_2 - E_1) = h\nu$.



If there are many number of atoms in the ground state then each atom will absorb the energy from the incident photon and goes to the excited state then,

The rate of absorption (R_{12}) is proportional to,

$R_{12} \propto$ Energy density of incident radiation (ρ_ν)

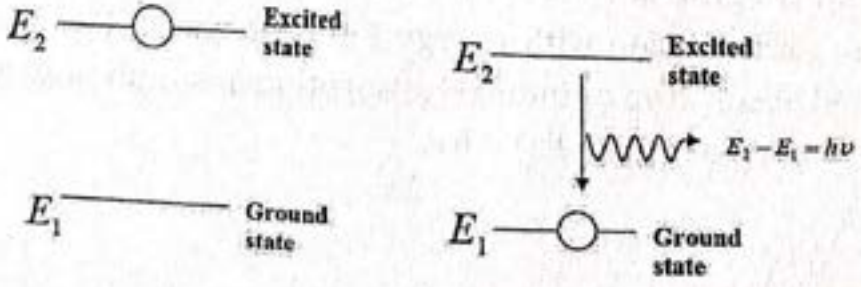
$\propto$ No. of atoms in the ground state (N_1)

$$\boxed{R_{12} = B_{12}\ \rho_\nu\ N_1}$$

Where, B_{12} is a constant which gives the probability of absorption transition per unit time.

2. Spontaneous emission

The natural tendency of an atom is to seek out the lowest energy configuration. The excited atoms do not stay in the excited state for longer time but tend to return to the lower state by giving up the excesses energy $h\nu$ as shown in fig. The atom in the excited state E_2 returns to the ground state E_1 by emitting a photon of energy $h\nu$ without any external energy. Such emission of radiation not initiated by any external influence is called spontaneous emission. This emission is uncontrollable.



The rate of spontaneous emission R_{21} (Sp) is proportional to number of atoms or molecules present in the excited state.

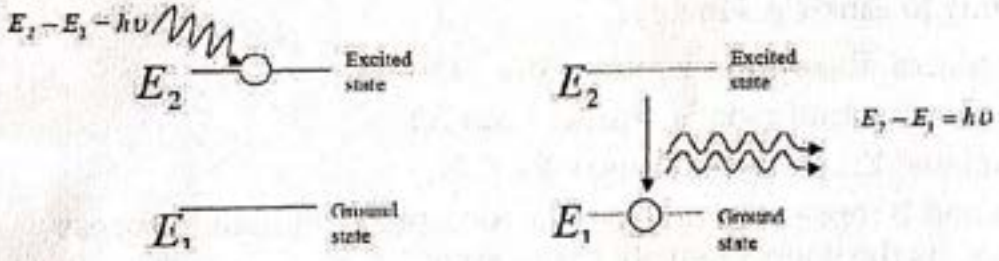
i.e $R_{21}\,(Sp) \propto N_2$

$$\boxed{R_{21}\,(Sp) = A_{21}\,N_2}$$

where A_{21} is a constant which gives the probability of spontaneous emission transitions per unit time.

3. Stimulated emission

The atom in the excited state E_2 as shown in fig. A photon of energy $h\nu$ can stimulate the atom to move to its ground state. During this process the atom emits an additional photon whose energy is also $h\nu$. As the emission is stimulated by external photon, this process is known as stimulated emission.



The rate of stimulated emission R_{21} (St) is proportional to,

$R_{21} \propto$ Energy density of incident radiation (ρ_ν)

$\propto$ No. of atoms in the excited state (N_2)

i.e $R_{21}\,(St) \propto \rho_\nu N_2$

$$\boxed{R_{21}\,(St) = B_{21}\,\rho_\nu\,N_2}$$

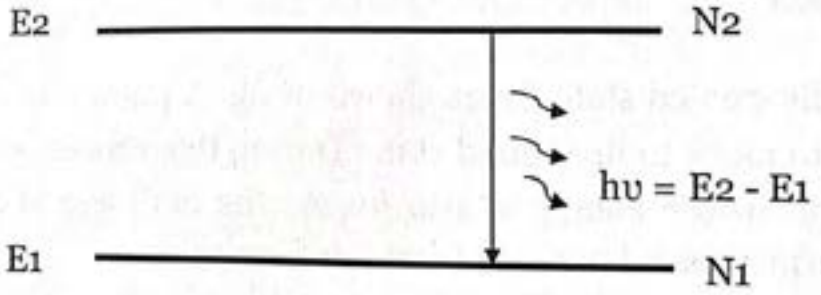
where B_{21} is a constant which gives the probability of stimulated emission transitions per unit time.

Einstein's A and B Coefficient:

(Relation between Einstein's coefficient and Energy density of radiation)

Einstein's theory of absorption and emission of light by an atom is based on Planck's theory of radiation.

Consider two energy levels E1 and E2 having number of atoms N1 and N2 respectively, as shown in figure.



According to Einstein's theory,

Rate of Stimulated absorption is, $R_{12} = B_{12}\, E_v\, N_1$

Rate of Spontaneous Emission is, $R_{21(Sp)} = A_{21}\, N_2$

Rate of Stimulated Emission is, $R_{21(St)} = B_{21}\, E_v\, N_2$

Where, A and B represents the Spontaneous and Stimulated process respectively. E_υ is the energy density of radiation.

At thermal equilibrium,

The rate of absorption = The rate of emission

$$B_{12}\, E_v\, N_1 = A_{21}N_2 + B_{21}\, E_v\, N_2 \text{ ----------(1)}$$

$$E_v\,[B_{12}\, N_1 - B_{21}\, N_2] = A_{21}N_2$$

$$E_\upsilon = \frac{A_{21}N_2}{[B_{12}N_1 - B_{21}N_2]}$$

$$E_\upsilon = \frac{A_{21}}{[B_{12}\frac{N_1}{N_2} - B_{21}]} \text{ ---------- (2)}$$

Under thermal equilibrium, the population of energy levels obeys the Boltzmann's distribution law.

We know from Boltzmann distribution law,

$$N_1 = N_0 e^{\frac{-E_1}{KT}}$$

$$N_2 = N_0 e^{\frac{-E_2}{KT}}$$

Where, K is the Boltzmann constant,

T is the absolute temperature and

N_o is the number of atoms at absolute zero at equilibrium,

we can write the ratio of population as follows,

$$\frac{N_1}{N_2} = e^{\frac{E_2 - E_1}{KT}}$$

since $E_2 - E_1 = h\nu$, we have

$$\therefore \quad \frac{N_1}{N_2} = e^{\frac{h\nu}{KT}} \text{ ..... (3)}$$

Substitute eq(3) in eq(2), we get

$$E_\upsilon = \frac{A_{21}}{\frac{h\nu}{[B_{12}e^{KT} - B_{21}]}}$$

Divide both numerator and denominator by B_{12} , we get

$$E_\upsilon = \frac{\frac{A_{21}}{B_{12}}}{\frac{h\nu}{[e^{KT} - \frac{B_{21}}{B_{12}}]}} \quad \text{--------(4)}$$

According to Maxwell-Boltzman statistics

$$\frac{A_{21}}{B_{12}} = \frac{8\pi h\nu^3}{c^3} \quad \text{and} \quad \frac{B_{21}}{B_{12}} = 1$$

Equation (4) becomes,

$$E_\upsilon = \frac{8\pi h\upsilon^3}{\frac{h\nu}{c^3\,[e^{KT} - 1]}}$$

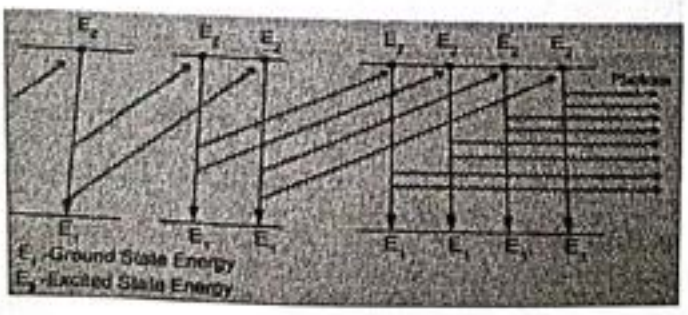
This is the relation between Einstein's coefficient and Energy density of radiations(E_υ).

Difference between Stimulated and Spontaneous Emission :

Sl.No	Stimulated Emission	Spontaneous Emission
1.	An atom in the excited state is induced to return to ground state, thereby resulting in two photons of same frequency and energy is called stimulated emission.	The atom in the excited state returns to ground state thereby emitting a photon, without any external inducement is called spontaneous emission.
2.	The emitted photons move in same direction and are highly directional.	The emitted photons move in all directions and are random.
3.	The radiation is high intense, monochromatic and coherent.	The radiationis less intense and is incoherent.
4.	The photons are in phase.	The photons are not in phase.
5.	The rate of transition is given by $R_{21}(St) = B_{21} \rho_\nu N_2$	The rate of transition is given by $R_{21}(Sp) = A_{21}N_2$

Light amplification :

Let us consider many numbers of atoms in the excited state. We know the photons emitted during stimulated emission have same frequency, energy and are in phase as the incident photon. Thus results in 2 photons of similar properties. These two photons induce stimulated emission of 2 atoms in excited state thereby resulting in 4 photons. These 4 photons induce 4 more atoms and give rise to 8 photons etc., as shown in Fig.



Principle: Due to stimulated emission the photons multiply in each step giving rise to an intense beam of photons that are coherent and moving in the same direction. Hence the Light is Amplified by Stimulated Emission of Radiation, termed as LASER.

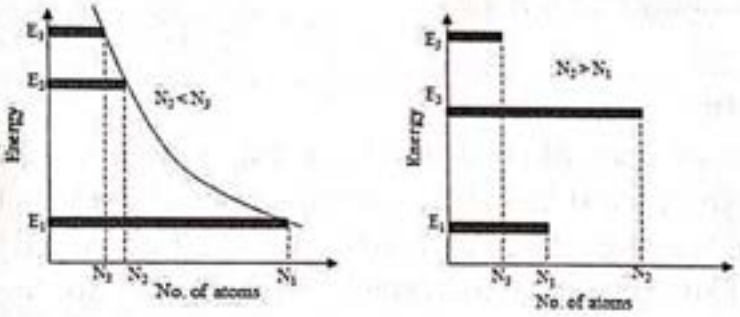
Population inversion:

When a system is in thermal equilibrium, the distribution of atoms in energy states at a given temperature follows the Boltzmann's law as

$$\frac{N_1}{N_2} = e^{\frac{h\upsilon}{KT}}$$

From the above equation, it is clear that the population is maximum in ground state as compared with excited state. i.e N1 > N2 .

If the situation is reverse, i.e N2 > N1 , there are more atoms in an excited state than the ground state as shown in fig(b), this condition is called **"Population inversion".**



When a suitable energy is supplied to the system, atoms get excited into E_3. After their lifetime 10^{-8} *seconds*, the atoms are transit to E_2. Due to more lifetime of an atom in state $E_2(10^{-3}$ *secconds*), the atomsstay for longer time than compare with the state E_3. Due to the accumulation of atomsin E_2, the population inversion is established in between the E_2 and E_1 states.

Pumping methods :

The process of achieving population inversion is called pumping. Pumping can be classified into the following types based on the type of source of pumping.

1. **Optical pumping:** Here the atoms are excited with the help of photons emitted by an optical source. The atoms absorb energy from the photons and raises to excited state. Optical pumping is used in solid laser.
   Examples : Ruby Laser, Nd-YAG Laser

2. **Electrical pumping:** Electrical discharge pumping is used in gas lasers. Since gas lasers have very narrow absorption. The electrons are accelerated to very high velocities by strong electric field and they collide with gas atoms and these atoms are raised to excited state.
   Examples : Argon Laser, CO_2 Laser, He-Ne Laser

3. **Chemical pumping:** Due to some chemical reactions, the atoms may be raised to excited state. Examples : Dye Laser.

Metastable state :

It is an excited state of an atom with a longer life time than the other excited states. Atoms in the metastable state remain excited for a considerable time in the order of 10^{-6} to 10^{-3} seconds. Such relatively long-lived states are called as Metastable state. An atom can exist in a metastable energy level for a longer time before radiating than itcan in an ordinary energy level.

An atom can be excited to a higher level by supplying energy to it. Normally, excited atoms have short life times and release their energy in a matter of 10^{-8} seconds through spontaneous emission. It means atoms do not stay long to be stimulated. As a result, they undergo spontaneous emission and rapidly return to the ground level; thereby population inversion could not be established. In order to do so, the excited atoms are required to 'wait' at the upper energy level till a large number of atoms accumulate at that level, that is A Meta stable state.

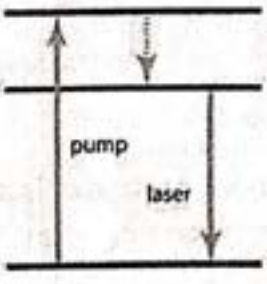
These levels lie in the forbidden gap of the host crystal. There could be no population inversion and hence no laser action, if metastable states don't exist.

Optical Pumping: Three- and Four-Level Systems

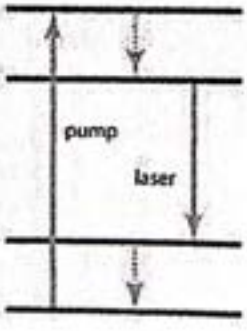
In a simple two-level system, it is not possible to obtain a population inversion with optical pumping because the system can absorb light (i.e., gain energy) only as long as population inversion, and thus light amplification, is not achieved. Essentially, the problem isstimulated emission caused by the pump light itself.

Inversion by optical pumping becomes possible when using a three-level system. Pump light with a shorter wavelength (higher photon energy) can transfer atoms from the ground state to the highest level. From there, spontaneous emission or a non-radiative process (e.g., involving phonons in a laser crystal) transfers atoms to an intermediate level, called the upper laser level. From that level down to the ground state, the laser transition with stimulated emission can occur. With sufficiently high pump intensity, population inversion for the laser transition can be reached as stimulated emission by the pump radiation is prevented by the transfer to the intermediate level.

Laser gain with a much lower excitation level is possible in a four-level system, such as Nd:YAG. Here, the lower level of the laser transition is somewhat above the ground state, anda rapid (most often non-radiative) transfer from there to the ground state keeps the population of the lower laser level very small. Therefore, a moderate population in the third level (the upper laser level), as achieved with a moderate pump intensity, is sufficient for laser amplification.



Three level



four level laser

Components of Lasers

Active Medium:

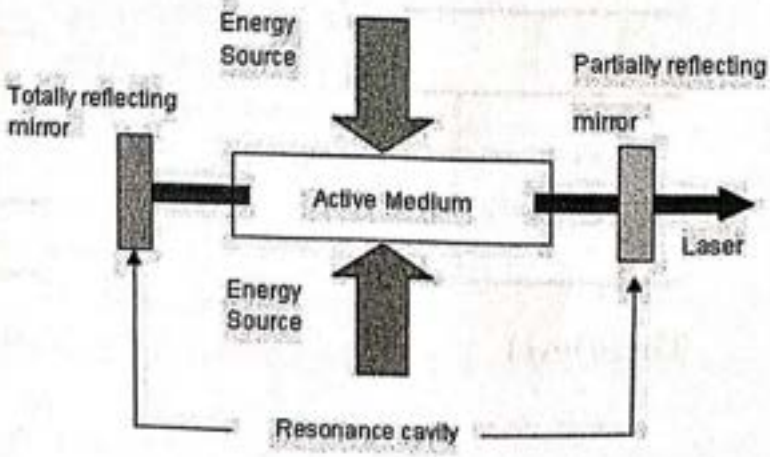
It is the material in which the laser action takes place. The active medium may be solid crystals such as liquid dyes, gases like CO_2 or Helium-Neon, or semiconductors such as GaAs. This medium decides the wavelength of laser radiation. Active mediums contain atoms which can produce more stimulated emission than spontaneous emission and cause amplification they are called "Active Centers".

Pumping Energy Source (Excitation Mechanism):

Energy Source (Excitation mechanisms) pumps the active centers from ground state to excitedstate to achieve population inversion. The pumping by energy source can be optical, electricalor chemical depending on the active medium.

Resonance Cavity:

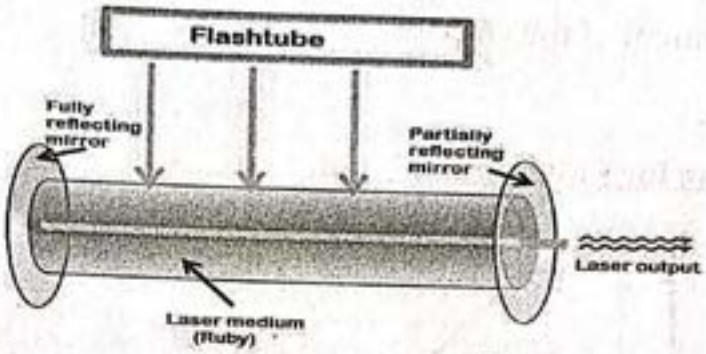
The optical resonator contains a pair of reflecting surfaces of which one is fully reflecting and the other partially reflecting. The active material is kept in between the two reflecting surfaces. Photons (light) emitted due to transitions between the energy states of the active material are bounced back and forth between the two reflecting surfaces, so the intensity of the light is increased. Finally the intense amplified beam called laser is coming out through the partial mirror as shown in the diagram.



Types of Lasers

1. Ruby Laser

The first working laser was built in 1960 by Maiman, using a ruby crytal and so called the Ruby laser. Ruby belongs to the family of gems consisting of Al_2O_3 with various types of impurities. For example, pink Ruby contains 0.05% Cr atoms. The schematic diagram of Ruby laser can be drawn as:



Construction of Ruby Laser

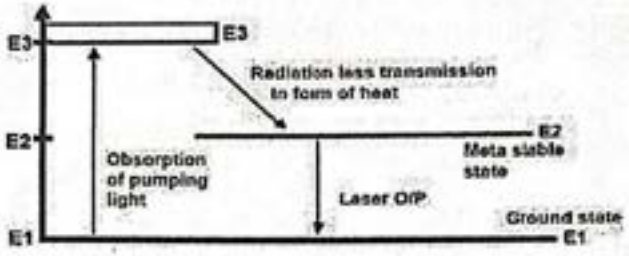
The ruby laser consists of a ruby rod. which is made of chromium doped ruby material. At the opposite ends of this rod there are two silver polished mirrors. Whose one is fully polished andother is partially polished. A spring is attached to the rod with fully polished end for adjustment of wave length of the laser light. Around the ruby rod a flash light is kept for the pump input. The whole assembly is kept in the glass tube. Around the neck of the glass tube the R.F source and switching control is designed in order to switch on and off the flash light for desired intervals.

Operation of Ruby Laser:

When we switch on the circuit the R.F operates. As a result, the flash of light is obtained aroundthe ruby rod this flash causes the electrons within ruby rod to move from lower energy band towards higher. This flash causes the electrons within ruby rod to move from lower energy band towards higher energy band. The population inversion take place at high energy band and electrons starts back to travel towards the lower energy band. During this movement the electron emits the laser light. This

emitted light travels between the two mirrors where cross reflection takes place of this light. The stimulated laser light now escapes from partially polished mirror in shape of laser beam. The switching control of the R.F source is used to switch on and off the flash light so that excessive heat should not be generated due to very high frequency of the movement of the electron.

Energy Level Diagram for Ruby Laser



The above three level energy diagram show that in ruby lasers the absorption occurs, this makes raise the electrons from ground state E_1 to the band of level E_3 higher than E_1. At E_3 these excited levels are highly unstable and so the electrons decays rapidly to the level of E_2. This transition occurs with energy difference ($E_1 - E_2$) given up as heat (radiation less transmission). The level E_2 is very important for stimulated emission process and is known as Meta stable state. Electrons in this level have an average life time of about 5ms before they fall to ground state. After this the population inversion can be established between E_2 and E_1. The population inversion is obtained by opticalpumping of the ruby rod with a flash lamp. When the flash lamp intensity becomes large enough to create population inversion, then stimulated emission from the Meta stable level to the ground level occurs which result in the laser output.

Advantages of Ruby Lasers

- Beam diameter of the ruby laser is comparatively less than CO_2 gas lasers.
- Output power of Ruby laser is not as less as in He-Ne gas lasers.
- Since the ruby is in solid form therefore there is no chance of wasting material of

active medium.

- Construction and function of ruby laser is self-explanatory.

Disadvantages of Ruby Laser

- In ruby lasers no significant stimulated emission occurs, until at least half of the groundstate
- electrons have been excited to the Meta stable state.
- Efficiency of ruby laser is comparatively low.
- Optical cavity of ruby laser is short as compared to other lasers, which may beconsidered a disadvantage.

Applications of Ruby Laser

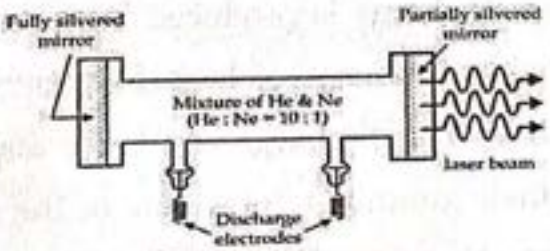
- Due to low output power they are class-I lasers and so may used as toys for children's.
- It can be used in schools, colleges, universities for science programs.
- It can be used as decoration piece & artistic display.

2. Helium -Neon (He-Ne) Laser

Construction:

Active medium:

It is a gas laser, which consists of a narrow quartz tube filled with a mixture of Helium and Neon gases in the ratio 10:1 respectively, at low pressure (~0.1 mm of Hg). Ne atoms act as active centers and responsible for the laser action, while He atoms are used to help in the excitation process. The length of the quartz tube is about 50 cm and the diameter is about 1 cm.



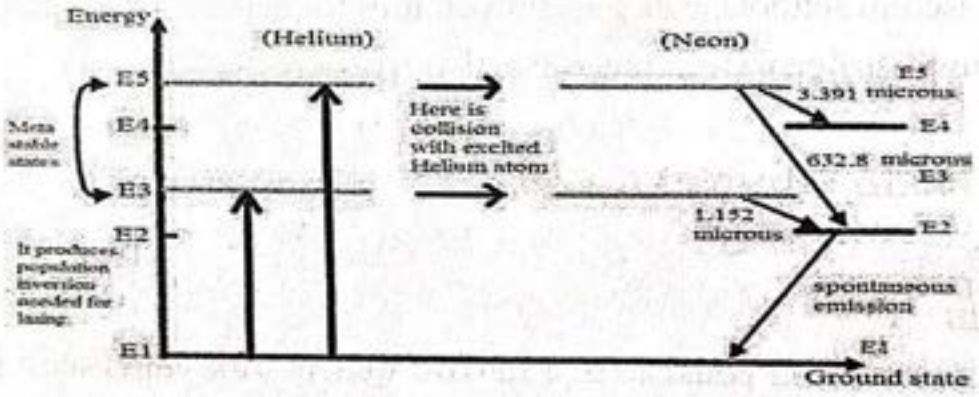
He-Ne LASER

Optical resonator:

To construct the optical resonator cavity, two parallel mirrors are placed at the ends of the quartz tube one of them is partly transparent while the other is fully reflecting. The spacing between the mirrors is adjusted such that it should be equal to the integral multiple of half- wavelengths of the laser light.

Pumping system:

The pumping is done through electrical discharge by using electrodes that are connected to a high frequency alternating current source.



The common helium-neon gas laser achieves a population inversion in a different way. A mixture of about 10 parts of Helium and 1 part of Neon at a low pressure is placed in a glass tube that has parallel mirrors, one of them partly transparent, at both ends. The spacing of the mirrors is equal to an integral number of half-wavelengths of the Laser light. An electric discharge is produced in the gas by means of electrodes outside the tube connected to a source of high-frequency alternating current, and collisions with electrons from the discharge excite He and Ne atoms to metastable states respectively above their ground states. Some of the excited He atoms transfer their energy to ground-state Ne atoms in collisions. The purpose of the He atoms is thus to help achieve a population inversionin the Ne atoms.

The laser transition in Ne is from the metastable state to an excited state with the emission of a 650nm of photon. Then another photon is spontaneously emitted in a transition to a lower metastable state; this transition yields only incoherent light.

Characteristics of He-Ne Laser

The He-Ne laser is a relatively low power device with an output in the visible red portion of the spectrum. The most common wavelength produced by He-Ne lasers is 632.8nm. Majority of He-Ne lasers generate less than 10m watt of power, but some can be obtained commercially with up to 50m watts of power. For He-Ne lasers the typical laser tube is from 10 to 100 cm in length and the life time of such a tube can be as high as 20,000 hours.

Applications of He-Ne Laser

The Helium-Neon gas laser is one of the most commonly used Laser today because of the following applications.

- Many schools / colleges / universities use this type of laser in their science programs and experiments.
- He-Ne lasers also used in super market checkout counters to read bar codes and QRcodes.
- The He-Ne lasers also used by newspapers for reproducing transmitted photographs.
- He-Ne lasers can be use as an alignment tool.
- It is also used in Guns for targeting.

Advantages of He-Ne Laser

- He-Ne laser has very good coherence property.
- He-Ne laser tube has very small length approximately from 10 to 100cm and best lifetime of 20.000 hours.
- Cost of He-Ne laser is less from most of other lasers.
- Construction of He-Ne laser is also not very complex.
- He-Ne laser provide inherent safety due to low power output.

Disadvantages of He-Ne Laser

- It is relatively low power device means its output power is low.
- He-Ne laser is low gain device.
- High voltage requirement can be considered its disadvantage.
- Escaping of gas from laser plasma tube is also its disadvantage.

Applications of Lasers

LASER Cutting

Laser is used as a tool to cut thin metal sheets by properly focusing the laser onto any particular area to be cut, for a longer time. Thus due to thermal effect the sheet is cut.

LASER Welding

In ordinary welding process the heat will be made to fall on the area to be welded, so that the material in that area will go to molten state. This on cooling will join the material. In this process the heat will spread all over the surroundings and will affect the other area of the material and hence the material gets damaged. This damage can be avoided by using laser welding. In laser welding the beam is focused onto the area to be welded and other areas remain unaffected. Without affecting the material the area to be welded alone melted and joined.

LASERS in Industry

Using high power lasers we can weld or melt any material. We can produce very small holes that cannot be done by mechanical drilling. Lasers can be used for cutting and for testing the quality of the materials. During laser welding and drilling there is no damage the structure of the materials. Lasers can be used for surface hardening techniques.

MEDICAL APPLICATIONS

Laser cosmetics surgery is used for removing tattoos, scars, stretch marks, sunspots, wrinkles and hairs.

1. Laser types used in dermatology:
   It include Ruby (694nm), pulsed diode arrays (810nm), Nd: YAG (1064nm) and Er : YAG (2940nm)
2. Laser eye surgery:
   Laser eye surgery is a medical procedure that uses a laser to reshape a surface of the eyes. This is done to correct short sightedness, long sightedness and astigmatism (uneven curvature of the eye surface).
3. Soft- Tissue surgery:
   a. In soft tissue laser surgery, a highly focused laser beam vapourises the soft tissue with the high water content.

b. Soft tissue laser surgery is used in a variety of applications which include general surgery, neuro surgery, ENT, dentistry and oral surgery.

c. Soft tissue laser surgery is also used in veterinary surgical fields.

4. Laser light therapy

   Laser light therapy involves exposure to laser light of specific variant. The light is administered for a prescribed amount of light. This is commonly used for skin diseases and disorders.

5. Laser is widely used for no-touch removal of tumors, especially of the brain and spinal cord

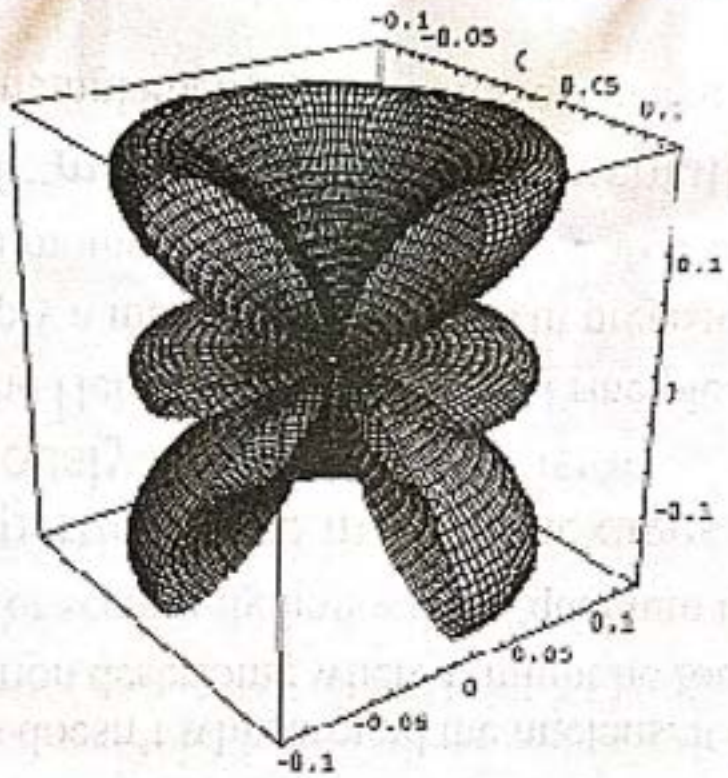
6. In dentistry, laser is used for tooth whitening and carries removal.

LASER SURGERY

A type of surgery that uses the cutting power of a laser beam to make bloodless cuts in tissue or remove a surface lens such as a skin tumor. There are a number of different types of lasers that differ in emitted light wavelengths and power ranges and in their ability to clot, cut or vapourise tissue. Among the commonly used lasers are pulsed dye laser, the YAG laser, the CO_2 laser and the argon laser.

Questions

1. Distinguish between Ordinary light and Laser light.
2. Distinguish between spontaneous and stimulated emission?
3. List out the characteristics of LASER.
4. What is meant by Spontaneous emission?
5. What is meant by stimulated emission?
6. What is meant by population inversion?
7. What is meant by pumping?
8. What are different methods of pumping?
9. What are the conditions required for laser action?
10. What are Einstein's coeffecients?
11. Define active medium.
12. What is meant by Optical resonator or Resonance cavity?
13. Explain construction and working of He-Ne Laser.
14. Explain construction and working of Ruby Laser.
15. Derive Einstein's relation for stimulated emission and hence explain the existence of stimulated emission.
16. Discuss the applications of laser in various fields.



Quantum Mechanics

Small things are weird

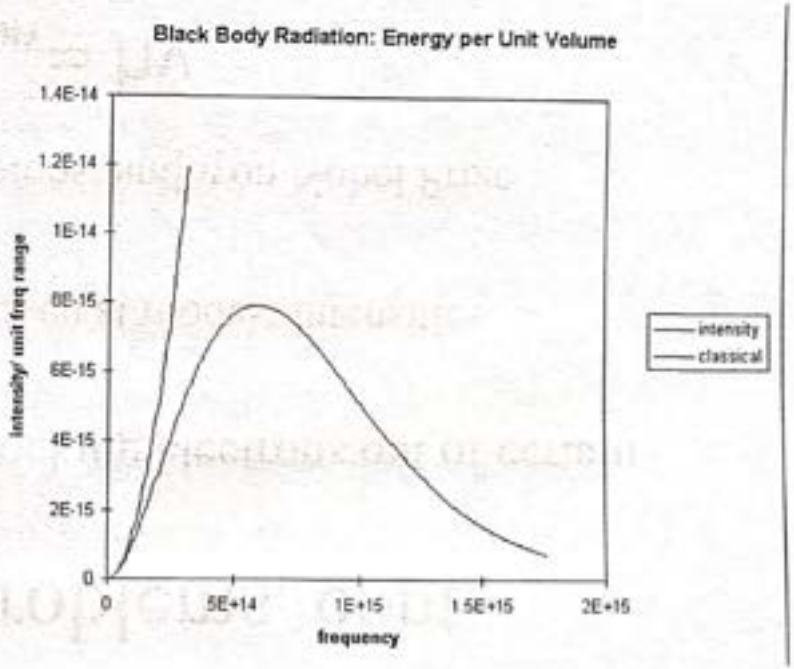
The Quantum Mechanics View

- All matter (particles) has wave-like properties
  - so-called particle-wave *duality*
- Particle-waves are described in a probabilistic manner
  - electron doesn't whiz around the nucleus, it has a probability distribution describing where it might be found
  - allows for seemingly impossible "quantum tunneling"
- Some properties come in dual packages: can't know both simultaneously to arbitrary precision
  - called the Heisenberg Uncertainty Principle
  - not simply a matter of measurement precision
  - position/momentum and energy/time are example pairs
- The act of "measurement" fundamentally alters the system
  - called entanglement: information exchange alters a particle's state

Crises in physics that demanded Q.M.

- Why don't atoms disintegrate in nanoseconds?
  - if electron is "orbiting", it's accelerating (wiggling)
  - wiggling charges emit electromagnetic radiation (energy)
  - loss of energy would cause prompt decay of orbit

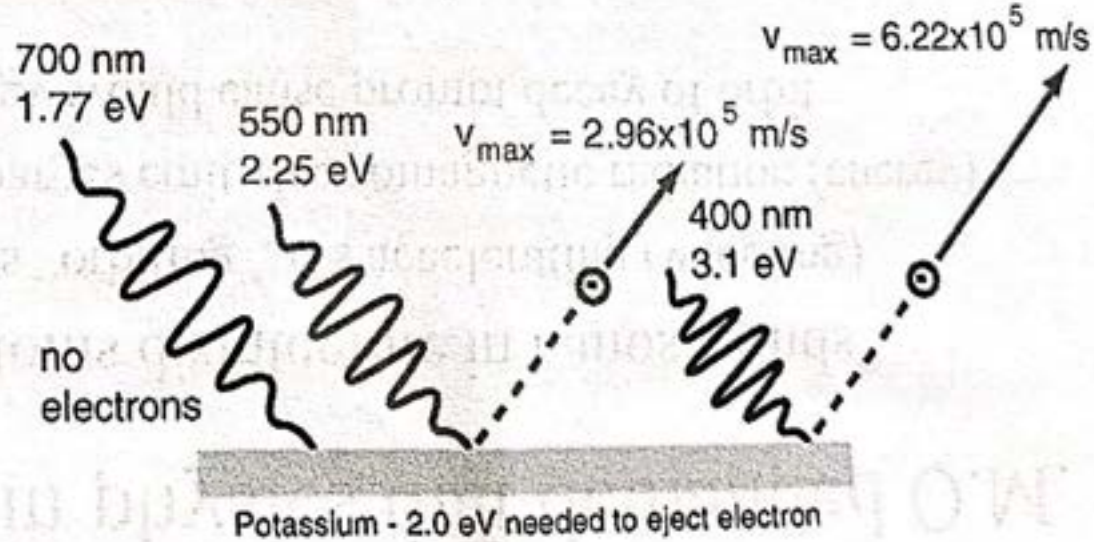
- Why don't hot objects emit more ultraviolet light than they do?
  - classical theory suggested a "UV catastrophe," leading to obviously nonsensical infinite energy radiating from hot body
  - Max Planck solved this problem by postulating light quanta (now often called the father of quantum mechanics)



Pre-quantum problems, cont.

- Why was red light incapable of knocking electrons out of certain materials, no matter how bright
  - yet blue light could readily do so even at modest intensities
  - called the photoelectric effect
  - Einstein explained in terms of photons, and won Nobel Prize

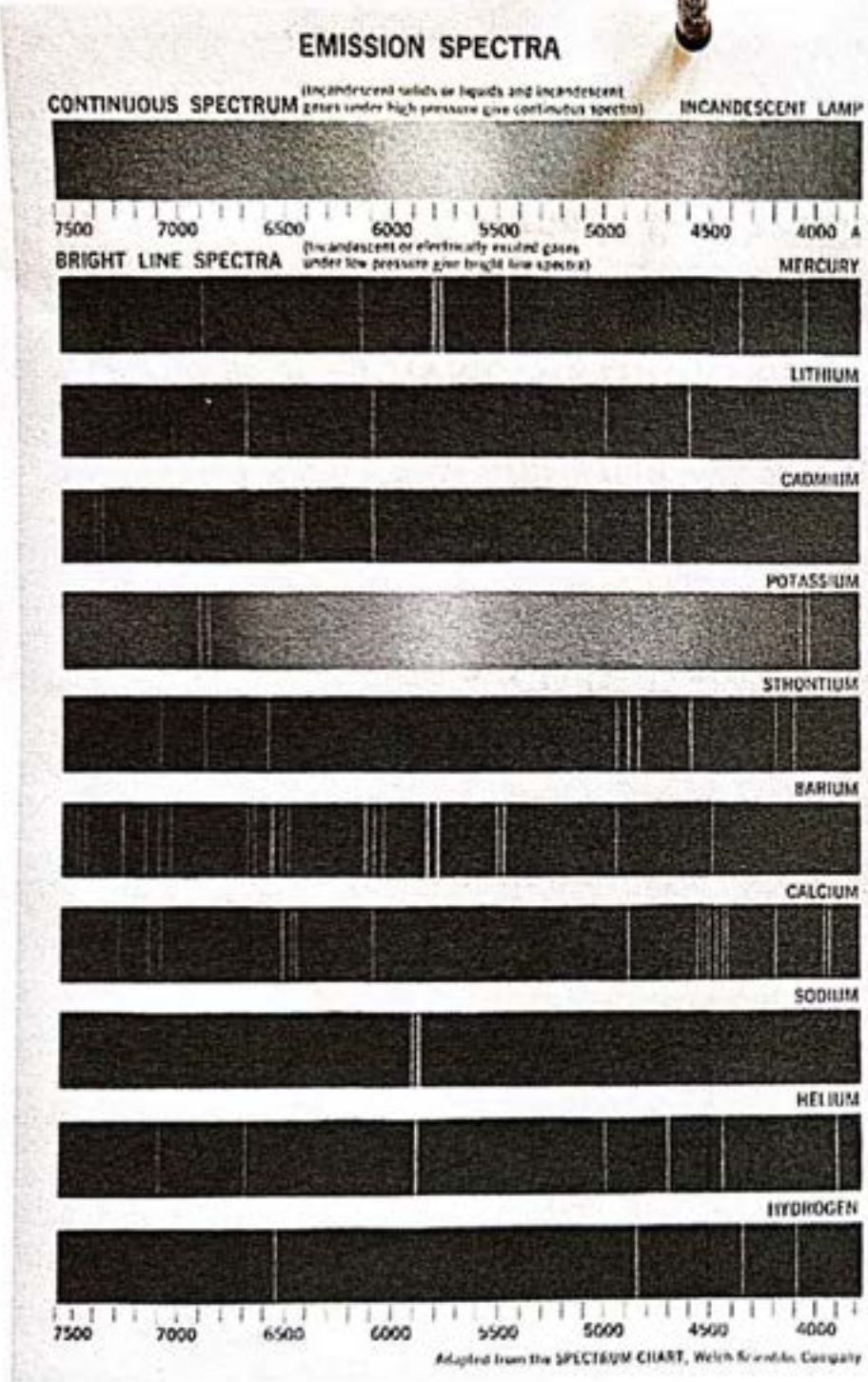
$$E_{photon} = h\nu$$



Photoelectric effect

Problems, cont.

- What caused spectra of atoms to contain discrete "lines"
  - it was apparent that only a small set of optical frequencies (wavelengths) could be emitted or absorbed by atoms
- Each atom has a distinct "fingerprint"
- Light only comes off at very specific wavelengths
  - or frequencies
  - or energies
- Note that hydrogen (bottom), with only one electron and one proton, emits several wavelengths



The victory of the weird theory

- Without Quantum Mechanics, we could never have designed and built:
  - semiconductor devices
    - computers, cell phones, etc.
  - lasers
    - CD/DVD players, bar-code scanners, surgical applications
  - MRI (magnetic resonance imaging) technology
  - nuclear reactors
  - atomic clocks (e.g., GPS navigation)
- Physicists didn't embrace quantum mechanics because it was gnarly, novel, or weird
  - it's simply that the #$!&@ thing worked so well

Let's start with photon energy

- Light is *quantized* into packets called *photons*
- Photons have associated:
  - frequency, ν (nu)
  - wavelength, λ ($\lambda\nu = c$)
  - speed, c (always)
  - energy: $E = h\nu$
    - higher frequency photons → higher energy → more damaging
  - momentum: $p = h\nu/c$
- The constant, h, is Planck's constant
  - has *tiny* value of: $h = 6.63\times10^{-34}$ J·s

How come *I've* never seen a photon?

- Sunny day (outdoors):
  - 10^{15} photons per second enter eye (2 mm pupil)
- Moonlit night (outdoors):
  - 5×10^{10} photons/sec (6 mm pupil)
- Moonless night (clear, starry sky)
  - 10^{8} photons/sec (6 mm pupil)
- Light from dimmest naked eye star (mag 6.5):
  - 1000 photons/sec entering eye
  - integration time of eye is about 1/8 sec → 100 photon threshold signal level

Quantum Wavelength

- Every particle or system of particles *can* be defined in quantum mechanical terms
  - and therefore have wave-like properties
- The quantum wavelength of an object is:

$$\lambda = h/p \qquad (p \text{ is momentum})$$

  - called the de Broglie wavelength
- typical macroscopic objects
  - masses ~ kg; velocities ~ m/s $\rightarrow p \approx 1$ kg·m/s
  - $\lambda \approx 10^{-34}$ meters (too small to matter in macro environment!!)
- typical "quantum" objects:
  - electron (10^{-30} kg) at thermal velocity (10^{5} m/s) $\rightarrow \lambda \approx 10^{-8}$ m
  - so λ is 100 times larger than an atom: very relevant to an electron!

The Uncertainty Principle

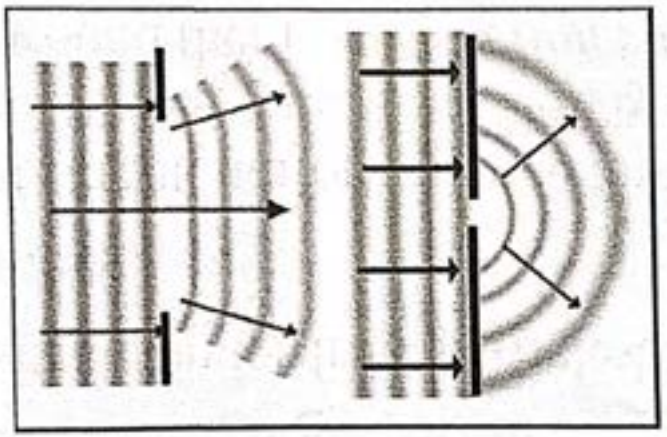
- The process of measurement involves interaction
  - this interaction necessarily "touches" the subject
  - by "touch," we could mean by a photon of light
- The more precisely we want to know where something is, the "harder" we have to measure it
  - so we end up giving it a kick
- So we must unavoidably alter the velocity of the particle under study
  - thus changing its momentum
- If Δx is the position uncertainty, and Δp is the momentum uncertainty, then inevitably,

$$\Delta x \Delta p \geq h/2\pi$$

Example: Diffraction

- Light emerging from a tiny hole or slit will diverge (diffract)
- We know its position very well (in at least one dimension)
  - so we give up knowledge of momentum in that dimension—thus the spread

large opening: greater position uncertainty results in smaller momentum uncertainty, which translates to less of a spread angle



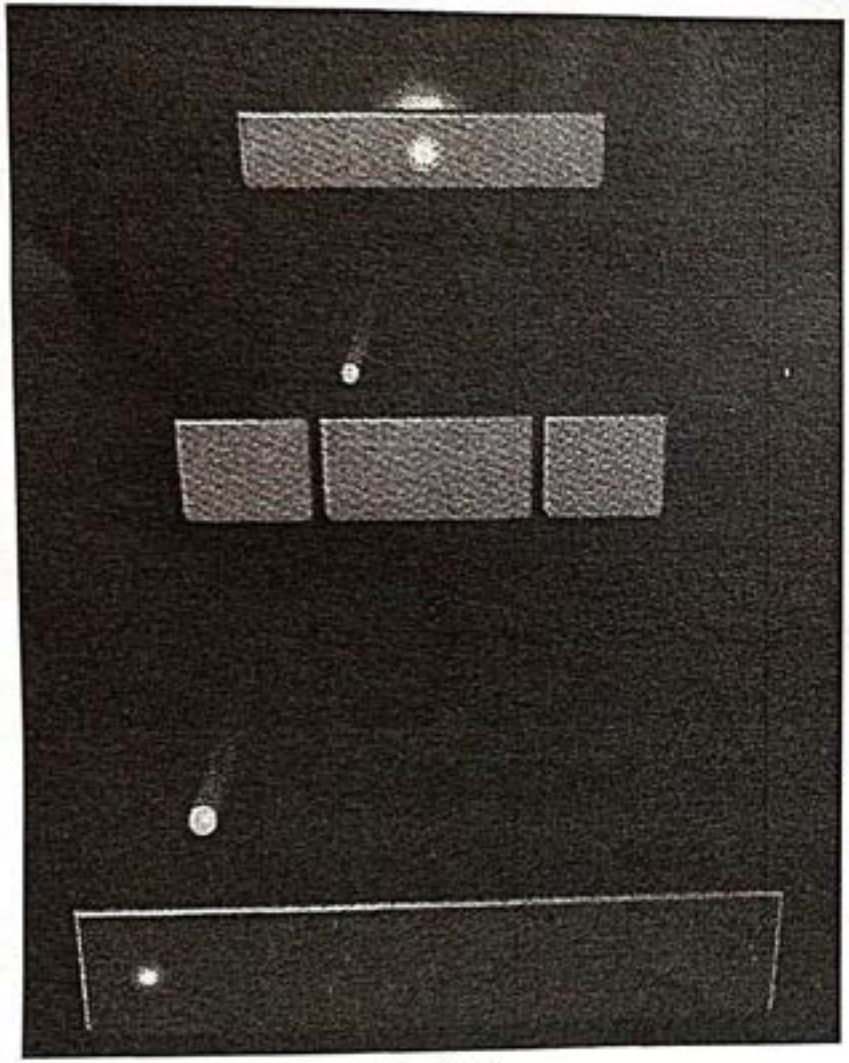
small opening: less position uncertainty results in larger momentum uncertainty, which translates to more of a spread angle

$$\text{angle} \approx \Delta p/p \approx h/p\Delta x \approx h\lambda/h\Delta x = \lambda/\Delta x$$

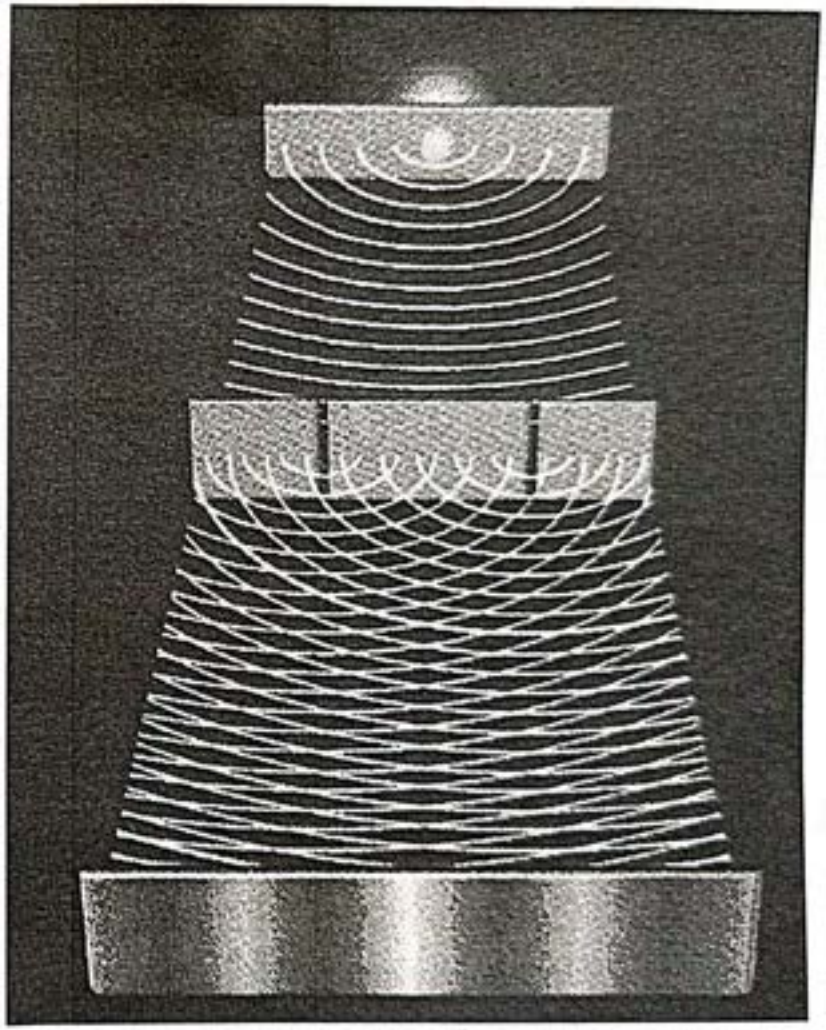
Diffraction in Our Everyday World

- Squint and things get fuzzy
  - opposite behavior from particle-based pinhole camera
- Eye floaters
  - look at bright, uniform source through tiniest pinhole you can make—you'll see slowly moving specks with rings around them—*diffraction rings*
- Shadow between thumb and forefinger
  - appears to connect before actual touch
- Streaked street-lights through windshield
  - point toward center of wiper arc: diffraction grating formed by micro-grooves in windshield from wipers
  - same as color/streaks off CD

The Double Slit Experiment



particle?



wave?

Results

- The pattern on the screen is an interference pattern characteristic of waves
- So light is a wave, not particulate
- But repeat the experiment one photon at a time
- Over time, the photons *only land on the interference peaks*, not in the troughs
  - consider the fact that they also pile up in the middle!
  - pure ballistic particles would land in one of two spots

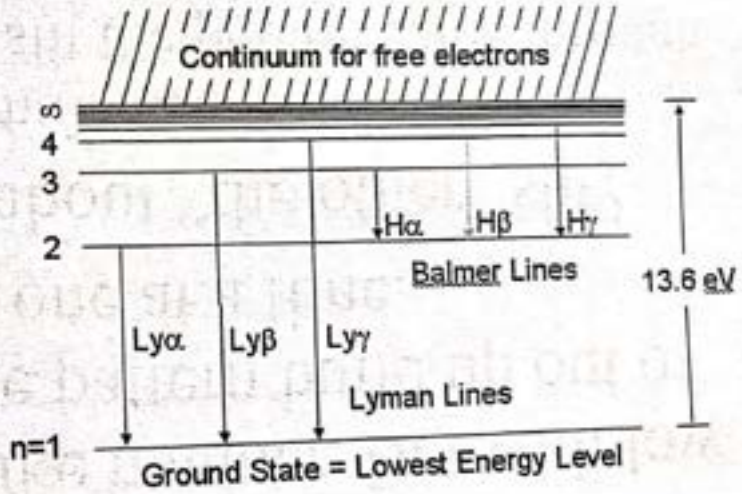
Wave or Particle? Neither; Both; take your pick

- Non-intuitive combination of wavelike *and* particle-like
- Appears to behave in wavelike manner. But with low intensity, see the interference pattern build up out of individual photons, arriving one at a time.
- How does the photon *know* about "the other" slit?
  - Actually, it's impossible to simultaneously observe interference *and* know which slit the photon came through
  - Photon "sees", or "feels-out" *both* paths simultaneously!
- Speak of wave-part describing *probability distribution* of where individual photons may land

The hydrogen atom

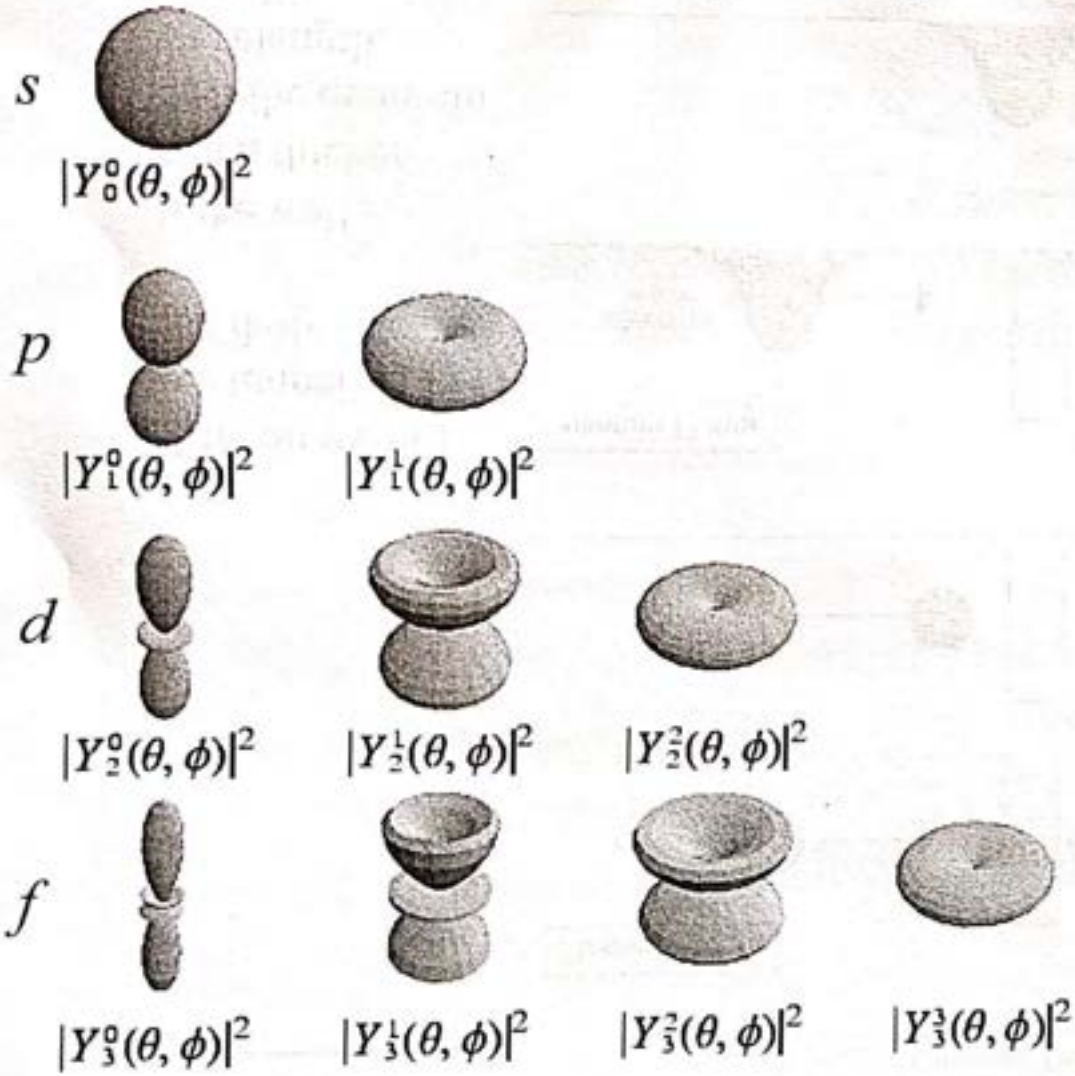
- When the mathematical machinery of quantum mechanics is turned to the hydrogen atom, the solutions yield energy levels in exact agreement with the optical spectrum
  - Emergent picture is one of probability distributions describing where electrons can be

The energy levels of hydrogen match the observed spectra, and fall out of the mathematics of quantum mechanics



- Probability distributions are static
  - electron is not thought to whiz around atom: it's in a "stationary state" of probability
- Separate functions describe the radial and angular pattern
  - http://hyperphysics.phy-astr.gsu.edu/hbase/hydwf.html

The angular part of the story

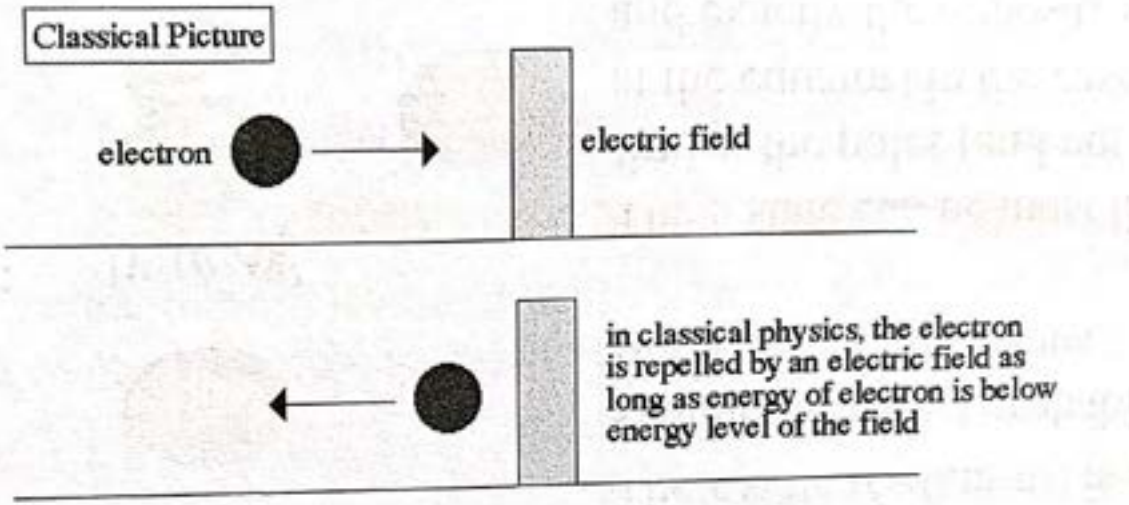


These plots describe the directions in which one is likely to find an electron. They are denoted with quantum numbers ℓ and m, with ℓ as the subscript and m as the superscript.

The *s* state (ℓ=0,m=0) is spherically symmetric: equal probability of finding in all directions.

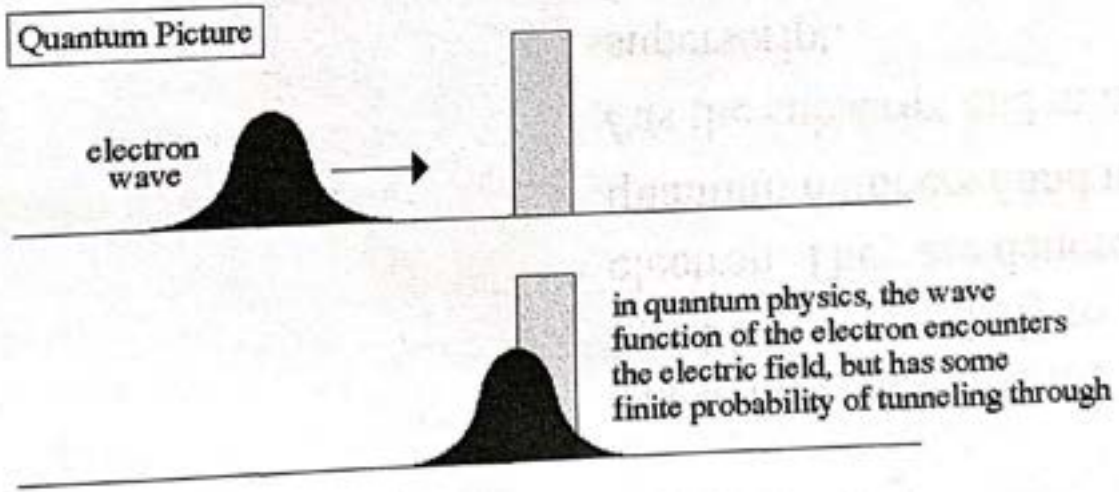
The *p* state can be most likely to find at the poles (and not at all at the equator) in the case of (1,0), and exactly the opposite situation in the (1,1) state.

Quantum Tunneling



electron always repelled

Why do we not see tunneling in our daily lives?



electron usually repelled, but will occasionally pop out on the other side of the barrier, even though it does not have enough energy to do so classically

If the wall is much thicker than the quantum wavelength, tunneling becomes improbable

this is the basis for transistors

Assignments

- References:
  - Brian Greene's *The Elegant Universe* has an excellent description/analogy of the quantum solution to the ultraviolet catastrophe (among other quantum things)
  - Chapter 31 isn't half bad: read it for fun, even!
- Assignments:
  - Read Hewitt chapters 30 & 31 (Quantum & Light)
  - Read Hewitt pp. 566–572 on diffraction & interference
  - HW 7 due 5/30: 26.E.3, 26.E.4, 26.E.10, 26.E.14, 26.E.38, 26.P.4, 31.E.4, 31.E.9, plus 4 additional questions available from website

STELLA MARY'S COLLEGE OF ENGINEERING

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2023 - 2024

TWO MARKS QUESTIONS WITH ANSWERS

PH3151 Engineering Physics R-2021

Question Bank

UNIT – I MECHANICS

PART A

1. Define multiparticle dynamics.

Multi-particle dynamics (or) dynamics in a system of particles, is the study of motion in respect of a group of particles in which the space between the particles will be very small I.e., the distancebetween them will be negligible.

The dynamics of a particle system consists of the application of Newton's laws of motion to a set ofparticles, which can be discrete (the particles can be counted) or form part of an extended object, inthis case the system it is continuous. To explain the motion of a system of particles, it is inconvenient to analyze each one separately and see what forces act on it. Instead, a representative point of the set is defined, called the center of mass .

2. Define centre of mass of the system.

Centre of mass is the point in the body or a system of particles where the mass of the whole body seems to be concentrated. It is found by taking the weighted average position of the mass.
Centre of mass is the point at which the distribution of mass is equal in all directions and does not depend on gravitational field.
Taking first the simple case of a system of just two particles of masses m_1 and m_2 and of a total mass M, with r_1 and $r_2$as their position vectors with respect to some origin, if R vector be the position vector of the centre of mass, we have

$$\vec{R} = \frac{m_1 \vec{r_1} + m_2 \vec{r_2}}{m_1 + m_2} = \frac{m_1 \vec{r_1} + m_2 \vec{r_2}}{M}$$

Or,

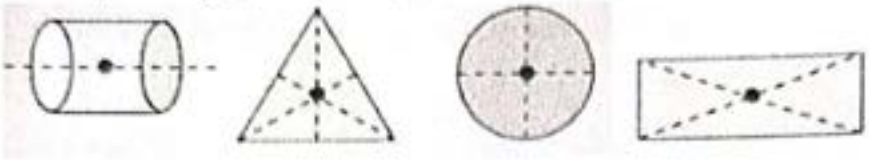
$$M \vec{R} = m_1 \vec{r_1} + m_2 \vec{r_2},$$

i.e., the product of the total mass of the system and the position vector of the centre of mass (CM) is equal to the sum of the products of the individual masses and their respective position vectors.The position of the CM of the system may thus be easily obtained.

3. What is centre of mass (CM)?

Centre of mass of a body or system of a particle is defined as, a point at which the whole of the mass of the body or all the masses of a system of particle appeared to be concentrated. In physics, we can say that the centre of mass is a point at the centre of the distribution of mass in space (also known as balance point). For simple rigid objects with uniform density, the centre of mass is located at the centroid.

- The center of mass of a two-particle system lies on the line connecting the particles (or, more precisely, their individual centers of mass). The center of mass is closer to the more massive object.
- The center of mass of a solid triangle lies on all three medians and therefore at the centroid, which is also the average of the three vertices.
- The center of mass of a rectangle is at the intersection of the two diagonals.
- In a spherically symmetric body, the center of mass is at the center.



4. Give the example for motion of centre of mass

The moon revolving around the earth in a circular orbit

- We know that the moon revolves around the earth in a circular orbit. The force of attraction between the moon and earth is the gravitational force which is again an internal force.
- To eliminate the chances of the moon and earth colliding with each other due to the presence of internal forces, we assume that both moon and earth are revolving around their centre of mass, such that they are always at the opposite side of their centre of mass.

5. How centre of mass is determined for rigid body and regular shape?

- The center of mass of a body is defined as a point where the entire mass of the body appears to be concentrated. Therefore, this point can represent the entire body.
- For bodies of regular shape and uniform mass distribution, the center of mass is at the geometric center of the body.
- For simple rigid objects with uniform density, the center of mass is located at the centroid.

6. Define rigid body.

A rigid body is usually considered as a continuous distribution of mass. It can be also defined as a collection of particles with the property that the distance between particles remains unchanged during the course of motions of the body.

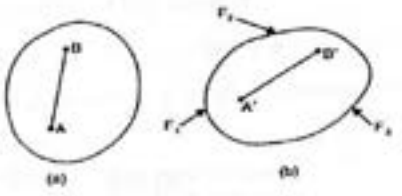


Fig. 1.1

A rigid body (also known as a rigid object) is a solid body in which deformation is zero or so small it can be neglected. The distance between any two given points on a rigid body remains constant in time regardless of external forces exerted on it.

7. Define rigid body rotation

- Rigid body rotation is featured prominently in science, sports, and engineering. Theoretically, it is a collection of particles that are at a fixed distance from one another. In an ideal scenario, these bodies do not change their shape or deform. These kinds of bodies are usually a continuous distribution of mass. For analyzing the motion of such bodies, the position of the center of mass is required. When forces are applied to such bodies, it produces an angular acceleration and linear acceleration. It becomes essential to study how these forces affect rigid bodies and produce an angular and linear acceleration in them.

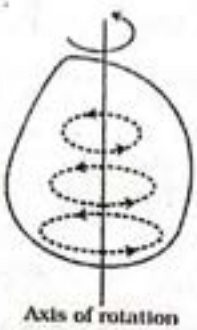


Fig Rotational motion

Let's see them in the detail about the rotational motion of a rigid body. Rotational motion is more complicated than linear motion, and only the motion of rigid bodies will be considered here. A rigid body is an object with a mass that holds a rigid shape. Many of the equations for the mechanics of rotating objects are similar to the motion equations for linear motion.

- Rigid body rotation is a motion that occurs when a solid body moves in a circular path around something. The rotational motion can be broken down into two types of rotation – Rotation about a fixed axis and rotation about a fixed point. Rotation about a fixed axis is said to be when the body is rotating about an axis that has a fixed location and orientation relative to the body.
- Example of such rotations includes – hinged door.
- The second type of rotational motion involves the rotation of the body around a point. A child's spinning top is one example of this type of rotational motion.

9. Write down the equation of motion for rotational motion.

In the case of rotational motion, different constituent particles have different linear velocities but all of them have the same angular velocity.

$$\omega = \omega_o + \alpha t$$

$$0 = \omega_o t + \frac{1}{2}\alpha t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha\, 0$$

10. Define moment of inertia of a body

Moment of inertia from a Physics point of view is basically a quantitative measure of the rotational inertia or the angular mass of a body. In simple terms, it is the opposition that the body exhibits to the change in rotation about an axis which may further be internal or external.

The moment of inertia (I) is mostly specified based on the distribution of mass in the body with respect to the axis of rotation.

The moment of inertia is a measure of how resistant an object is to changes in its rotational motion. The moment of inertia of the cross-section of a body is its resistance to changes in its rotation.

11. Define moment of inertia of a particle.

- Moment of inertia of a particle is defined as the quantity expressed by the body resisting angular acceleration which is the sum of the product of the mass of every particle with its square of a distance from the axis of rotation.
- The formula for the moment of inertia of a particle is the "sum of the product of mass" of each particle with the "square of its distance from the axis of the rotation". The formula of Moment of Inertia of a particle is expressed as $\mathbf{I = mr^2}$

12. Define moment of inertia of a rigid body.

The expressions of moments of inertia (MI) for different object forms as :

$$1.\ \text{For a particle}: \quad I = mr^2$$

$$2.\ \text{For a system of particles}: \quad I = \sum m_i r_i^{\,2}$$

$$3.\ \text{For a rigid body}: \quad I = \int r^2 dm$$

Rigid body is a continuous aggregation of particles. We, therefore, need to modify the summation in the expression of moment of inertia by integration as :

$$I = \int r^2 dm$$

13. What factors the moment of inertia depends?

The moment of inertia of a body is directly proportional to its mass and the distance of the particles of the body from the axis of rotation. Hence, the moment of inertia depends on **mass and distance from the rotating axis**, and force and density do not affect the moment of inertia of a body.

$$I = mr^2$$

14. What is the physical significance of moment of inertia?

The physical significance of moment of inertia is that it performs the same role in rotational motion that the mass does in linear motion. Just as the mass of a body resists change in its state of linear motion, the moment of inertia resists a change in its rotational motion. This property of the moment of inertia has been put to a great practical use. Most machines, which produce rotational motion have as one of their components a disc which has a very large moment of inertia.

Examples of such machines are the steam engine and the automobile engine. The disc with a large moment of inertia is called a flywheel. To understand how a flywheel works, imagine that the driver of the engine wants to suddenly increase the speed. Because of its large moment of inertia, the flywheel resists this attempt. It allows only a gradual increase in speed. Similarly, it works against the attempts to suddenly reduce the speed, and allows only a gradual decrease in the speed. Thus , the flywheel, with its large moment of inertia, prevents jerky motion and ensures a smooth ride for the passengers.

15. What is radius of gyration?

The moment of inertia of a rotational rigid body is often written as

$I = M K^2$

where M is the total mass of the body

and K is called the radius of gyration of the body.

The radius of gyration is that distance from the axis of rotation where the whole mass of the body can be assumed to be placed to get the same moment of inertia which the body actually has. It is important to remember that the moment of inertia of a body about an axis depends on the distribution of mass around that axis. If the distribution of mass changes, the moment of inertia will also change.

16. What are the theorems on moment of inertia?

The two theorems of Moment of Inertia are

(i) Parallel axes theorem

(ii Perpendicular axes theorem

17 . State parallel axis theorem.

The moment of inertia of a body about any axis is equal to the sum of its moment of inertia about a parallel axis through its centre of gravity and the product of the mass of the body and the square of the distance between the two axes.

$$Izz = Ixx + Iyy$$

18. State perpendicular axis theorem.

The moment of inertia of a plane laminar body about an axis perpendicular to the plane is equal to the sum of the moments of inertia about two mutually perpendicular axes in the plane of the lamina such that the three mutually perpendicular axes have a common point of intersection.

$$I_{AB} = I_{OO'} + Ay_c^2$$

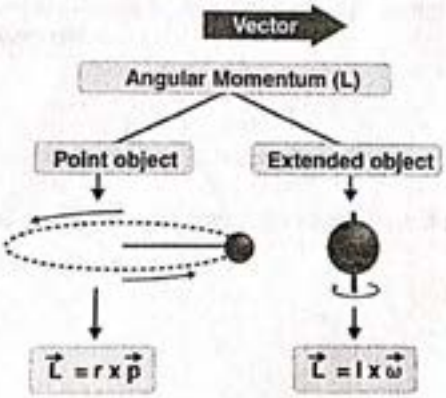
19. Define angular momentum.

Like linear momentum, angular momentum is the measure of the "quantity of motion". From Newton's second law, we know that first time derivative of linear momentum gives net external force on a particle. By analogy, we expect that this quantity (angular momentum) should have an expression such that its first time derivative yields torque on the particle.

1: Angular momentum of a particle in general motion is given as:

$$\ell = \mathbf{r} \times \mathbf{p} = m(\mathbf{r} \times \mathbf{v})$$

where "**r**" is the linear vector connecting the position of the particle with the "point" about which angular momentum is measured and "**p**" is the linear momentum vector. In case, the point coincides with the origin of coordinate system, the vector "**r**" becomes the position vector that small letter "ℓ" is used to denote angular momentum of a particle. The corresponding capital letter "L" is reserved for angular momentum of a system of particle or rigid body.



2: For rotation of a particle, angular momentum has additional expression in terms of moment of inertia and angular velocity as :

$$\ell = I\omega = mr^2\omega$$

20. *Define torque.*

Torque is the measure of the force that can cause an object to rotate about an axis. Force is what causes an object to accelerate in linear kinematics. Similarly, torque is what causes an angular

acceleration. Hence, torque can be defined as the rotational equivalent of linear force. The straight line about which the object rotates is called the axis of rotation.

In physics, torque is simply the tendency of a force to turn or twist. Different terminologies such as moment or moment of force are interchangeably used to describe torque. The distance of the point of application of force from the axis of rotation is sometimes called the moment arm or lever arm.

How is Torque Calculated?

A simple way to calculate the magnitude of the torque is to first determine the lever arm and then multiply it times the applied force.

Now, from the above observation, we conclude that the torque produced depends on the magnitude of the force and the perpendicular distance between the point about which torque is calculated and the point of application of force. So, mathematically torque is represented as:

$$\tau = Fr\sin\Theta$$

where r is the length of the lever arm and θ is the angle between the force vector and the lever arm.

21. State conservation of angular momentum

When applied to angular momentum, the law of conservation means that the momentum of a rotating object does not change unless some type of external torque is applied. Torque, in this sense, can refer to any outside force that acts upon the object to cause it to twist or rotate. Without the application of torque -- when net torque is zero -- the angular momentum remains constant; that is, the momentum remains conserved.

$$\frac{d\mathbf{L}}{dt} = 0$$

or $\mathbf{L}$ = constant.

Thus, if the total external torque on a system of particles is zero, then the total angular momentum of the system is conserved, i.e. remains constant.

22. What is gyroscope?

A gyroscope is defined as the device has a spinning disc that is mounted on the base such that it can move freely in more than one direction so that the orientation is maintained irrespective of the movement in the base. 'Gyre' is a Greek word, meaning 'circular motion' and Gyration means the whirling motion.

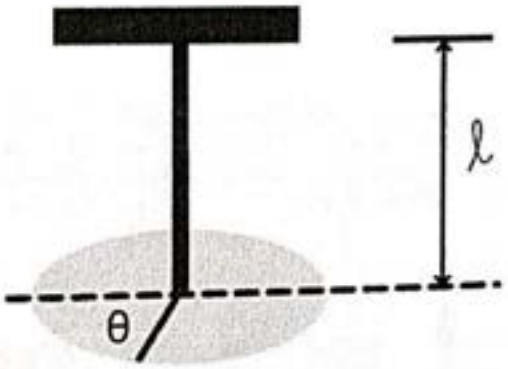
A gyroscope is a spatial mechanism which is generally employed for the study of precessional motion of a rotary body. Gyroscope is generally employed for the control of angular motion of a body. If we attempt to move some of its parts, it does not only resist this motion but even evades it. This resistance to change in the direction of rotational axis is called the gyroscopic effect.

23. What are the uses of gyroscope?

Gyroscope finds applications in gyrocompass, used in aircraft, naval ship, control system of missiles and space shuttle.

24. What is torsional pendulum

The torsional pendulum is the disc suspended to the thin bar which creates twisting oscillations around the axis of the bar. The restoring force developed by twisting or torsional action creates the oscillations in the disc.If the initial angular displacement θ is given to the disc by applying twisting torque, the thin rod generates the restoring torque, which causes the disc to revolve in the opposite direction.



This mechanism creates simple harmonic motion in the torsional pendulum.

$$\text{Period of torsional pendulum} = t = 2\pi\sqrt{\frac{I}{C}} \quad \text{—(7)}$$

25. What are the uses of torsional pendulum?

Torsion pendulums are often used for time-keeping purposes. For instance, the balance wheel in a mechanical wristwatch is a torsion pendulum in which the restoring torque is provided by a coiled spring.

26. What is double pendulum?

A double pendulum is a pendulum with another pendulum attached to its end, forming a simple physical system that exhibits rich dynamic behavior with a strong sensitivity to initial onditions. The motion of a double pendulum is governed by a set of coupled ordinary differential equations and is chaotic.

PH3151 Engineering Physics R-2021

Question Bank

UNIT – II ELECTROMAGNETIC WAVES

PART A

1. Write Maxwell's equation – I from Gauss's law in electrostatics.

Maxwell's first equation is based on the Gauss law of electrostatic, which states that "when a closed surface integral of electric flux density is always equal to charge enclosed over that surface"

Gauss law for electricity

$$\vec{\nabla}.\vec{D} = \rho$$

2. Write Maxwell's equation – II from Gauss's law in magneto statics

Maxwell second equation is based on Gauss law on magnetostatics. Gauss law on magnetostatics states that "closed surface integral of magnetic flux density is always equal to total scalar magnetic flux enclosed within that surface of any shape or size lying in any medium."

Gauss law for magnetism

$$\vec{\nabla}.\vec{B} = 0$$

3. Write Maxwell's equation –III from Faraday laws of electromagnetic induction.

Maxwell's 3rd equation is derived from Faraday's laws of Electromagnetic Induction. It states that "Whenever there are n-turns of conducting coil in a closed path placed in a time-varying magnetic field, an alternating electromotive force gets induced in each coil." Lenz's law gives this. Which states, " An induced electromotive force always opposes the time-varying magnetic flux."

Faraday's law of electromagnetic induction

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

4. Write Maxwell's equation –IV from Ampere's circuital law.

It is based on Ampere's circuit law. Ampere's circuit law states that "The closed line integral of magnetic field vector is always equal to the total amount of scalar electric field enclosed within the path of any shape".

Ampere's law

$$\vec{\nabla} \times \vec{H} = \vec{I} + \frac{\partial \vec{D}}{\partial t}$$

5. Give the Maxwell's equations in differential form.

The Maxwell's equations in differential form can be written as-

$$\vec{\nabla}.\vec{D} = \rho$$

This is Maxwell's first equation in differential form.

$$\vec{\nabla}.\vec{B} = 0$$

This is the Maxwell's second equation in differential form.

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

This is the Maxwell's third equation in differential form.

$$\vec{\nabla} \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$$

This is the Maxwell's fourth equation in differential form

6. Give the Maxwell's equations in integral form.

$$\oint_S \vec{D}.ds = \oint_V \rho.dv$$

This is the Maxwell's first equation in integral form.

$$\oint_S \vec{B}.ds = 0$$

This is the Maxwell's second equation in integral form.

$$\oint_l \vec{E}.dl = -\oint_S \frac{d\vec{B}}{dt}.ds$$

This is the Maxwell's third equation in integral form.

$$\oint_l \vec{H}.dl = \oint_S \left(\vec{J} + \frac{\partial \vec{D}}{\partial t}\right).\vec{ds}$$

This is the Maxwell's fourth equation in integral form

7. Write the Maxwell's equations for free space.

If the electromagnetic wave field vector is constant over any plane perpendicular to the direction of wave propagation at any instant then this wave is called plane progressive wave.

Consider a plane electromagnetic wave vacuum or free space. Let permittivity ϵ_0, permeabilit; μ_0 are constants. And Conductivity, $\sigma = 0$

Maxwell's equations for free space can be written as

$$\vec{\nabla}.\vec{E} = 0 \qquad -----(1)$$

$$\vec{\nabla}.\vec{B} = 0 \qquad -----(2)$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \qquad -----(3)$$

$$\vec{\nabla} \times \vec{B} = \epsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t} \qquad -----(4)$$

8. Write the Maxwell's equations for conducting medium.

$$\nabla^2 \vec{E} - \sigma\mu \frac{\partial \vec{E}}{\partial t} - \epsilon\mu \frac{\partial^2 \vec{E}}{\partial t^2} = 0$$

This is the wave equation in terms of electric field.

$$\nabla^2 \vec{B} - \mu\sigma \frac{\partial \vec{B}}{\partial t} - \mu\epsilon \frac{\partial^2 \vec{B}}{\partial t^2} = 0$$

This is the wave equation in terms of magnetic field

9. What are the characteristics of Maxwell's First equations.

The net quantity of the electric flux leaving a volume is proportional to the charge inside the

volume.

10. What are the characteristics Maxwell's second equations.

The second law states that there are no "magnetic charges (or monopoles)" analogous to electric charges, and that magnetic fields are instead generated by magnetic dipoles. Thus, the total magnetic flux through a surface surrounding a magnetic dipole is always zero.

11. What are the characteristics Maxwell's Third equations.

Whenever the magnetic flux associated with any closed loop changes an induced emf develops in the circuit and that sends current through the circuit which last so long as the change of flux lasts. He also showed that the induced emf produced is directly proportional to magnetic flux linked with the coil. Thus, the total magnetic flux through a surface surrounding a magnetic dipole is always zero.

12. What are the characteristics Maxwell's Fourth equations.

Amperes law states that the line integral of the magnetic field B⟶ around any closed path or circuit is equal to the current enclosed by the path. Thus, magnetic field B around any closed path or circuit is equal to the conductions current plus the time derivative of electric displacement through any surface bounded by the path.

13. Write down general electromagnetic wave equation in terms of electric field vector for free space.

If the electromagnetic field vector is constant over any plane perpendicular to the direction of wave propagation at any instant then this wave is called plane progressive wave. The wave equations are:

$$\vec{\nabla}.\vec{E} = 0 \qquad \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

14. Write down general electromagnetic wave equation in terms of magnetic field vector for free space.

If the electromagnetic field vector is constant over any plane perpendicular to the direction of wave propagation at any instant then this wave is called plane progressive wave. The wave equations are:

$$\vec{\nabla}.\vec{B} = 0$$

15. Write down the expression for velocity of electromagnetic wave equation in terms of in free space.

Free space is a region where there is no matter and no gravitational or electromagnetic fields. The expression for velocity of the wave equation is

$$\frac{c}{\sqrt{\mu_r \epsilon_r}} = v$$

Where, μ_r – relative permittivity and ε_r – Absolute permittivity

16. Write down the general solution of wave equation for plane polarized EM wave.

Polarization refers to the relationship between the orientation of electric and magnetic field Vectors and the direction of propagation of EM waves. If E_{ox} and E_{oy} are real numbers and if the electric and magnetic vectors are in phase, then it is plane polarized wave. The solution for the plane polarized wave is given by

$$\vec{E}(z,t) = \left[i\vec{E}_{ox} + j\vec{E}_{oy}\right]e^{i(Kz-\omega t)}$$

17. Write down the relation between the electric field vector E and magnetic field vector.

The relation between the electric field vector E and magnetic field vector.

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \qquad \nabla \times \vec{B} = \mu\epsilon \frac{\partial \vec{E}}{\partial t}$$

$$i\vec{k} \times \vec{E} = -(-i\omega)\vec{B} \qquad i\vec{k} \times \vec{B} = \mu\epsilon(-i\omega)\vec{E}$$

$$i\vec{k} \times \vec{E} = i\omega\vec{B} \qquad i\vec{k} \times \vec{B} = -i(\omega\mu\epsilon)\vec{E}$$

$$\vec{k} \times \vec{E} = \omega\vec{B} \qquad \text{and} \qquad \vec{k} \times \vec{B} = -(\omega\mu\epsilon)\vec{E}$$

Where, the wave vector k is perpendicular to both electric and magnetic fields respectively.

18. What is intrinsic or characteristic impedance of free space?

The characteristic impedance of free space, also called the Zo of free space, is an expression of the relationship between the electric-field and magnetic-field intensities in an electromagnetic field (EM field) propagating through a vacuum.

$$\boxed{Z_0 = \frac{E}{H} = \sqrt{\frac{\mu_0}{\epsilon_0}}}$$

Now substitute the value of μ_0 and ϵ_0 i.e.

$$\mu_0 = 4\pi \times 10^{-7}$$

$$\epsilon_0 = 8.854 \times 10^{-12}$$

$$Z_0 = \sqrt{\frac{4\pi \times 10^{-7}}{8.854 \times 10^{-12}}}$$

$$\boxed{Z_0 = 376.73\ \Omega}$$

$$\boxed{Z_0 = 120\pi\ \Omega}$$

19. What is poynting vector?

The Poynting vector represents the directional energy flux (the energy transfer per unit area per unit time) or power flow of an electromagnetic field. It is denoted by S. The SI unit of the Poynting vector is the watt per square metre (W/m2); kg/s3 in base SI units.

20. Write the general wave equation for the electric vector in an EM wave in conducting medium.

The general wave equation for the electric vector in an EM wave in conducting medium is

$$\nabla^2\vec{E} - \epsilon\mu\frac{\partial \vec{E}}{\partial t} - \epsilon\mu\frac{\partial^2 \vec{E}}{\partial t^2} = 0$$

This is the wave equation in terms of electric field.

21. Write the general wave equation for the magnetic vector in an EM wave in conducting medium.

The general wave equation for the magnetic vector in an EM wave in conducting medium is

$$\nabla^2\vec{B} - \mu\sigma\frac{\partial \vec{B}}{\partial t} - \mu\epsilon\frac{\partial^2 \vec{B}}{\partial t^2} = 0$$

This is the wave equation in terms of magnetic field.

22. What is skin depth?

The skin depth is that distance below the surface of a conductor where the current density has diminished to 1/e of its value at the surface. The thickness of the conductor is assumed to be several (perhaps at least three) times the skin depth.

23. Define intensity of EM wave.

Intensity of electromagnetic wave is defined as the energy crossing per second per unit area

held perpendicular to the direction of propagation of electromagnetic waves. Intensity of electromagnetic wave, $I=2\eta c\varepsilon|E|$. The S.I unit of intensity is Watt per square meter (W/m^2) or (kgs^{-3})

24. Define radiation pressure.

Radiation pressure is the mechanical pressure exerted upon any surface due to the exchange of momentum between the object and the electromagnetic field. The radiation pressure is doubled if the radiation is reflected rather than absorbed. The radiation pressure P exerted on the surface is given by $P = 2\,I\,c$, where c is the speed of light.
The SI unit of pressure is Pascal (Pa), and pressure is a scalar quantity since it has only magnitude and no direction.

25. Give the properties of Electromagnetic waves.

1. In electromagnetic waves the electric field vector E and magnetic field vector B and propagation vector K are mutually perpendicular for a right-handed system. Hence electromagnetic waves are transverse in nature.
2. Electromagnetic waves travel with speed of light.
3. Electromagnetic waves doesn't need any medium to propagate.
4. Electromagnetic waves are not deflected by electric or magnetic field.

PART B

1. Derive Maxwell's equation in differential and integral form
2. Deduce Maxwell's equation for free space.
3. Write Maxwell's equation and explain the characteristics of each equation.
4. Give an account of Maxwell's equation for free space. Apply the equations to deduce the EM wave equation and determine the velocity of light in vacuum.
5. Deduce Maxwell's equation for free space and prove that electromagnetic waves are transverse.
6. Discuss production and propagation EM wave from vacuum to a non-conducting medium.

UNIT –III OSCILLATION, OPTICS AND LASER

Chapter 03- Laser

PART A

1. What is stimulated emission?

An atom in the excited state is induced to return to the ground state, thereby resulting in two photons of same frequency and energy is called Stimulated emission.
The rate of stimulated emission is given by

$$R_{21}(St) = B_{21}\rho_v N_2$$

2. What is spontaneous emission?

The atom in the excited state returns to the ground state thereby emitting a photon, without any external inducement is called Spontaneous emission.
$R_{21}(Sp) = A_{21}$ The rate of spontaneous emission is $R_{21}(Sp)$
Where A_{21} is a constant which gives the probability of spontaneous emission transitions per unit time.

3. What is stimulated absorption?

An atom in the lower energy level or ground state energy level E1 absorbs the incident photon radiation of energy and goes to the higher energy level or excited level E2 as shown in figure. This process is called absorption.

The rate of absorption (R_{12}) is proportional to the following $R_{12\alpha}\rho_\nu N_1 = B_{12}\rho_\nu N_1$

4. What is laser?

LASER stands for Light Amplification by Stimulated Emission of Radiation. Laser is a device which emits a powerful, monochromatic collimated beam of light. The emitted light waves are coherent in nature.

5. What are the conditions necessary for stimulating emission of radiation?

Condition for Population inversion

1. There must be at least two energy levels E2> E1.
2. There must be a source to supply the energy to the medium.
3. The atoms must be continuously raised to the excited state.

6. Write the difference between spontaneous emission and stimulated emission.

S. No.	Stimulated Emission	Spontaneous emission
1.	An atom in the excited state is induced to return to the ground state , thereby resulting in two photons of same frequency and energy is called Stimulated emission	The atom in the excited state returns to the ground state thereby emitting a photon, without any external inducement is called Spontaneous emission.
2	The emitted photons move in the same direction and is highly directional	The emitted photons move in all directions and are random
3	The radiation is highly intense, monochromatic and coherent	The radiation is less intense and incoherent
4	The photons are in phase, there is a constant phase difference	The photons are not in phase (i.e.) there is no phase relationship between them.
5	The rate of transition is given by $R_{12}(Sp) = A_{21}\ N_2$	The rate of transition is given by $R_{12}(Sp) = A_{21}\ N_2$

7. What is meant by population inversion and how is it achieved?

Population Inversion creates a situation in which the number of atoms in higher energy statels more than that in the lower energy state. The Phenomenon of making $N_2 > N_1$ is known as Population Inversion.

8. Explain the need for population inversion in the production of laser?

Usually at thermal equilibrium, the number of atoms N2 i.e., the population of atoms at higher energy state is much lesser than the population of the atoms at lower energy state N1 that is N1>N2. The Phenomenon of making N2> N1 is known as Population Inversion.

9. What is pumping action?

The process to achieve the population inversion in the medium is called Pumping action. It is essential requirement for producing a laser beam.

10. What are the methods commonly used for pumping action?

The methods commonly used for pumping action are:

1. Optical pumping (Excitation by Photons)
2. Electrical discharge method (Excitation by electrons)

3. Direct conversion
4. In elastic atom – atom collision between atoms.

11. What is optical pumping?

When the atoms are exposed to light radiations energy, atoms in the lower energy state absorb these radiations and they go to the excited state. This method is called Optical pumping. It is used in solid state lasers like ruby laser and Nd-YAG laser. In ruby laser, xenon flash lamp is used as pumping source.

12. What is meant by active material in laser?

A medium in which population inversion can be achieved is known as active medium.

13. What are the characteristics of the laser? (or) What are the properties of the laser beam?

Laser is basically a light source. Laser light has the following important characteristics

- High Directionality
- High Intensity
- Highly Monochromatic
- Highly Coherence

14. Under which conditions a set of laser beams is said to be coherent?

In lasers the wave trains of same frequency are in phase, the radiation given out is in mutual agreement not only in phase but also in the direction of emission and polarization. Thus, it is a coherent beam. Due to high coherence, it results in an extremely high power.

15. Compare the characteristics of laser with ordinary light.

S.No.	Ordinary light	Laser beams
1	In ordinary light the angular spread is more	In laser beam the angular spread is less.
2	They are not directional.	They are highly directional.
3	It is less intense	It is highly intense
4	It is not a coherent beam and is not in	It is a coherent beam and is in phase
	phase.	
5	The radiation are polychromatic	The radiations are monochromatic
6	Example: Sun light, Mercury vapor lamp	He- Ne Laser, Co2 laser

16. What is optical resonant cavity?

An optical resonator consists of a pair of reflecting surfaces in which one is fully reflecting (R_1) and the other is partially reflecting (R_2). The active material is placed in between these two reflecting Surfaces. The photons generated due to transitions between the energy states of active material are bounced back and forth between two reflecting surfaces. This will induce more and more stimulated transition leading to laser action.

17. What is the function of resonator cavity in laser?

The photons generated due to transitions between the energy states of active material are bounced back and forth between two reflecting surfaces. This will induce more and more stimulated transition leading to laser action.

18. What is the principle of laser action?

Due to stimulated emission the photons multiply in each step-giving rise to an intense beam of photons that are coherent and moving in the same direction. Hence the light is amplified by Stimulated Emission of the Radiation termed LASER.

19. What are the three important components of any laser device?
Active medium, Active center and Pumping mechanism.

20. What are the conditions required for laser action?
Condition for Population inversion
1. There must be at least two energy levels E2> E1.
2. There must be a source to supply the energy to the medium.
3. The atoms must be continuously raised to the excited state.

21. What are Einstein's coefficients?
The constants A and B are called as Einstein Coefficients, which accounts for spontaneous and stimulated emission probabilities.

22. How lasers are classified? (or) Mention the various types of lasers.
There are several ways to classify the different types of lasers What material or element is used as active medium Mode of operation: CW or Pulsed. Lasers may be classified as Solid State Lasers – Ruby and Nd-YAG Laser – Gas Lasers – He-Ne and CO2 lasers – semiconductor lasers – Heterojunction Lasers – Liquid Dye Lasers.

S.No	TYPES OF LASER	EXAMPLES
1.	Solid State laser Ruby Laser	Nd:YAG laser
2.	Gas laser He-Ne Laser,	CO_2 Laser, Argon – ion laser
3.	Liquid Laser	$SeOCL_2$ Laser, Europium Chelate Laser
4.	Dye laser	Rhodamine 6G laser, Coumarin dye laser
5	Semiconductor Laser	GaAs laser, GaAsP laser

23. What is Nd: YAG laser?
It is a solid state and 4 level system as it consists of 4 energy levels. Nd ion is rare earth metal and it is doped with solid state host.Due to doping, yttrium ions get replaced by the Nd3+ ions.

24. What are the applications of Nd: YAG laser?
Applications of Nd:YAG Laser
- Military applications to find the desired target.
- Application in medical field for the surgical purpose.
- Used in welding and cutting of steel and
- Used in communication system

25. What is CO2 laser?
In a molecular gas laser, laser action is achieved by transitions between vibrational and rotational levels of molecules. Its construction is simple and the output of this laser is continuous. In CO2 molecular gas laser, transition takes place between the vibrational states of Carbon dioxide molecules.

26. What is the active medium in CO2 laser?
The active medium is a gas mixture of CO2, N2 and He. The laser transition takes place between the vibrational states of CO2molecules.

27. What are the applications of CO2 laser?
Applications
1.High power CO2 laser finds applications in material processing, welding, drilling, cutting soldering etc.
2.The low atmospheric attenuation (10.6μm makes CO2 laser suitable for open air communication.

3.It is used for remote sensing
4.It is used for treatment of liver and lung diseases.
5.It is mostly used in neuro surgery and general surgery.
6.It is used to perform microsurgery and bloodless operations.

28. What is semiconductor laser?
It is specifically fabricated p-n junction diode. This diode emits laser light when it is forward biased.

29. What is homo-junction laser?
A PN junction diode made from single crystal of gallium arsenide is used as an active medium.

30. What are the drawbacks of homo junction laser diodes?
Disadvantages
1. It is difficult to control the mode pattern and mode structure of laser.
2. The output is usually from 5° to 15° i.e., laser beam has large divergence.
3. The purity and monochromacity are poor than other types of lasers
4. Threshold current density is very large (400A/mm2).
5. It has poor coherence and poor stability.

31. What are the applications of semiconductor laser?
Applications:
1. This type of laser is mostly used in optical applications
2. It is widely used in computers, especially on CD-ROMs.

32. What is laser material processing?
Laser material processing finds applications in industry. They are welding, cutting, drilling , machining etc.

33. Mention the applications of lasers in industry.
Laser material processing finds applications in industry. They are welding, cutting, drilling , machining etc.

34. What is laser welding?
Laser welding is a much more accurate manufactoring process and welds can be as small as one hundredths of a millimetre. Small pulses of heat are used to create the weld which leads to a higher quality finish which is stronger providing a better depth to width ratio.

35. What are the advantages of laser welding?
- Aesthetically better weld finishes
- More suited to high value items such as jewelry
- Ideal for solenoids and machined components
- Perfect for medical devices where weld quality is vital for hygiene and precision

36. What is heat treatment of laser?

37. What are advantages laser cutting?

PART B

1. For atomic transition, derive Einstein relations and hence deduce the expression for the ratio of spontaneous emission rate to stimulated emission rate.
2. Explain the principle, construction and working of Nd: YAG laser with neat diagram.
3. Explain the modes of vibrations of CO2 molecule. Describe the principle, construction and working

of CO_2 laser with necessary diagrams.

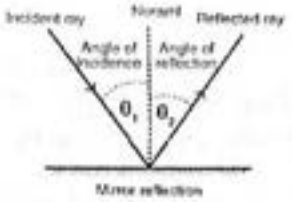
4. Describe the principle, construction and working of semiconductor laser with neat diagram.
5. (a) What are different pumping mechanisms used in lasers? Give an example for each (b) List out the applications of laser beam in industries and in medical field.

Chapter 02 – Optics

PART A

1. State laws of reflection

1. The law of reflection defines that upon reflection from a smooth surface, the angle of the reflected ray is equal to the angle of the incident ray, with respect to the normal to the surface that is to a line perpendicular to the surface at the point of contact.
2. The reflected ray is always in the plane defined by the incident ray and the normal to the surface at the point of contact of the incident ray.



2. State laws of refraction

1. The incident ray, the refracted ray and the normal at the point of incidence, all lie in the same plane.
2. The ratio of the sine of the angle of incidence i to the sine of the angle of refraction is constant for the pair of given media. This constant is called the refractive index of the second medium w.r.t. the first medium.

$1\mu2=\sin i / \sin r$

Note: When light ray is incident normally, only speed changes and direction of light remains the same.When light ray passes from rarer medium to denser medium, it bends towards the normal. When light ray passes from denser medium to rarer medium, it bends away from the normal.

3. Define refractive index of the medium

Refractive index of a medium is defined as ratio of speed of light in vacuum to that in the medium. It is a dimensionless quantity that describes how the light travels in the medium.

$\mu=vc$

4. What is total internal reflection?

The phenomenon which occurs when the light rays travel from a more optically denser medium to a less optically denser medium. Consider the following situation. A ray of light passes from a medium of water to that of air. Light ray will be refracted at the junction separating the two media. Since it passes from a medium of a higher refractive index to that having a lower refractive index, the refracted light ray bends away from the normal. At a specific angle of incidence, the incident ray of light is refracted in such a way that it passes along the surface of the water. This particular angle of incidence is called the critical angle. Here the angle of refraction is 90 degrees. When the angle of incidence is greater than the critical angle, the incident ray is reflected back to the medium. We call this phenomenon total internal reflection.

5. Define critical angle.

Total internal reflection is a complete reflection of a ray of light within a medium such as water or glass from the surrounding surfaces back into the medium. It only occurs when both of the following two conditions are met: A light ray is in the more dense medium and approaching the less dense medium. The angle of incidence for the light ray is greater than the so-called critical angle.

The critical angle is the angle of incidence, for which the angle of refraction is 90°. If light enters a denser medium from a comparatively rarer medium, then the direction of light changes and the light ray bends towards the normal.

6. Give conditions of total internal reflection.

- The light ray moves from a more dense medium to a less dense medium.
- The angle of incidence must be greater than the critical angle.

7. Write expression for critical angle.

$n_1 \sin \theta_1 = n_2 \sin \theta_2$. Thus we have the following expression for the critical angle: $\sin \theta_c = n_2/n_1$.

8. Mention a few applications of total internal reflection.

- Total internal reflection is also used in optical fibres. An optical fibre consists of an inner core of high refractive index glass and surrounded by an outer cladding of lower refractive index.
- When light is introduced into the inner core at one end, it will propagate along the fibre in a zigzag path undergoing a series of total internal reflections.
- Optical fibres are useful for getting light to inaccessible places. They are used in many important practical applications. This includes fibre optic diagnostic tools in medicine and fibre optic cables in telecommunications.
- An endoscope is an instrument made of a fibre optic cable. It is used by doctors to see the inside of the human body such as the stomach and the duodenum.
- In telecommunications, copper cables are now replaced by fibre optic cables in the telephone system.
- Multiple signals can be sent at high speeds through bundles of fibres by using flashes of light from a laser.

9. What is interference?

Interference is what happens when two or more waves meet each other. Depending on the overlapping waves' alignment of peaks and troughs, they might add up, or they can partially or entirely cancel each other. As per the interference definition, it is defined as ,the phenomenon in which two or more waves superpose to form a resultant wave of greater, lower or the same amplitude.

10. What is air wedge?

An air wedge is a simple interferometer used to visualize the disturbance of the wave front after propagation through a test object.

11. What is the expression for the fringe width in air wedge experiment?

Light rays coming from slits S_1 and S_2 interfere at point P

From figure, $S_2P = \sqrt{(y - \frac{d}{2})^2 + D^2}$

Or $S_2P = \sqrt{y^2 - \frac{yd}{2} + \frac{d^2}{4} + D^2}$

Or $S_2P = D\sqrt{\frac{y^2}{D^2} - \frac{yd}{2D^2} + \frac{d^2}{4D^2} + 1}$

As $D >> d$ and $y << D$, we neglect $d^2/4D$ and y^2/D^2.

We get

Or $S_2P = D\sqrt{1 - \frac{yd}{D^2}}$

Or $S_2P = D[1 - \frac{yd}{2D^2}]$

Or $S_2P = D - \frac{yd}{2D}$

Similarly we get $S_1P = D + \frac{yd}{2D}$

Path difference between two light rays $\Delta x = S_2P - S_1P$

Or $\Delta x = (D - \frac{yd}{2D}) - (D + \frac{yd}{2D}) = \frac{yd}{D}$

For constructive interference, $\Delta x = n\lambda$

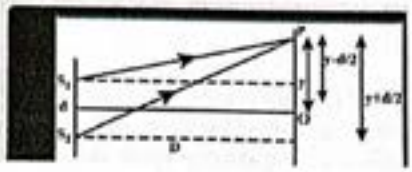
$\therefore \frac{yd}{D} = n\lambda$

$\Rightarrow y = \frac{n\lambda D}{d}$

Fringe width $\beta = y_n - y_{n-1}$

$\therefore \beta = \frac{n\lambda D}{d} - (n-1)\frac{\lambda D}{d}$

$\Rightarrow \beta = \frac{\lambda D}{d}$



12. What is the expression for the thickness of the wire in air wedge experiment?

$d/l = \lambda / 2\mu\beta$ i.e $d = l\lambda / 2\beta$

for an air film $\mu = 1$, β which is distance between two dark or bright/dark bands can be measured experimentally. Therefore, diameter can be determined.

13. What is Michelson interferometer?

The Michelson interferometer produces interference fringes by splitting a beam of light so that one beam strikes a fixed mirror and the other a movable mirror. When the reflected beams are brought back together, an interference pattern results.

14. What are the applications of Michelson interferometer?

- The detection of gravitational waves – LIGO is a massive interferometer with two lasers positioned thousands of kilometres apart
- In astronomical interferometry.
- In optical coherence tomography.
- In fibre optics.

PART B

1. Explain the formation of interference fringes in an air-wedge shaped film.
   How is the thickness of the wire determined by this method?
2. How will you use Michelson's interferometer to determine the thickness of a thin transparent film or plate?
3. Explain the construction, types of fringes and applications of Michelson's interferometer.
4. (i) Describe the construction of a Michelson's interferometer and discuss the different types of interference fringes formed in it. (ii) How will you use it to determine the wavelength of a monochromatic source?

UNIT –IV

BASIC QUANTUM MECHANICS

PART A

1. State Compton effect

The Compton effect is defined as the effect that is observed when x-rays or gamma rays are scattered on a material with an increase in wavelength. It is dependent on the angle of scattering and on the wavelength of the incident beam.

2. What is Compton wavelength?

The Compton wavelength is the quantum mechanical property of a particle and is defined as the wavelength of the particle equal to the wavelength of the photon with same mass. It is well explained through the process called Compton scattering. The standard Compton wavelength is denoted by Greek letter λ (Lambda) measured using the SI unit of length angstrom (meter).

3. What are matter waves?

According to the De-Broglie concept, with each moving particle a wave is associated. These associated waves are called matter waves. That is, the wave–particle duality present in light must also occur in matter. So, starting from the momentum of a photon $p = h\nu/c = h/\lambda$, we can generalize this relation to any material particle with non zero rest mass. Each material particle of momentum behaves as a group of waves whose wavelength λ and wave vector are governed by the speed and mass of the particle.

$$\lambda = \frac{h}{p} \quad \& \quad \vec{k} = \frac{\vec{p}}{\hbar}$$

Wave has wavelength λ here h is Planck's constant and p is the momentum of the moving particle.

4. How de – Broglie justified his concept?

de Broglie came up with an explanation for why the angular momentum might be quantized in the manner Bohr assumed it was. de Broglie realized that if you use the wavelength associated with the electron, and assume that an integral number of wavelengths must fit in the circumference of an orbit, you get the same.

5. Write an expression for the wavelength of matter waves?

de Broglie's wavelength of matter waves: de Broglie equated the energy equations of Planck(wave) and Einstein(particle).

For a wave of frequency ν, the energy associated with each photon is given by Planck's relation,

$E = h\nu$ ——————(1)

Where h is Planck's constant.

According to Einstein's mass energy relation, a mass m is equivalent to energy.

$E = mc^2$ ——————(2)

where c is the velocity of light.

If, $h\nu = mc^2$

$\therefore \frac{hc}{\lambda} = mc^2$ (or) $\lambda = \frac{h}{mc}$ ——————(3)

(since $\nu = \frac{c}{\lambda}$)

For a particle moving with a velocity v, if c = v from equation (3)

$\lambda = \frac{h}{mv} = \frac{h}{p}$

Where p = mv, the momentum of the particle. These hypothetical matter

6. Write an expression for the de-Broglie wavelength associated with electrons?

An electron of mass m is accelerated through a potential difference of V volt. The kinetic energy acquired by the electron is given by

$\frac{1}{2}mv^2 = eV$

Therefore, the speed v of the electron is

$v = \sqrt{\frac{2eV}{m}}$

Hence, the de Broglie wavelength of the electron is

$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2meV}}$

Substituting the known values in the above equation, we get

$\lambda = \frac{6.626 \times 10^{-34}}{\sqrt{2V \times 1.6 \times 10^{-19} \times 9.11 \times 10^{-31}}}$

$\lambda = \frac{12.27 \times 10^{-10}}{\sqrt{V}}$ meter (or) $\lambda = \frac{12.27}{\sqrt{V}}$ Å

For example, if an electron is accelerated through a potential difference of 100 V, then its de Broglie wavelength is 1.227 Å.

Since the kinetic energy of the electron, E = eV, then the de Broglie wavelength associated with electron can be also written as

$\lambda = \frac{h}{\sqrt{2mE}}$

7. State the properties of the matter waves.

1. Matter waves are not electromagnetic in nature
2. Matter-wave represents the probability of finding a particle in space.
3. Matter waves are independent of the charge on the material particle.
4. Electron microscope works on the basis of de-Broglie waves.
5. Matter waves can propagate in a vacuum, hence they are not mechanical wave.
6. The number of de-Broglie waves associated with nth orbital is n.
7. The phase velocity of matter waves can be greater than the speed of light.
8. The number of de-Broglie waves associated with the nth orbital electron is n.

8. Write down Schrodinger time independent and dependent wave equations.

ie Time Independent Schrödinger Equation.

$$\frac{-\hbar^2}{2m}\frac{\partial^2 u(x)}{\partial x^2} + V(x)u(x) = E\,u(x)$$

time dependent solution is

$$\psi(x,t) = u(x)e^{-iEt/\hbar}$$

9. Mention some of the physical significance of the wave function.

The wave function ψ associated with a moving particle is not an observable quantity and does not have any direct physical meaning. It is a complex quantity. The complex wave function can be represented as $\psi(x, y, z, t) = a + ib$ and its complex conjugate as $\psi^*(x, y, z, t) = a - ib$. The product of wave function and its complex conjugate is $\psi(x, y, z, t)\psi^*(x, y, z, t) = (a + ib)(a - ib) = a^2 + b^2$ is a real quantity. However, this can represent the probability density of locating the particle at a place in a given instant of time. The positive square root of $\psi(x, y, z, t)\ \psi^*(x, y, z, t)$ is represented as $|\psi(x, y, z, t)|$, called the modulus of ψ. The quantity $|\psi(x, y, z, t)|^2$ is called the probability.

10. What are Eigen values and Eigen functions?

The solution to the Schrodinger equation for a given energy E_i involves also finding the specific function ψ_i which describes that energy state. The solution of the time independent Schrodinger equation takes the form

$$H_{op}\psi_i = E_i\psi_i$$

The eigenvalue concept is not limited to energy. When applied to a general operator Q, it can take the form

$$\underbrace{Q_{op}}_{\text{operator}}\psi_i = \underbrace{q_i}_{\text{eigenvalue}}\overbrace{\psi_i}^{\text{eigenfunction}}$$

If the function ψi is an eigenfunction for that operator. The eigenvalues qi may be discrete, and in such cases we can say that the physical variable is "quantized" and that the index i plays the role of a "quantum number" which characterizes that state.

11. What is Schrodinger wave equation?

Schrodinger wave equation is a mathematical expression describing the energy and position of the electron in space and time, taking into account the matter wave nature of the electron inside an atom. It is based on three considerations. They are;

- Classical plane wave equation,
- Broglie's Hypothesis of matter-wave, and
- Conservation of Energy.

Schrodinger equation gives us a detailed account of the form of the wave functions or probability waves that control the motion of some smaller particles. The equation also describes how these waves are influenced by external factors. Moreover, the equation makes use of the energy conservation concept that offers details about the behaviour of an electron that is attached to the nucleus.

12. What is wave function?

The wave function is an equation or a set of equations derived from Schrodinger's Equation. Schrodinger's Equation does not calculate the behavior of quantum particles directly. First it must be used to generate a wave function(s). It's the wave function that actually describes the behavior of quantum particles.

13. Define correspondence principle.

A principle of spectroscopy: the characteristics of spectral series are in approximate agreement with both the classical electromagnetic theory and the quantum theory of electron transitions, the correspondence becoming closer as the quantum numbers involved become greater.

14. Define degenerate and non-degenerate state.

The **key difference between degenerate and non-degenerate semiconductors** is that in degenerate semiconductors, the injection of electrons or holes is only possible from the Fermi energy level, whereas non-degenerate semiconductors can cause the formation of two types of contacts to organic material.

Semiconductors are materials having an electrical conductivity value that falls between the conductivity of conductors and insulators. Degenerate semiconductors are a type of semiconductors in which a high level of doping can be observed, making the semiconductor act as metal than a semiconductor.

PART B

1. What is Compton Effect? Derive an expression for the wavelength of the scattered photon
2. Explain the experimental verification of Compton shift in wavelength with neat diagram.
3. Derive the time independent Schrodinger equation for a one-dimensional case. Use it to prove that a particle enclosed in a one-dimensional box has quantized energy values.
4. Derive Schrodinger Time independent and Time dependent wave equation.
5. Derive Eigen value and Eigen function for two-dimension potential box.
6. Obtain Eigen value and Eigen function for three dimension potential box.

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

QUESTION BANK

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

INTERNAL EXAM QUESTION PAPERS

S1 114 PH3151 Reg. No.:

9635 – STELLA MARY'S COLLEGE OF ENGINEERING

INTERNAL EXAM I (2023 – 2024 ODD)

I Year / I Semester

PH3151- ENGINEERING PHYSICS

(MECH, EEE, CSE B)

Date &Time: 07/11/2023 & 9.15 AM to 11.15 AM **Max. : 60 Marks**

Note:

- *Write the examination using blue or black pen. Draw neat sketch with pencil (if necessary)*
- *Use tables or charts (if necessary)*
- *Answer all questions*

Q.No.	Question	Bloom's Taxonomy Level	CO
	Part – A (Each Question carries 2 Marks)		
1.	Define Centre of Mass.	Applying	CO1
2.	What is called non-linear oscillation? Give example	Remembering	CO1
3.	Write the properties of electromagnetic waves?	Remembering	CO2
4.	What is radiation pressure?	Remembering	CO2
5.	What are the methods commonly used for pumping action?	Understanding	CO3
	Part – B Answer for each question carries 10 Marks		
Q.No.	**Question**	**Bloom's Taxonomy Level**	**CO**
6.	Derive the relation between rotational kinetic energy and moment of inertia. (or) Derive an expression for time period of torsion pendulum. Explain how it is used to find the rigidity modulus of the wire	Creating Understanding	CO1
7.	State and proof the theorem of parallel and perpendicular axis for moment of inertia (or) Write a note on non-linear oscillations and its importance.	Creating	CO1
8	Derive Maxwell's equations in differential and integral form (or) Derive an expression for plane electromagnetic waves in vacuum	Evaluating	CO2

Q.P. Code: 17273

S1 104 A PH3151

Reg. No.:

9635 – STELLA MARY'S COLLEGE OF ENGINEERING
INTERNAL EXAM II (2023 – 2024 ODD)
I Year / I Semester
PH3151- ENGINEERING PHYSICS
(CIVIL, ECE, AI&DS, CSE A)

Date &Time: 08/12/2023 & 9.15 AM to 11.15 AM /FN **Max. : 60 Marks**

Note:

- *Write the examination using blue or black pen. Draw neat sketch with pencil (if necessary)*
- *Use tables or charts (if necessary)*
- *Answer all questions*

Q. No.	Question	Bloom's Taxonomy Level	CO
	Part – A (Each Question carries 2 Marks)		
1.	What is resonance?	Understanding	CO3
2.	Mention the physical significances of wave function.	Remembering	CO4
3.	Calculate the minimum energy an electron can posses in an infinitely deep potential well of width 4nm.	Applying	CO4
4.	List out the applications of STM.	Remembering	CO5
5.	What is quantum tunneling?	Understanding	CO5
	Part – B Answer for each question carries 10 Marks		
Q. No.	**Question**	**Bloom's Taxonomy Level**	**CO**
6.	State and explain Doppler effect. Derive an expression for the change in frequency of a note when both the source of sound and the observer are in motion. Give its applications. (Or) Explain the construction, types of fringes and working of Michelson's Interferometer.	Understanding Creating	CO3
7.	State Compton effect. Derive an expression for the wavelength of scattered photon. Also briefly explain its experimental verification. (Or) Determine the energy of a particle confined in one dimensional potential well and find the normalization of wave function to study the behavior inside the potential well.	Creating Applying	CO4
8	Derive Schrodinger's time independent and time dependent wave equation. (Or) Find the Eigen functions and Eigen values for a particle in 3D potential well of infinite height and discuss the solutions.	Evaluating Creating	CO4

Q.P. Code: 17273

Reg. No.:

9635 – STELLA MARY'S COLLEGE OF ENGINEERING
INTERNAL EXAM II (2023 – 2024 ODD)
I Year / I Semester
PH3151- ENGINEERING PHYSICS
(CIVIL, ECE, AI&DS, CSE A)

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- *Use tables or charts (if necessary)*
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Q. No.	Question	Bloom's Taxonomy Level	CO
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4.	List out the applications of STM.	Remembering	CO5
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6.	State and explain Doppler effect. Derive an expression for the change in frequency of a note when both the source of sound and the observer are in motion. Give its applications. (Or) Explain the construction, types of fringes and working of Michelson's Interferometer.	Understanding Creating	CO3
7.	State Compton effect. Derive an expression for the wavelength of scattered photon. Also briefly explain its experimental verification. (Or) Determine the energy of a particle confined in one dimensional potential well and find the normalization of wave function to study the behavior inside the potential well.	Creating Applying	CO4
8	Derive Schrodinger's time independent and time dependent wave equation. (Or) Find the Eigen functions and Eigen values for a particle in 3D potential well of infinite height and discuss the solutions.	Evaluating Creating	CO4

9.	Discuss Barrier penetration and quantum tunneling. (Or) Explain the construction and working of scanning tunneling microscope.	Understanding	CO5
10	Write a brief note on Bloch's theorem for particles in a periodic potential and Kronig Penny model. (Or) Elucidate the theory and working of a resonant diode. Discuss its V-I characteristics.	Understanding Applying	CO5

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2023 - 2024

INTERNAL EXAM

ANSWER KEY

9635 - Stella Mary's College of Engineering.

Common to EEE, CSEB, MECH

PH3151 - Engineering physics

ANSWER KEY (set : 2)

Part - A

1. Multiparticle dynamics

↳ Study about Rotational and vibrational motion of System of particles in which the distance between the particle is very small.

2. Applications of Gyroscope:

* used as compasses in boats, aeroplanes, air crafts etc.
* used in Spacecraft.
* used to stabilize the ships, satellites, ballistic missiles etc
* used in gyro theodolites.

3. Poynting vector

↳ amount of energy flow of electromagnetic wave per unit area per unit time along the wave propogation.

$$\vec{S} = \vec{E} \times \vec{H}$$

Applications of Maxwell's equation

* the existence of electromagnetic waves
* Unified the domains of electricity, magnetism & light
* Established the interlink between electric & magnetic field.
* mathematical model for electric, optic & radio technologies.

Critical angle.

When the an incident angle is equal to 90°, the light undergoes total internal re This is called as Critic angle.

Characteristics of SHM

* acceleration is directly proportional to displacement.
* motion is periodic
* Straight line

Doppler effect

The apparent change in frequency of sound due to relative motion of source of sound is called doppler effect

8. Pumping Methods

* Optical pumping
* Electrical discharge
* Direct conversion
* Inelastic collision

9. Transmission coefficient

↳ Ratio of square of the intensity of reflected wave to the square of the intensity of incident wave.

$$T = \frac{|C|^2}{|A|^2}$$

10 Eigen values & Eigen function.

For each value of quantum number, there is an energy value is called eigen value, the corresponding wavefunction is called eigen function.

Part - B

11. Theorems of MOI

a) Based on Orientation (i) Paeallel axis theorem
(ii) Perpendicular " "

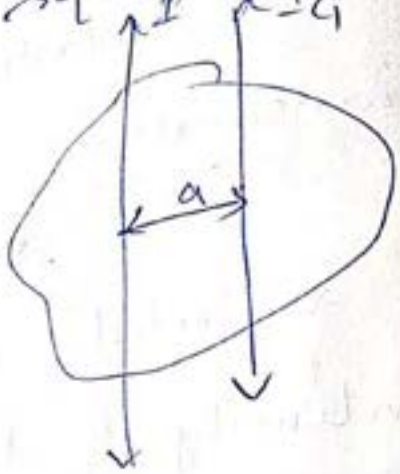
field.

Parallel axis theorem: (8)

Statement (2)

MoI of an axis is equal to sum of MoI of an axis passing through centre of gravity and square of the perpendicular distance.

$$I = I_G + Ma^2$$



Explanation (4 mark)

Diagram : (2)

Perpendicular (8 mark)

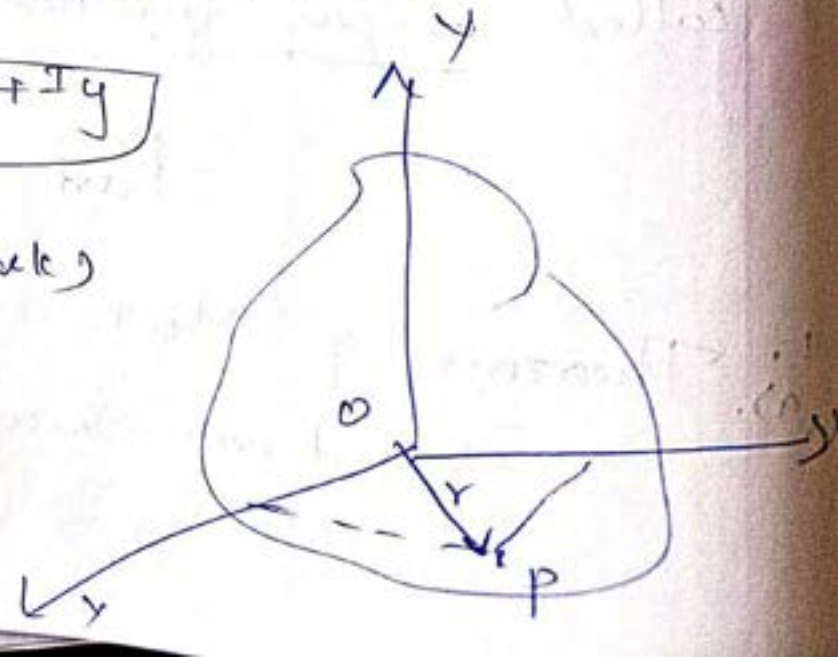
Statement (2 mark)

MoI of an axis is equal to Sum of moment of inertia of two mutually perpendicular axis, which are mutually perpendicular with each other.

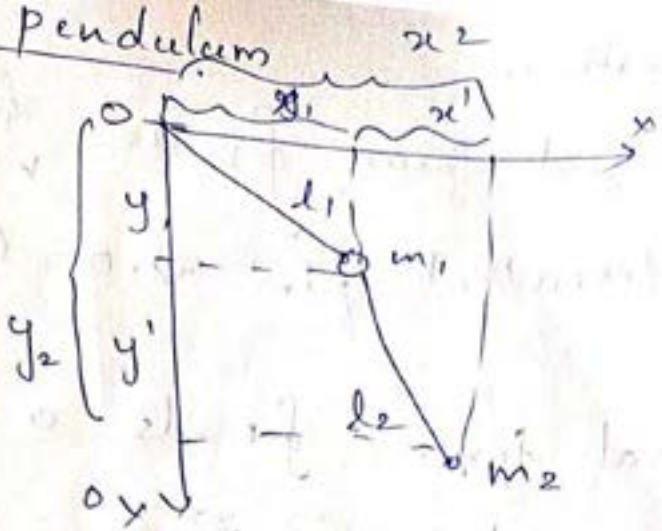
$$I_z = I_x + I_y$$

Explanation: (4 mark)

Diagram: (2)



11 b) Double pendulum



Displacement x_1, x_2, y_1 & y_2 (2 marks)

Velocity

$$V_{x_1} = \frac{dx_1}{dt} \quad (4 \text{ marks})$$

$$V_{y_1} = \frac{dy_1}{dt}$$

$$V_{x_2} = \frac{dx_2}{dt}$$

$$V_{y_2} = \frac{dy_2}{dt}$$

Kinetic Energy (4 mark)

Potential energy (2 mark)

Lagrangian $L = T - V$ (2 mark)

12. a) Maxwell's equation.

I eqn. Integral form $\oint D \cdot ds = \int_V \rho dv$ (2)

Differential form $\nabla \cdot D = \rho$ (2)

II eqn Integral form $\oint B \cdot ds = 0$ (2)

Differential form $\vec{\nabla} \cdot \vec{B} = 0$. (2)

III eqn Integral form $\oint E \cdot dl = \int -\frac{\partial B}{\partial t} ds$ (2)

Differential form $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ (2)

IV eqn Integral form $\oint H \cdot dl = \oint J + \frac{\partial D}{\partial t} ds$ (2)

Differential form $\vec{\nabla} \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$ (2)

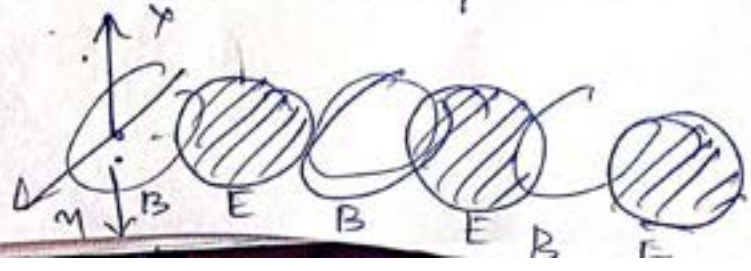
12. b) Production of em waves

Stationary charge particle → produces $\vec{E}$

Moving " → $\vec{B}$

Charge particle is Oscillating

↓ EM waves produced



a). Analog between electrical and Mechanical Oscillation:

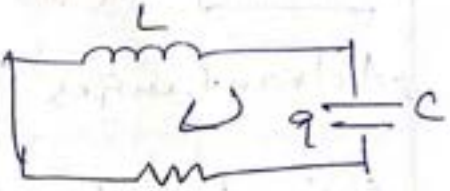
Mechanical Oscillation (8 mark)

Spring mass system

$$m\frac{d^2y}{dt^2} + b\frac{dy}{dt} + ky = 0$$

Electrical Oscillation

$$L\cdot\frac{dI}{dt} + IR + \frac{q}{C} = 0$$



Analogues $L = m$

$b = R$

$k = \frac{1}{C}$

* Semiconductor Lasers
  * Homojunction
  * Heterojunction

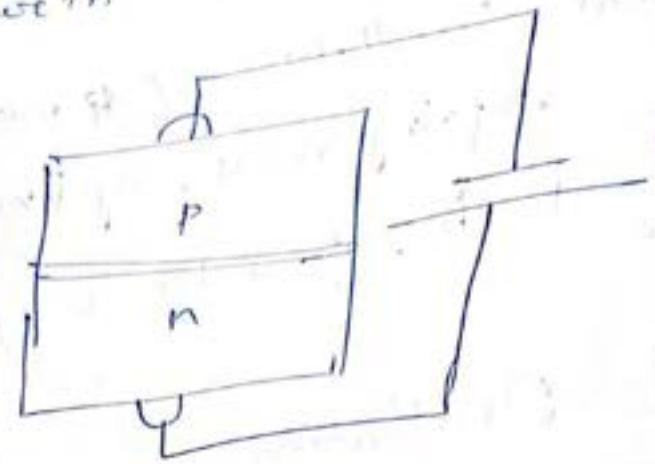
Homojunction: made p-n junctions are made up of same material

Principle An electron from n-region, hole from p-region recombine with each

Laser light

During recombination process, is emitted with wavelength 8000 A°.

Construction



Working (2)

Advantanges (1)

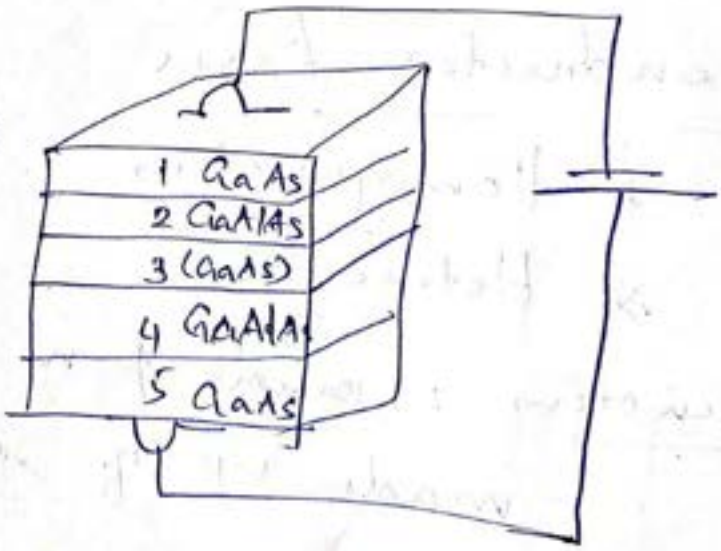
Disadvantages (1)

* Hetero junction Semiconductor Lasers

Pn-n -junction are made from dif material (GaAs & GaAlAs)

Principle (2)

Construction (2)



Working (2)

Advantage (1)

Disadvantages (1)

14.
a). Compton effect:

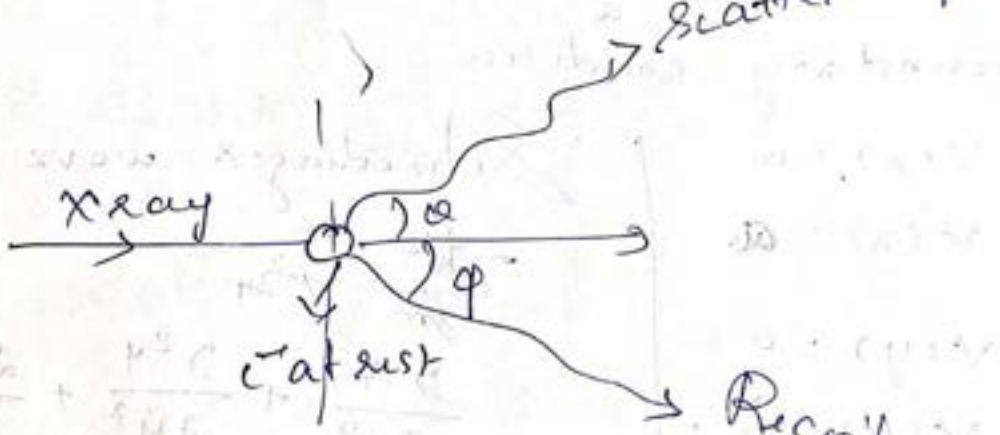
When a monochromatic light is incident on a scatterer, the light ray is divided into two ways

* Unmodified - there is no change in wavelength - as that of incident radiation

* Modified - There is change in wavelength

The change in wavelength is called Compton wavelength. The effect is called Compton effect.

Theory



Total energy (2)

Total momentum (2)

From theory of relativity

$$m = \frac{m_0}{\sqrt{1 - v^2/c^2}}$$

$$\Delta\lambda = \frac{h}{m_0 c}(1-\cos\theta)$$

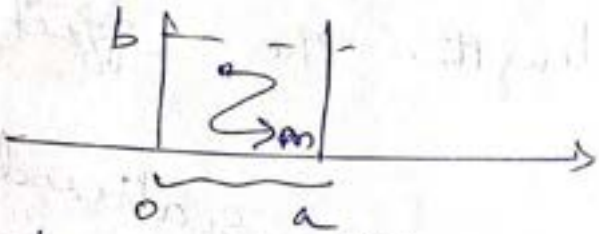
Special cases

Case (i) $\theta = 0^\circ$, $\Delta\lambda = 0$

Case (ii) $\theta = 90^\circ$, $\Delta\lambda = 0.024\,A^\circ$ compton wavelength

Case (iii) $\theta = 180^\circ$ $\Delta\lambda = 0.048\,A^\circ$

14. b) Particle in 2D box



Boundary condition

$V(x) = 0$

$V(x) = \infty$

$V(y) = 0$

$V(y) = b$.

Schrodinger's wave eqn

$$\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{2m}{\hbar^2}(E-V)\psi$$

$V = 0$.

$k = \frac{n\pi}{a}$

Energy $E_{n_x, n_y} = \frac{n^2 h^2}{8m}\left[\frac{1}{a^2} + \frac{1}{b^2}\right]$

$$\psi_{n_x, n_y} = \frac{2}{\sqrt{ab}} \sin\frac{n\pi}{a} \sin\frac{n\pi}{b}.$$

5.

1) Simple Harmonic Oscillator

Schroedinger wave eqn:

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E - V)\psi = 0$$

$$V = \tfrac{1}{2}kx^2$$

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E - \tfrac{1}{2}kx^2)\psi = 0.$$

$$\frac{d^2f}{dy^2} - 2y\frac{df}{dy} + 2nf = 0$$

~~$\psi_n(y) = N H_n(y) e^{-y^2/2}$~~

This is same as Hermite polynomial

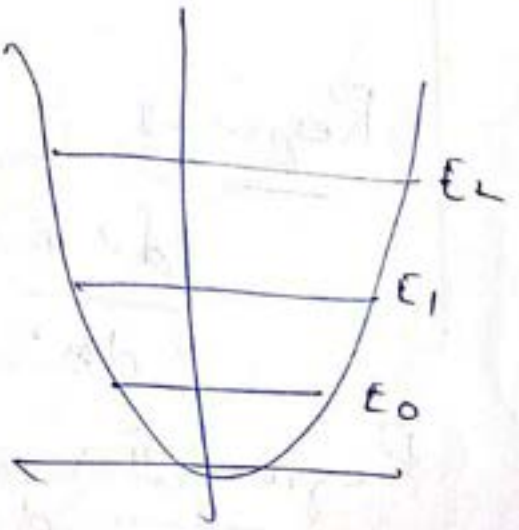
$$\frac{d^2H}{dy^2} - 2y\frac{dH}{dy} + 2nH = 0$$

The solutions are

$$\psi_n(y) = N H_n(y) e^{-y^2/2}$$

Eigen values

$$E_n = (n + \tfrac{1}{2})h\nu$$

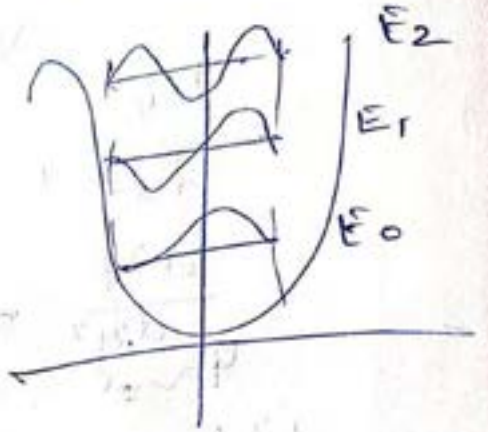


Normalised wave function

$$\int_{-\infty}^{+\infty} |\psi_n|^2 dy = 1 \quad \text{where } n = 0, 1, 2, 3 \ldots$$

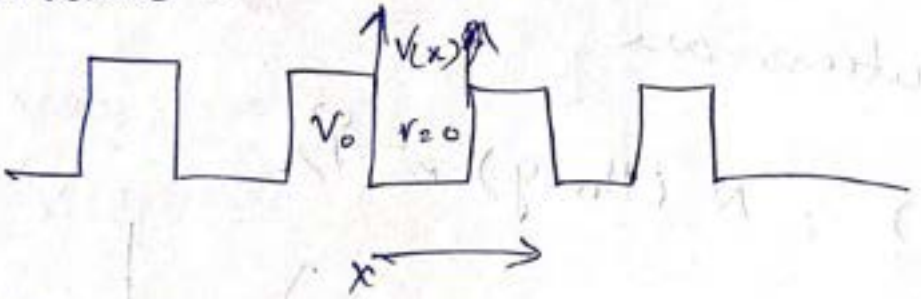
$$\psi_n(y) = \frac{1}{\sqrt{2^n n! \sqrt{\pi}}} e^{-y^2/2} H_n(y)$$

$$N = \frac{1}{\sqrt{2^n n! \sqrt{\pi}}}$$



5. b) Kronnig - Penny Model

It is example of one dimensional periodic potential.



Region - I

$$\frac{d^2\psi}{dx^2} + \alpha^2 \psi = 0 \qquad \alpha^2 = \frac{2mE}{\hbar^2}$$

Region - II

$$\frac{d^2\psi}{dy} + \beta^2 \psi = 0 \qquad \beta^2 = \frac{2m}{\hbar^2}(V_0 -$$

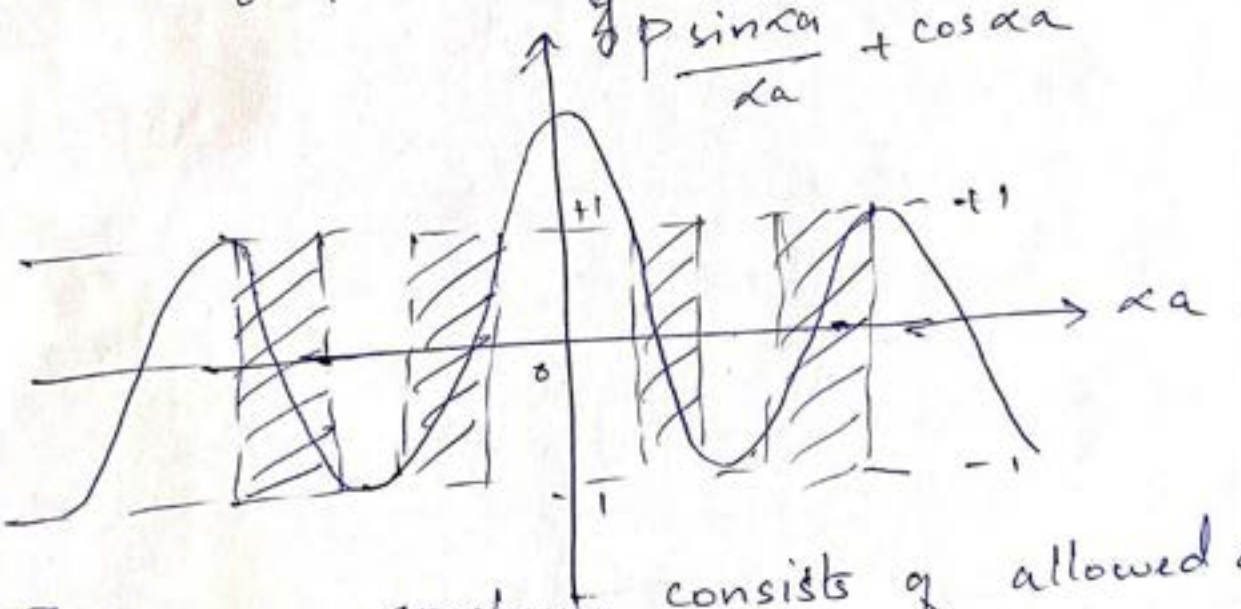
From Bloch, Solution is

$$\psi(x) = e^{ikx} u_k(x)$$

Differentiating the above eqn

$$P \frac{\sin \alpha a}{\alpha a} + \cos \alpha a = \cos ka$$

where $P = \frac{mV_0 ab}{\hbar^2}$ → Scattering Power of potential barrier.



* The energy spectrum consists of allowed and forbidden band
* when P ↑, allowed band ↓
  forbidden band ↑
* when P ↓, allowed band ↑
  forbidden band ↓

Physics Model Exam

Rishi. V.J
MECH
No: 41

Part - A

1) The study of motion of group of Particles with negligible distance between the particle is known as multi particle dynamics.

2) * Large gyroscope are used in ship stabilizer to Counteract rolling.
* Automatic steering System, such as those used in airplanes and missiles.

3. The Vector specifies amount of energy Passing through Unit area per second in Perpendicular direction of propagation of electromagnetic waves per second is known as Poynting Vector

$$S = E \times H$$

4 * Provides Mathematical Model for electric Optical and radio technologies

* Applied in the study of power generation and wireless communication.

5. Light travel form denses to arrear medium and if angle of incidence(θ_i) is increased angle of refraction (θ_r) also increased until it reaches 90°

The angle of incidence at which angle of refraction becomes 90° is called Critical angle (θ_i)

$$\theta_i = \theta_c \;, \theta_r = 90°$$

6. * The motion must be periodic
* The body must have inertia
* The body must be elastic

7. Doppler effect refers to the change is wave frequency during the relati motion between a wave source and its observer.

8. * Optical pumping
* Chemical pumping
* Thermal Pumping

9) The probability that particle gets through a potential barrier is Called transmission Coefficient (T)

$$T = e^{-2\beta L}$$

10. * The energy possessed by a particle at a particular energy level is defined or Eigen value (E_n)
* The wave function of a particle at a particular energy level is defined or Eigen functions (ψ_n)

Part-B

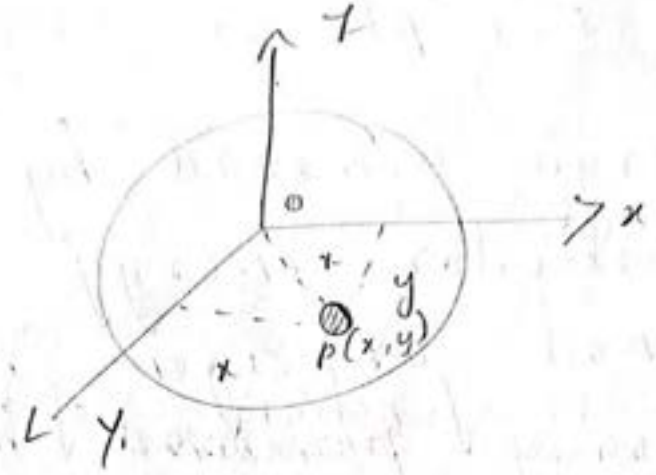
11.
a) Perpendicular axis

Statement

The moment of inertia of a Planar body about an axis Perpendicular its plane and passing through the Point of intersection of two mutually Perpendicular axes is equal to

Sum of moment of inertia about the two mutually perpendicular axes lying in the same line

Proof:



Explanation

Let I_x, I_y and I_z be the moment of inertia. $\boxed{I_z = I_x + I_y}$

A particle at P at distance r from O has Coordinates P(x, y) which gives

$$r^2 = x^2 + y^2 \longrightarrow (1)$$

$$OZ = mr^2$$

$$I_z = \Sigma m r^2 \longrightarrow (2)$$

$$I_x = \Sigma m x^2 \longrightarrow (3)$$

$$I_y = \Sigma m y^2 \longrightarrow (4)$$

eqn ③ and ② written as

$$I_z = \Sigma m(x^2+y^2)$$

$$I_z = \Sigma m x^2 + \Sigma m y^2$$

$$I_z = I_x + I_y$$

Hence, Perpendicular axis theorem Proved

Parallel axis Theorem

The moment of inertia of a Rigid body about any axis is equation Sum of moment of inertia about parallel axis through its Center of gravity and product of mass of the body and Square of distance between two Parallel axis

Explanation:

I be the moment of inertia of the body about any axis

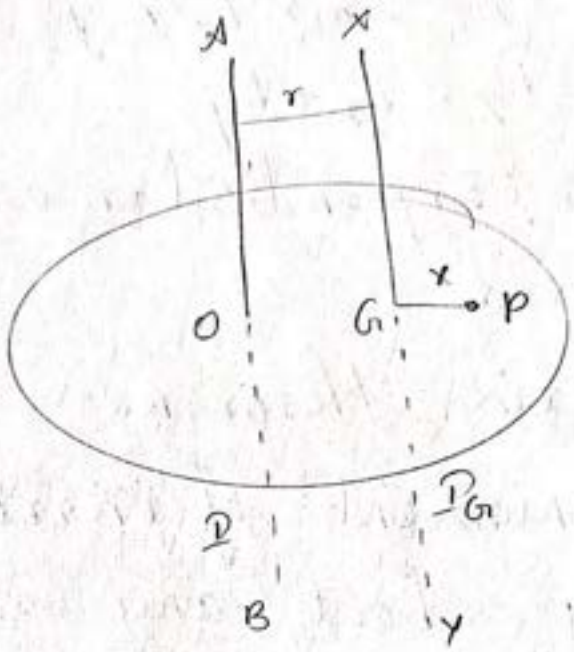
I_G be the moment of inertia through Centre of gravity

(or) be the Perpendicular distance

between the two axes

$$I = I_G + Mr^2$$

Proof



$AB = (r + x)$

$AB = m(r + x)^2$

$I = \Sigma m (r + x)^2$

$I = \Sigma m (r^2 + x^2 + 2rx)$

$I = \Sigma m r^2 + \Sigma m x^2 + 2r \Sigma m x \rightarrow (1)$

$\Sigma m = M$

$\Sigma m x^2 = I_G$

eqn (1) becomes $I = Mr^2 + I_G + 2r \Sigma m x \longrightarrow (2)$

$\Sigma m g x = 0$

$g \neq 0$

$\Sigma m x = 0$

$2r \Sigma m x = 0 \longrightarrow (3)$

eqn (3) in eqn (2)

$$I = I_{cm} + Mr^2 \longrightarrow (4)$$

Eqn (4) Hence parallel axis theorem Proved

12)

b) Neither stationary charges nor steady currents can produce electromagnetic waves. Electromagnetic waves are the combination of electric and magnetic field produced by moving charges

We know that a magnetic field will be produced in empty space if there is a changing electric field. A changing magnetic field produces an electric field that is itself changing and so on. The net result of these continuously interacting changing electric and magnetic field Produces and electromagnetic wave.

Theory:

Let us Consider two Conducting

rods which are connected to a source of alternating voltage. This setup will serve as an antenna for electromagnetic waves.

* The AC generator forces the charges to accelerate between the two rods.
* The antenna can be approximated and compared to an oscillating electric dipole.
* The electric field (E) surrounding the wire is produced by the charge distribution on the wire
* Both the electric field, E and the charge distribution vary as the current charges. The changing field propagates outward at the speed of light.
* The magnetic field associated with the changing electric field form concentric circle around the antenna and are perpendicular to the electric field lines at all points

13)

b) Semiconductors lasers are classified in two types as follows

i) Homojunction Semiconductor laser

ii) Heterojunction Semiconductor laser

i) Homojunction Semiconductor laser

Principle

Stimulated recombination - Electrons in the Conduction band recombines with holes in the Valence band and releases energy in the form of light photons. characteristics:

Active medium: PN junction

Active Centre - Electron - hole recombination

Pumping method - Direct Conservation

Optical resonated - Polished end faces of PN junctions

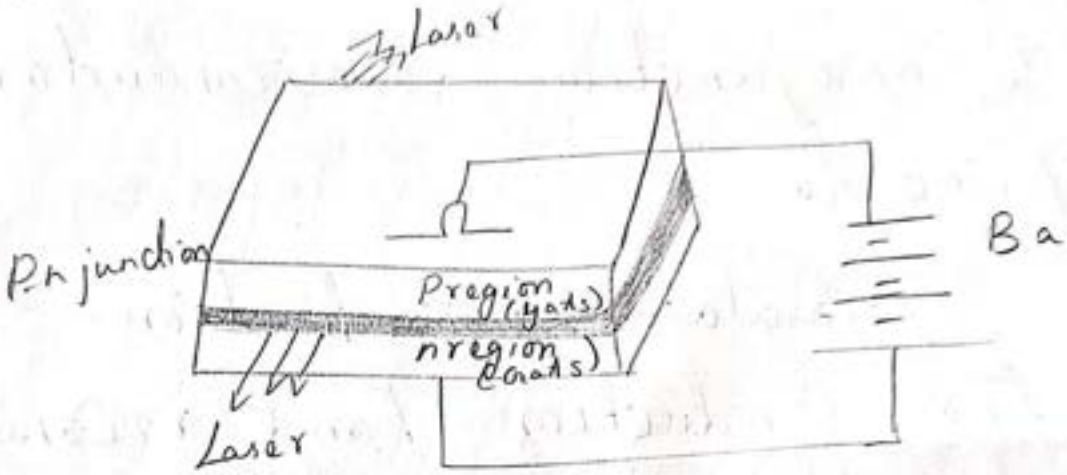
Power Output - 1 mW

Nature of Output - Pulsed

wavelength of Output - 8400Å - 8600Å.
Band gap - 1.44eV

Construction:

* The diode is made from semiconductor material GaAs.



* The battery provides the necessary bias to the diode.

Working

* The pn junction is forward bias with large applied voltage.
* The recombination of electrons and holes at the junction produ light emission.

Merits

* High power Output

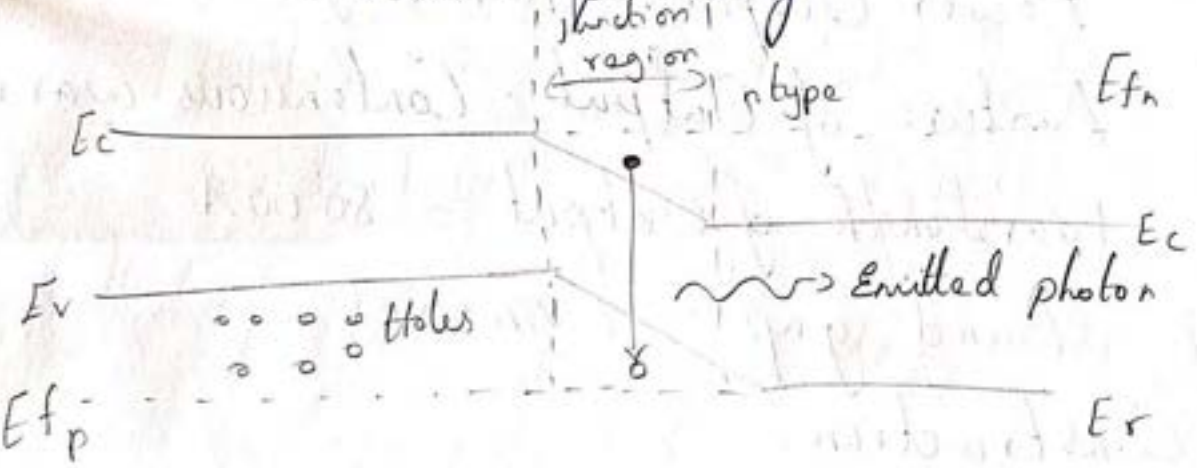
* High Coherence
* High Stability

Demerits

* High Cost
* Large divergence

Applications

* Data storage
* Laser Printing



ii) Heterojunction Semiconductor diode Laser.

Principle

Stimulated recombination Electrons in the Conduction band recombines with holes in the Valence band and releases energy in the form of light photons.

Characteristics:

Active medium - PN junction

Active Centre - Electron - hole recombination

Pumping method - Direct Conversion

Optical resonator - polished end faces of PN junction

Power Output - 10 mW

Nature of Output - Continuous wave

Wavelength of Output - 8000 Å

Band gap - 1.45eV

Construction

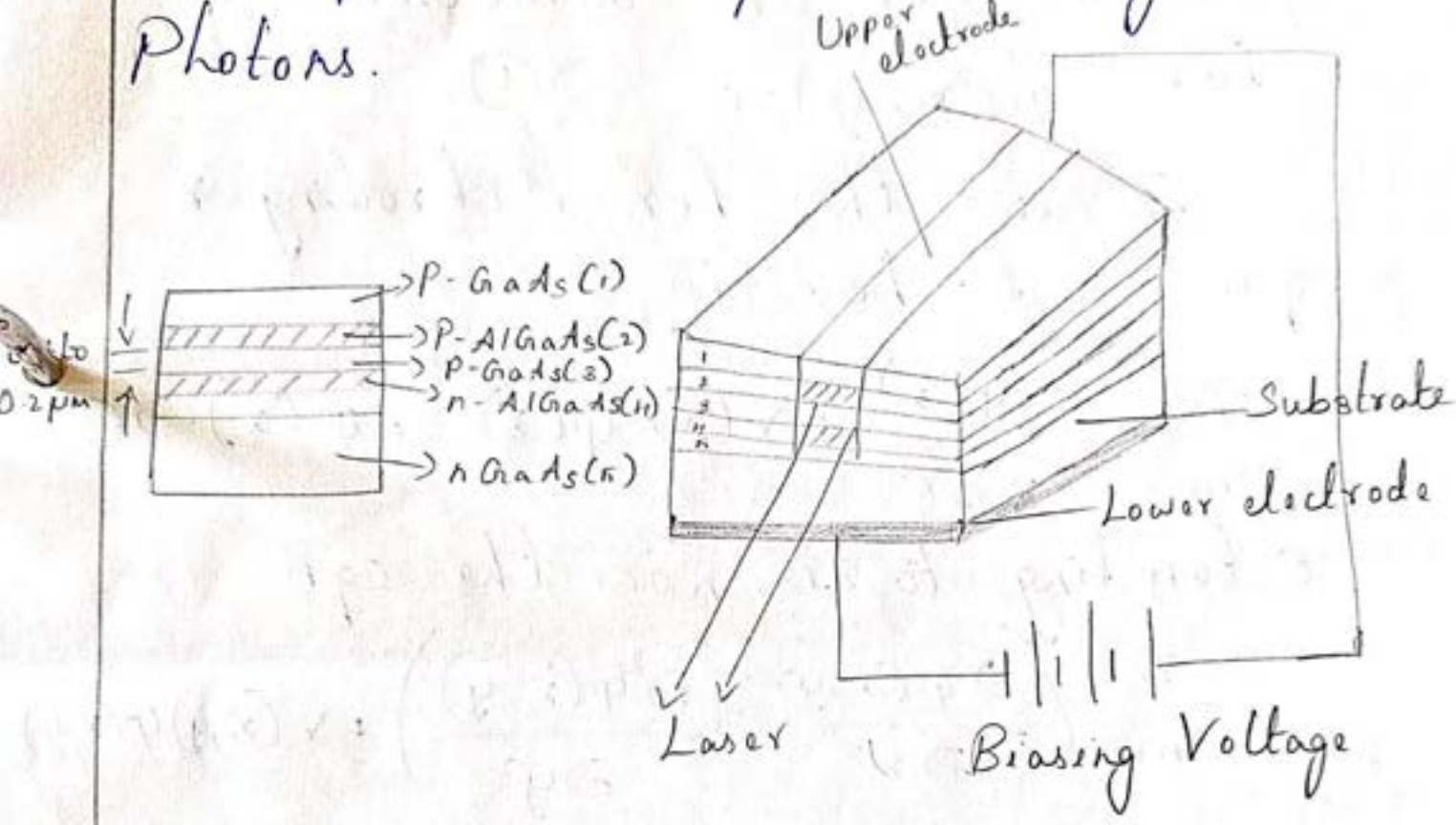
It Consists of the five layers A layers of GaAs p-type having narrow band gap as an active region. This 3rd layer is sandwitched between the 2nd layer and 4th Layer

Working

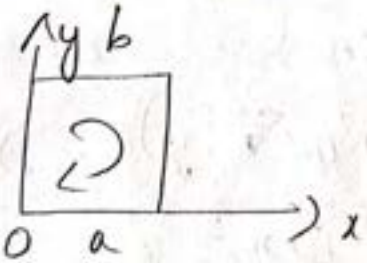
* The diode is forward biased and hence charge are Produced in

band gap layer.

* These injected Carriers Combine and produces spontaneously emitted Photons.



b) Schrodinger equation for an electron Confined in a 2D box



$$r(x, y) = 0$$

As the walls are impenetrable the wave function becomes

$\psi(x,y,t)=0$ at the walls

Outside the box the Schrodinger equation for one dimensional box $\psi(x,y)=0 \rightarrow (1)$

Inside the box Schrodinger eqn id box is

$$\frac{\hbar^2}{2m}\frac{\partial^2\psi(x)}{\partial x^2}+V(x)\psi(x)=E\psi(x) \rightarrow (2)$$

extending to 2D now the eqn

$$\frac{-\hbar^2}{2m}\left(\frac{\partial^2\psi(x,y)}{\partial x^2}+\frac{\partial^2\psi(x,y)}{\partial y^2}\right)+V(x,y)\psi(x,y) = E\psi(x,y) \rightarrow (3)$$

Boundary Condition

$V(x,y)=0$ within the box
$V(x,y)=\infty$ Outside the box $\}$ (4)

Put (4) in (3) we get

$$\frac{\hbar^2}{2m}\left(\frac{\partial^2\psi(x,y)}{\partial x^2}+\frac{\partial^2\psi(x,y)}{\partial y^2}\right)+0=E\psi(x,y$$

$$-\frac{\hbar^2}{2m}\left\{\frac{\partial^2\psi(x,y)}{\partial x^2}+\frac{\partial^2\psi(x,y)}{\partial y^2}\right. = E\psi(x,y)$$

$\rightarrow (5)$

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi(y)}{\partial y^2} = E_y\psi_y(y) \rightarrow (7)$$

X by eqn (6) & (7)

$$\Rightarrow \psi_x(x) = \sqrt{2/a}\sin\left(\frac{n_x\pi x}{a}\right) \rightarrow (8)$$

$$\psi_y(y) = \sqrt{2/b}\sin\left(\frac{n_y\pi y}{b}\right) \rightarrow (9)$$

We know

$$E_{nx} = \frac{n_x^2 h^2}{8ma^2} \rightarrow (10)$$

$$E_{ny} = \frac{n_y^2 h^2}{8mb^2} \rightarrow (11)$$

$$E_{nx}\,E_{ny} = h^2/8m\left[\frac{n_x^2}{a^2} + \frac{n_y^2}{b^2}\right]$$

Lowest energy state $n_x = n_y = 1$

For several Combination of quantum numbers same energy eigen values but different eigen function.

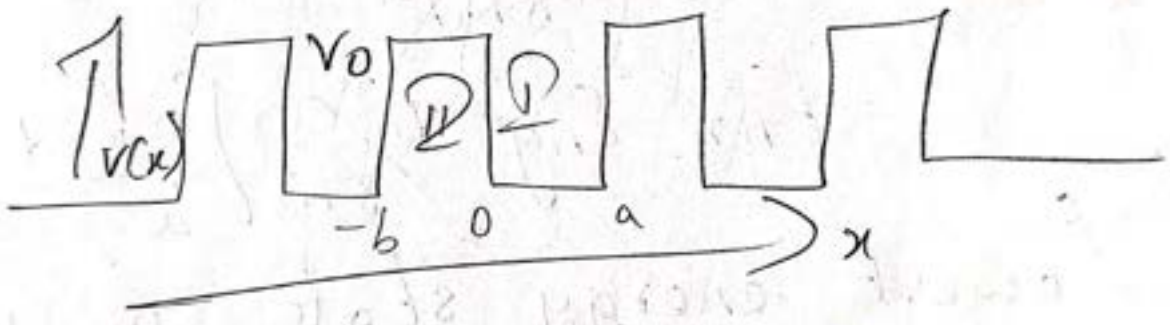
Such a state of energy levels is called degenerate state.

Suppose Only One wave function

value, the state is said to be called non-degenerate state.

(ii)

b) The study of essential behavior of electrons by approximating the Potentials inside a Crystal to the shape of rectangular steps is called Kronig Penney model of potentials



$V(x) = V_0$ for $-b < x < 0$

and

$V(x) = 0$ for $0 < x < a$

Period of potential $(a+b)$

Schrodingor equation

$$d^2\psi/dx^2 + 2m/\hbar^2 (E-V)\psi = 0$$

Region I $\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E)\psi = 0$ for $0 < x <$

$V = 0$ →

Region (II)

$$\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E - V_0)\psi = 0$$

for $-b < x < 0$ [Since $V = 0$] → (2)

$$\frac{d^2\psi}{dx^2} + \alpha^2\psi = 0 \quad \text{for } 0 < x < a \rightarrow (3)$$

$$\frac{d^2\psi}{dx^2} - \beta^2\psi = 0 \quad \text{for } -b < x < 0 \rightarrow (4)$$

$$\alpha^2 = \frac{2mE}{\hbar^2}$$

$$\beta^2 = 2m/\hbar^2 (V_0 - E)$$

$$\psi(x) = U(x)\cos kx \rightarrow (5)$$

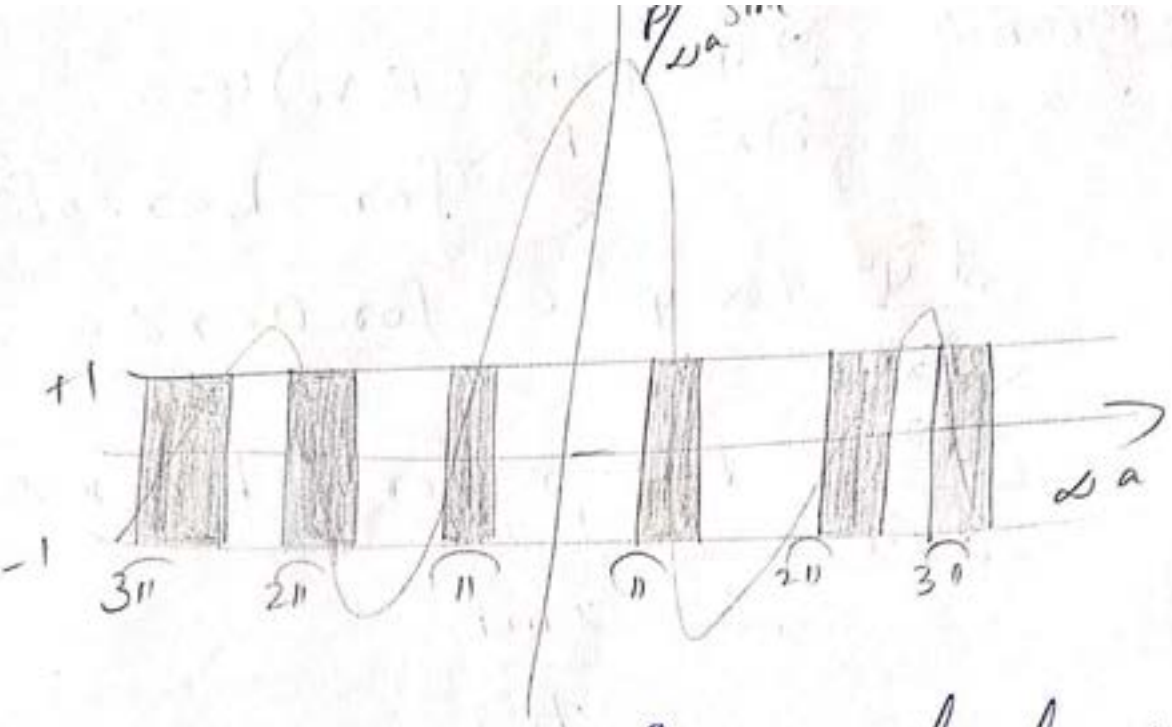
$$U(x) = U(x+a) \rightarrow (6)$$

eqn (3) and (4) boundary Conditions

$$\frac{8\pi^2 m V_0}{2\hbar^2 a} b \cdot \sin(\alpha a) + \cos(\alpha a) = \cos(ka) \rightarrow (7)$$

$$P/\alpha a \sin(\alpha a) + \cos(\alpha a) = \cos(ka) \rightarrow (8)$$

$$P = \frac{8\pi^2 m V_0 \alpha b}{2\hbar^2} = \text{potential barrier strength}$$



The energies of an electron moving under a periodic lattice Potential lie Only in Certain allowed other energies are forbidden

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2023 - 2024

SAMPLE ANSWER SHEET

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District - 629 202

Name of the Exam: INT. EXAM- I | INT. EXAM- II (Tick the appropriate box) → 8645 R. Siva keerthika

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Register Number: 0 0 0 2 3 R U M E D 4 6

College Code	9635		
College Name	Stella Mary's College of Engineering		
Degree/ Branch	B.E/ Mechanical	Semester	I
Subject Code	PH3151	Date & Session	7/11/23 2 FN
Subject Title	Engineering Physics	No. of Pages used	
Question Paper Code	017140	All particulars given are verified	Signature of the Hall Superintendent with date
Internal Assessment Examination Co-ordinator Signature / Fascimile		Name of the Hall Superintendent	G. Uthaya

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Date : 7/11/23 Session : FN

Subject Code / Title : PH3151 Engineering Physics

Question paper Code : 17140 No. of Pages used :

To be filled in by the candidate

Date : 7/11/23 Session : FN Question paper Code : 17140

Subject Code / Title : PH3151 Engineering Physics

Instruction to the Candidate : Put a tick mark (✓) for the questions attended in the tick mark column against each question in V-I

PART - A			PART - B & C									
Question No.	✓	Marks	Question No.		i ✓	i Marks	ii ✓	ii Marks	iii ✓	iii Marks	Total Marks	GRAND TOTAL (IN WORDS)
1		2	6	a								Five zero Six
				b		09+1					09+1	
2		2	7	a		10					10	
				b								
3		2	8	a								
				b		10					10	
4		2	9	a		—					—	380 80
				b								
5		2	10	a								GRAND TOTAL (IN NUMBERS)
				b		09+1					09+1	
TOTAL	10	08									380 80	

Declaration by the Examiner : Verified that all the questions attended by the student are valued and the total is found to be correct

Date	Name of the Examiner	Signature of the Examiner

Part - A

1. **Centre of Mass**

When the total Mass of a Particles Concentrated at the Centre is called Centre of Mass

3. **Properties of Electromagnetic waves**

1. Electromagnetic waves are transvers in nature
2. Electromagnetic waves produce accelarated charges
3. Electromagnetic travels at Speed of light

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \Rightarrow c = 3 \times 10^8$$

4. Electromagnetic waves exists the interfe and difraction to Propoghate

4. Radiation Pressure

The force per unit by a electromagnetic waves accelerated to the molecules is called Radiation Pressure.

5. Pumping:

Due to the pumping the ions in lower ener is excited to higher Energy State in the actio active medium is called pumping.

Methods of Pumping:

1. Optical Pumping
2. Electric discharge Pumping
3. Non-Electric discharge Pumping
4. Thermal Pumping.

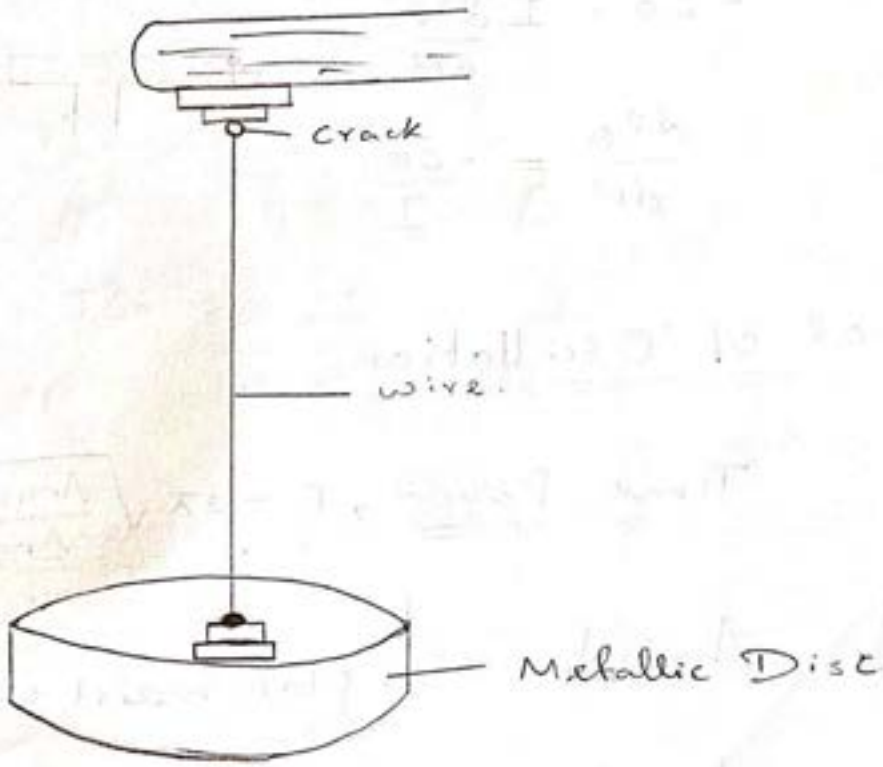
Part - B

6. ## Torsion Pendulum

The circular disc is suspendend on the wire, by twisting the disc it Produce torsional oscillation. is called Torsion Pendulum.

It Consists of a circular mettalic disc is Connected ~~to~~ ~~rigid~~ ~~wire~~ at one end and the thin wire at the other end.

Diagram.



When we twiste the circular disc and it release the ~~torque~~ torque Oscillation in Back and forth

$$\text{Tourque } \tau = -C\theta$$

(or)

$$\text{Restoring wire} = -C\theta \quad \text{—①}$$

~~Couples~~ ~~$I\frac{d^2\theta}{dt^2}$~~

$$= I\frac{d^2\theta}{dt^2} \quad \text{—②}$$

Equate eq ① & ②

$$-C\theta = I\frac{d^2\theta}{dt^2}$$

$$\frac{d^2\theta}{dt^2} = -\frac{C\theta}{I}$$

Period of Oscillation

$$\text{Time Period, } T = 2\pi\sqrt{\frac{\text{Angular displacement}}{\text{Angular acceleration}}}$$

$$\text{Angular displacement} = \theta$$

$$\text{Angular acceleration} = \frac{d^2\theta}{dt^2}$$

$$T = 2\pi \sqrt{\frac{\theta}{\frac{C\theta}{I}}}$$

$$T = 2\pi \sqrt{I/C} \quad \text{— (3)}$$

To Find:

Rigidity modulus of the wire

Couple per unit twist, $C = \frac{\eta \pi r^4}{2l}$

(3) $\Rightarrow$ $T = 2\pi \sqrt{I/C}$

Taking Squar on both side

$$T^2 = 4\pi^2 \frac{I}{C}$$

$$T^2 = 4\pi^2 \times \frac{I}{\frac{\eta \pi r^4}{2l}}$$

$$T^2 = \frac{4\pi^2 I \times 2l}{\eta \pi r^4}$$

$$T^2 = \frac{8\pi I l}{\eta r^4}$$

Moment of Inertia of a disc

$$I = \frac{\eta r^4 T^2}{8\pi l}$$

Rigidity modulus of the wire

$$\eta = \frac{8\pi I l}{r^4 T^2}$$

η —> Rigidity modulus of the wire

l —> length of a suspended wire

I —> Moment of Inertia of a disc.

---

8. ## Plane Electromagnetic waves in vacuum.

This ~~Expr~~ Expression is dirived by

Maxwell's equations in differential form.

Maxwell's Equations.

1. $\vec{\nabla} \cdot \vec{D} = \rho$

2. $\vec{\nabla} \cdot \vec{B} = 0$

3. $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

4. $\vec{\nabla} \times \vec{H} = J + \frac{\partial \vec{D}}{\partial t}$

Conditions:

$\rho = 0$

$J = 0$

$\vec{D} = \varepsilon_0 \vec{E}$

$\vec{H} = \frac{\vec{B}}{\mu_0} \Rightarrow \vec{B} = \mu_0 \vec{H}$

$\varepsilon_0 \longrightarrow$ Permitivity

$\mu_0 \longrightarrow$ Permiability

1. $\vec{\nabla} \cdot \vec{D} = \rho$

$\boxed{\vec{D} = \varepsilon_0 \vec{E} \;,\; \rho = 0}$

$\vec{\nabla} \cdot (\varepsilon_0 \vec{E}) = 0$

$\boxed{\varepsilon = \varepsilon_0 \varepsilon_r \qquad \varepsilon_0 = \frac{\varepsilon}{\varepsilon_r}}$

$\varepsilon_r \longrightarrow$ Relative permitivity $\Rightarrow \varepsilon_r = 1$

$\boxed{\varepsilon_0 = \varepsilon}$

$\vec{\nabla} \cdot (\varepsilon \vec{E}) = 0$

$\vec{\nabla} \cdot \vec{E} = 0 \quad — \quad (1)$

2. $\vec{\nabla} \cdot \vec{B} = 0 \quad — \quad (2)$

3. $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ — (3)

4. $\vec{\nabla} \times \vec{H} = J + \frac{\partial \vec{D}}{\partial t}$

$$\vec{H} = \frac{\vec{B}}{\mu_0} \quad , \quad J = 0 \quad , \quad \vec{D} = \varepsilon_0 E$$

$$\vec{\nabla} \times \frac{\vec{B}}{\mu_0} = \frac{\partial (\varepsilon_0 \vec{E})}{\partial t}$$

$$\vec{\nabla} \times \vec{B} = \varepsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t} \quad \text{— (4)}$$

Electro magnetic waves interms of electric fiel

(3) $\Rightarrow \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

Taking curl on both side

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{E}) = -\frac{\partial (\vec{\nabla} \times \vec{B})}{\partial t} \quad \text{— (5)}$$

Substitute equation (4) in (5)

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{E}) = -\frac{\partial \left(\varepsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}\right)}{\partial t}$$

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{E}) = -\varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}}{\partial t^2} \quad \text{— (6)}$$

Using identity vector

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{E}) = \vec{\nabla}(\vec{\nabla} \cdot \vec{E}) - \nabla^2 \vec{E} \quad \text{— (7)}$$

Compare equation (6) & (7)

$$\vec{\nabla}(\vec{\nabla} \cdot \vec{E}) - \nabla^2 \vec{E} = -\varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}}{\partial t^2}$$

$$\boxed{\vec{\nabla} \cdot \vec{E} = 0}$$

$$-\nabla^2 \vec{E} = -\varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}}{\partial t^2}$$

$$\nabla^2 \vec{E} = \varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}}{\partial t^2}$$

$$\boxed{\nabla^2 \vec{E} - \varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}}{\partial t^2} = 0} \quad \text{— (8)}$$

Electromagnetic wave equation interms of magnetic fi

(4) $\Rightarrow$ $\vec{\nabla} \times \vec{B} = \varepsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}$

Taking curl on both side

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{B}) = \varepsilon_0 \mu_0 \frac{\partial (\vec{\nabla} \times \vec{E})}{\partial t} \quad \text{— (9)}$$

Substitute equation (3) in (9)

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{B}) = \varepsilon_0 \mu_0 \frac{\partial (-\partial \vec{B}/\partial t)}{\partial t}$$

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{B}) = -\varepsilon_0 \mu_0 \frac{\partial^2 \vec{B}}{\partial t^2} \quad \text{— (10)}$$

Using identity Vector:

$$\vec{\nabla} \times (\vec{\nabla} \times \vec{B}) = \vec{\nabla}(\vec{\nabla} \cdot \vec{B}) - \nabla^2 \vec{B} \quad \text{— (11)}$$

Compare equation (10) & (11)

$$\vec{\nabla}(\vec{\nabla} \cdot \vec{B}) - \nabla^2 \vec{B} = -\varepsilon_0 \mu_0 \frac{\partial^2 \vec{B}}{\partial t^2}$$

$$\vec{\nabla} \cdot \vec{B} = 0$$

$$-\nabla^2 \vec{B} = -\varepsilon_0 \mu_0 \frac{\partial^2 \vec{B}}{\partial t^2}$$

$$\nabla^2 \vec{B} = \varepsilon_0 \mu_0 \frac{\partial^2 \vec{B}}{\partial t}$$

$$\boxed{\nabla^2 \vec{B} - \varepsilon_0 \mu_0 \frac{\partial^2 \vec{B}}{\partial t} = 0} \quad \text{— (12)}$$

10 **Nd-YAG Laser:**

Nd-YAG is a four level laser.

Nd stands for - Neodymium

YAG stands for - Yttrium Aluminum Garnet

Characteristic:

active Centre	Nd-YAG Rod
active Medium	Nd^{3+} ions
Pumping method	Optical Pumping
Electrical Resonand	The end of the rod is Polished and Silvered
laser output	Pluse (or) Continous
Wavelength of output	$\lambda = 1.064$ nm
Output Power	2×10^{-8} watt

Construction:

~~Ex Consists of elliptical~~

1. Nd-YAG Rod is placed on the glass tube on one foci

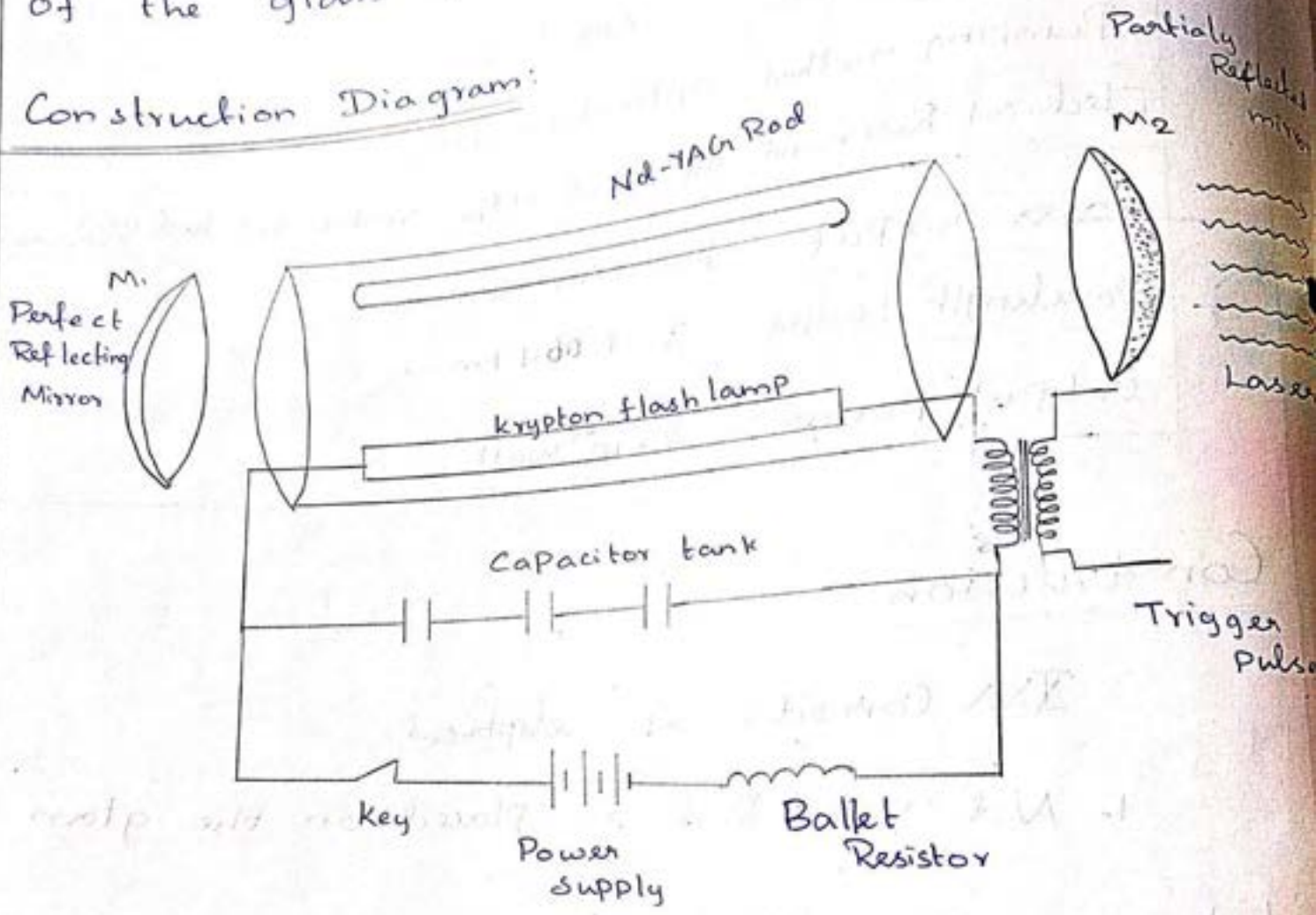
2. krypton flash lamp, Optical Pumping on the other foci of the tube

3. The Power supply is connected to give Power to the krypton flash lamp

4. M_1 mirror (reflected Mirror) and M_2 (Partiale Reflected

Mirror is placed on the two ends of the glass tube.

Construction Diagram:



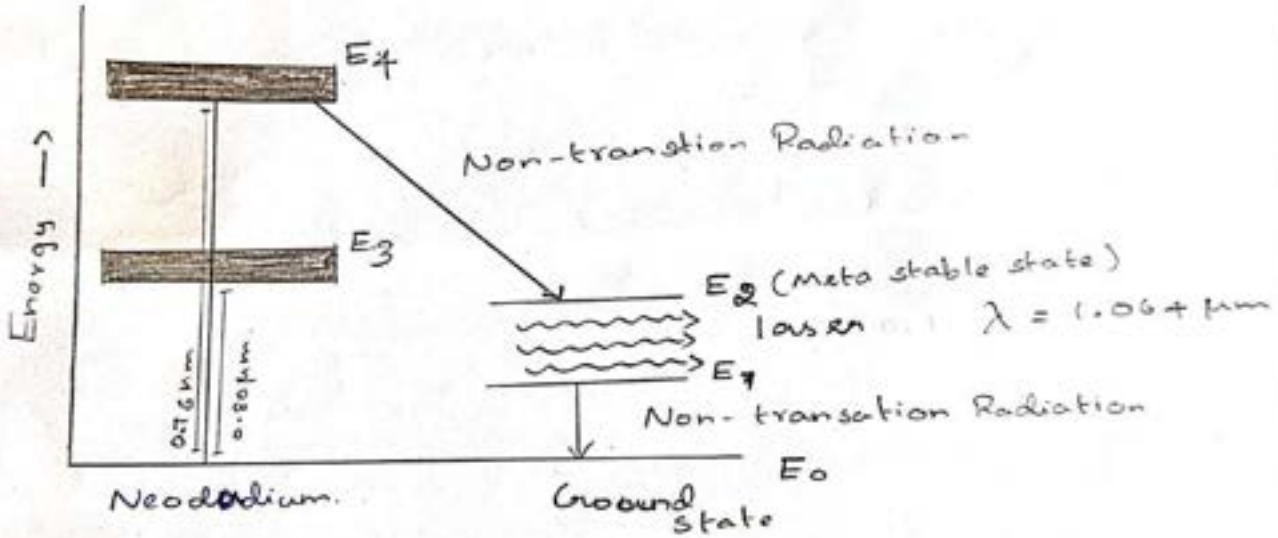
Principle:

1. Nd^{3+} ions Excited from lower energy level to higher energy level and it a result of optical Pumping

2. By Non-transation Radiation Nd^{3+} comes down to the metastable state. The the population inversion is achived.

3. Nd^{3+} ion comes to the lower energy state by Non-transation Radiation.

Working Diagram:



working:

* By the Power supply the light will blo
* The the Nd^{3+} ion excited to higer energy level E_4
* By Non-tanration Radiation Nd^{3+} ions

drop to the metastable state E_2. Then the Population inversion is achived.

* Nd^{3+} ion come to the lower energy state the Output is produce wavelength of Nd^{3+} ions is 1.064 μm.

Internal exam 1 - Retest

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District - 629 202

Name of the Exam: INT. EXAM- I ✓ | INT. EXAM- II — 145

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College Code	9635
College Name	Stella mary College of Engineering
Degree/ Branch	B.E Mechanical
Subject Code	PH3151
Subject Title	Engineering Physics
Semester	1
Date & Session	7-11-23 FN
No. of Pages used	15
Question Paper Code	17140
All particulars given are verified	Signature of the Hall Superintendent with date
Internal Assessment Examination Co-ordinator Signature / Facsimile	Name of the Hall Superintendent: Sheiva S

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(To be filled in by the candidate)

Date : 7-11-2023 Session : FN

Subject Code / Title : PH3151 Engineering physics.

Question paper Code : 17140 No. of Pages used : 15

To be filled in by the candidate

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1	✓	2	6	a									Three Four
				b	✓	08					08		
2	✓	1	7	a	✓	07					07		
				b									
3	✓	2	8	a	✓	06					06		
				b									
4	✓	1	9	a									34
				b	✓	00					00		
5	✓	2	10	a	✓	05					05		GRAND TOTAL (IN NUMBERS)
				b									
TOTAL		08									26		

Declaration by the Examiner : Verified that all the questions attended by the student are valued and the total is found to be corre

Date	Name of the Examiner	Signature of the Examiner

Part - A

Centre of mass

* Centre of mass of the body point at which whole mass of the body appeared to concentrated.
* For a rigid body it will be in centroid.

non linear oscillation

$$n = \frac{1}{f_1}$$

Non linear oscillation is basic building blocks is called Harmonics. and it coas known as non linear oscillation.

eg: interaction between bridge and foundation., ships and waves. wigs and blades.

3) properties of electromagnetic waves

* Electromagnetic wave require. both electric and magnetic field (E and B) of propagate and Coprogate.
* The wave travels in direction mutally perpendicular. to the propagate and direction.

$$S = E \times B$$

* The E and B at C. phase velocity will be measured.

4) radiation pressure

when electromagnetic wave encounters the surface of an object. The force exerted in to surface and momentum transfer. The force exerted in to area in the waves is called radiation pressure.

5) Pumping

Pumping is the lower energy state to higher energy state by active medium is called pumping. The pumping classify into to types. They are:

i) chemical pumping
ii) Thermal pumping.
iii) inelastic atom-atom collision.
iv) electric discharge pumping
v) optical pumping

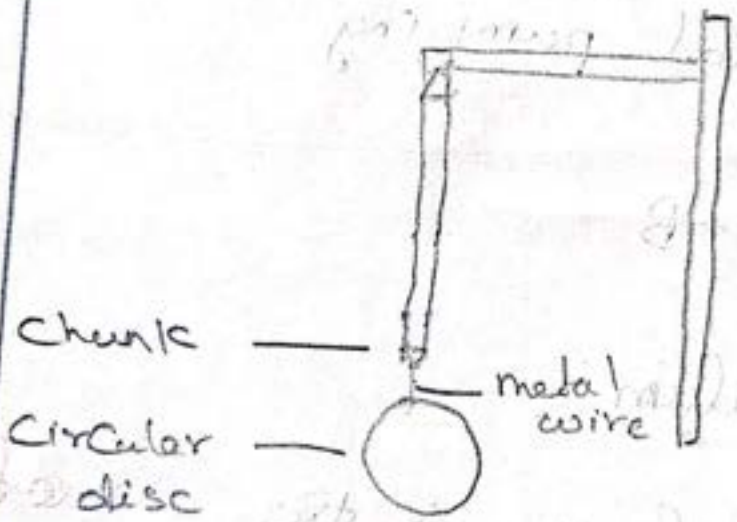
part-B

6) b) Torsion pendulum

Torsion pendulum is the metal wire connected with circular disc. The wire is twisted by. back and forth and we take the readings is called. Torsion pendulum.

Theory:

A circular metallic disc suspended by a thin wire which produce Torsional oscillation. It is twisted by back and forth and it produce the simple Harmonic motion.



Restoring Couple $= -C\theta$

Applied Couple $= I \frac{d^2\theta}{dt^2}$ — ②

Subs eqn ① and ② we get.

$$-C\theta = I \frac{d^2\theta}{dt^2}$$

$$T = 2\pi \sqrt{\frac{\text{angular displacement}}{\text{angular acceleration}}}$$

$$T = 2\pi \sqrt{\frac{\theta}{\alpha}}$$

$$T = 2\pi\sqrt{\frac{I}{C}}$$

This is time period torsion pendulum.

Rigidity Modulus of wire

$$T = 2\pi\sqrt{\frac{I}{C}}$$

Square on both sides

$$T^2 = 4\pi^2\frac{I}{C}$$

Couple for unit ~~square area~~ $C = \frac{\eta\pi r^4}{2l}$

$$C = \frac{\pi n r^4}{2l}$$

$$T^2 = 4\pi^2 \frac{I}{\frac{\pi n r^4}{2l}}$$

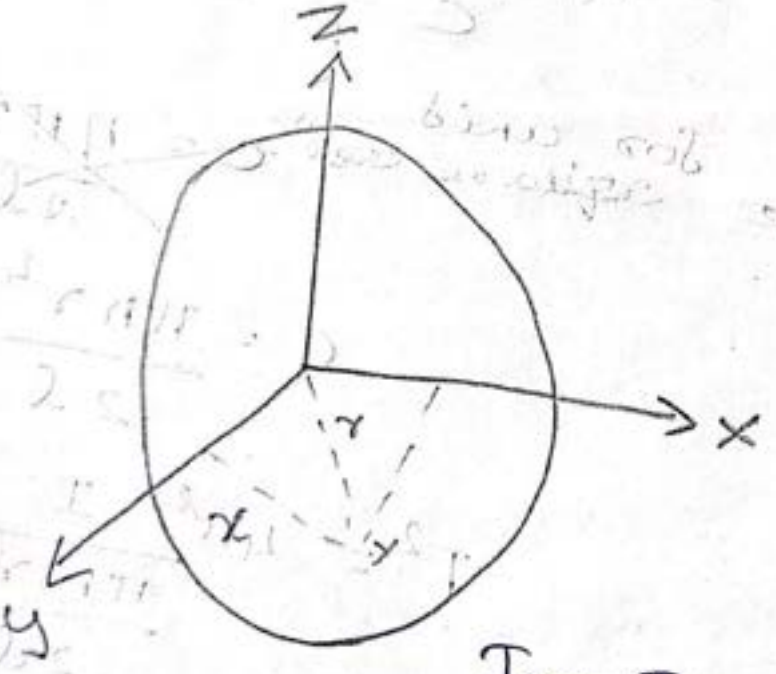
$$T^2 = \frac{4\pi I 2l}{n r^4}$$

$$\boxed{n = \frac{8\pi I l}{r^4}\frac{I}{T^2}}$$

This is rigidity modulus of wire

7) a) Perpendicular axis theorem

The moment of inertia perpendicular to the plane and its passing through the point of intersection of two mutally perpendicular axes. is equal two sum of moment of inertia.



$$I_z = I_x + I_y.$$

where, I_z, I_x, I_y along three mutally perpendicular axes passing through the coin.

Let planar body divided into large number of particles. each of mass

$r^2 = x^2 + y^2$

The moment inertia of planar body axis OZ is.

$$I_Z = mr^2$$

The total moment of inertia of planar body axis OZ is.

$$I_Z = \sum mr^2$$

The total moment inertia of planar body. axis oy is.

$$I_y = \sum my^2$$

The total moment of inertia of planar body axis ox is.

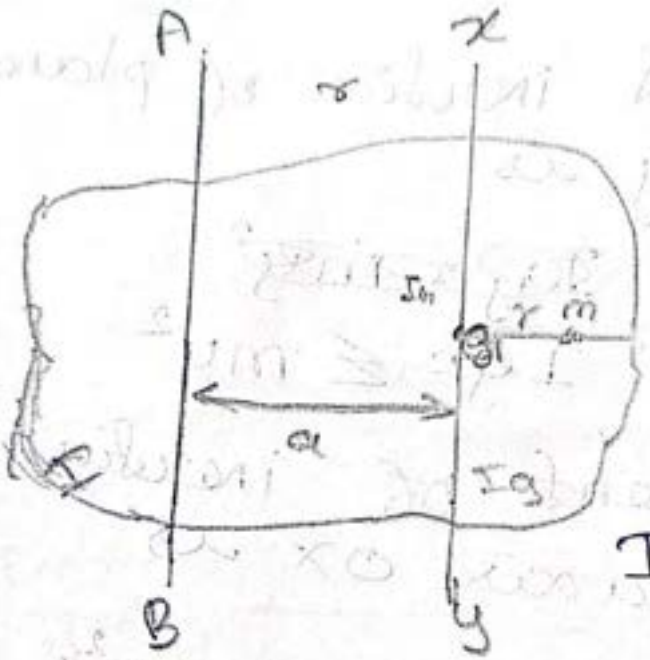
$$I_x = \sum mx^2.$$

$$I_Z = I_x + I_y$$

Perpendicular axis theorem is Hence proof.

Parallel axis theorem

The moment of inertia of rigid body about an axis is equal to: sum of moment of inertia about a parallel axis through it.



$$I = I_g + m r_2$$

The moment of inertia of rigid body about a axis through it. Let r be the distance of two lines. A to B be the I and x to y is the I_g.

$$AB = (r + x)$$

The moment of inertia of rigid body

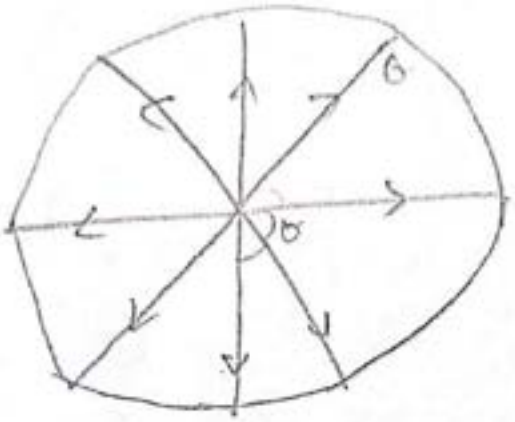
$AB = n(r+x)$

The moment of inertia of AB is.

$AB =$

8) a) Maxwell equation

i) First equation (electromagnetic equation)



where Q is charge, ρ is charge density.

equation.

$$\vec{\nabla} \cdot \vec{D} = 0$$

proof:

$$\oint_S \vec{E} \cdot d\vec{S} = \frac{Q}{\varepsilon_0}$$

$$\oint_S \varepsilon_0 \vec{E} \cdot d\vec{S} = Q \quad \text{— (1)}$$

$\varepsilon_r = 1$

$$\varepsilon_0 = \varepsilon_0 \varepsilon_r$$

$$\varepsilon_0 = \frac{\varepsilon}{\varepsilon_r}$$

$$\oint_S \varepsilon \vec{E} \cdot d\vec{S} = Q$$

$$\oint_S \vec{D} \cdot d\vec{S} = Q$$

$$\boxed{\vec{D} = \varepsilon \vec{E}}$$

~~To Curl on both side~~ surface integral into volume integral.

$$\oint_V \rho \cdot dV = \oint_S \vec{D} \cdot d\vec{S}.$$

To Curl on both side

$$\oint_S \cdot \rho \vec{\nabla} d\vec{S} = \oint_S \vec{D} \vec{\nabla} d\vec{S}$$

$$\boxed{\vec{\nabla} \cdot \vec{D} = 0}$$

---

ii) Maxwell second equation (Magnetic equation)

$$\phi = 0$$

$$\oint \vec{B} \cdot d\vec{l} = \phi$$

$$\oint \vec{B} \cdot d\vec{l} = 0$$

equation:

$$\boxed{\vec{\nabla} \times \vec{B} = 0}$$

To Curl on this side volume integral

$$\oint_V \vec{B} \cdot dV = \oint_S \vec{B} \cdot d\vec{V}$$

To Curl on both side

$$\oint \vec{B} \vec{\nabla} dV = \oint_S \vec{B} \cdot \vec{\nabla} \cdot dV$$

maxwell second equation

$$\boxed{\vec{\nabla} \times \vec{B} = 0}$$

---

iii) Maxwell third equation (Faraday law of magnetic induction).

equation:

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

Proof:

$$\mathcal{E}_f = -\frac{d\phi}{dt}$$

$\mathcal{E}_f \longrightarrow$ electromotive force

$\phi \longrightarrow$ magnetic flux.

$$\mathcal{E}_f = -\frac{d}{dt}\left(\oint_l \vec{B} \cdot dl\right)$$

$$\mathcal{E}_f = \oint_l -\frac{\partial \vec{B}}{\partial t} \vec{B} \cdot dl \quad \text{— (1)}$$

$$\frac{-d\phi}{\partial t} = \oint_l -\frac{\partial \vec{B}}{\partial t} \vec{B} \cdot dl$$

$$\frac{-\partial}{\partial t}\left(\oint \vec{B} \cdot dl\right) = \oint_l -\frac{\partial \vec{B}}{\partial t} \vec{B} \cdot dl$$

The maxwell third equation is (13)

$$\nabla \times \vec{E} = \frac{-\partial \vec{B}}{\partial t}$$

v) Maxwell fourth equation (Ampere Circuital law).

The ampere circuital law integrates the magnetic field intensity H on any closed path. is equal to current enclosed by path.

equation:

a) properties of electromagnetic waves

* Electromagnetic wave require both electric and magnetic field propagate. and Co propagate.

* The wave travels in direction mutually perpendicular to the propagate and direction.

$$S = E \times B$$

* The E and B at C. phase velocity will be measured.

10) Einstein relations

$$R(Ab) = B_{12} A_1 \rho \quad \text{— (1)}$$

$$R(sp^+) = A_{21} A_2 \quad \text{— (2)}$$

$$R(St) = B_{21} A_2 \rho \quad \text{— (3)}$$

$$R_{(AB)} = R(sp^+) + R(St).$$

$$B_{12} A_1 \rho = A_{21} A_2 + B_{21} A_2 \rho \quad \text{— (4)}$$

$$A_{21} A_2 = B_{12} A_1 \rho - B_{21} A_2 \rho \quad \text{— (5)}$$

$$A_{21} A_2 = \rho [B_{12} A_1 - B_{21} A_2]$$

$$\rho = \frac{A_{21} A_2}{B_{12} A_1 - B_{21} A_2} \quad \text{— (6)}$$

Denominator and numerator $\div B_{21} A_2$

$$\rho = \frac{\frac{A_{21} A_2}{B_{21} A_2}}{\frac{B_{12} A_1}{B_{21} A_2} - \frac{B_{21} A_2}{B_{21} A_2}}$$

$$C = \frac{\frac{A_{21}}{B_{21}}}{\frac{B_{12}A_1}{B_{21}A_2} - 1} \quad \text{(15)}$$

$$\frac{B_{12}A_1}{B_{21}A_2} = 1 \quad \text{(7)}$$

By Boltzmann theorem.

$$= h\nu^{K}/_{6}$$

By Planck' constant

$$\eta = \frac{8\pi h l^3}{2l}$$

$$\boxed{e = \frac{8\pi h l^3}{2l} \cdot \frac{1}{h\nu^{K}/_{6}}}$$

Comparing (7) and (8)

$$\frac{A_{21}}{B_{21}} = 1 \quad , \quad \frac{B_{12}A_1}{B_{21}A_2} = 1 \quad \therefore B_{12} = B_{21} = 1$$

This A and B are called Einstein Relations.

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M. Maruthappa.

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Date : 7-11-2023 Session : FN

Subject Code / Title : PH 3151 Engineering Physics.

Question paper Code : 14140 No. of Pages used :

To be filled in by the candidate

Date : 7-11-2023 Session : FN Question paper Code : 14140

Subject Code / Title : PH3151 Engineering physics.

Instruction to the Candidate : Put a tick mark (✓) for the questions attended in the tick mark column against each question in V-I

PART - A			PART - B & C										GRAND TOTAL (IN WORDS)
Question No.	✓	Marks	Question No.		i ✓	i Marks	ii ✓	ii Marks	iii ✓	iii Marks	Total Marks		
1		2	6	a									Two Six
				b		06					06		
2		—	7	a		07					07		
				b									
3		2	8	a		—					—		
				b									
4		0	9	a									26
				b		02					02		
5		1	10	a									GRAND TOTAL (IN NUMBERS)
				b		06					06		
TOTAL		05									21		

Declaration by the Examiner : Verified that all the questions attended by the student are valued and the total is found to be correct

Signature of the Examiner

Part - A

1. **Centre of Mass:-**

* The Centre of mass of the body is defined as the point at which the whole mass of the body is applied on it.

* For the simple rigid body, the Centre of mass is Centroid.

3. **The properties of the electromagnetic waves:-**

~~(i) The Ele~~

* The electromagnetic waves are transverse in ~~ta~~ n
* The electromagnetic waves are travells with the sp of light.
* The electromagnetic waves are produced by the accelerated charges.
* The electromagnetic waves are not deflected the electric or magnetic fields.

4. Radiation pressure:-

* The force exerted by the electromagnetic wave which is encountered by the surface of the object is known as radiation pressure of the electromagnetic waves.

5. Pumping action:-

* The phenomenon of accelerate the population inversion process in the active medium is called as pumping action.

Types of pumping action:-

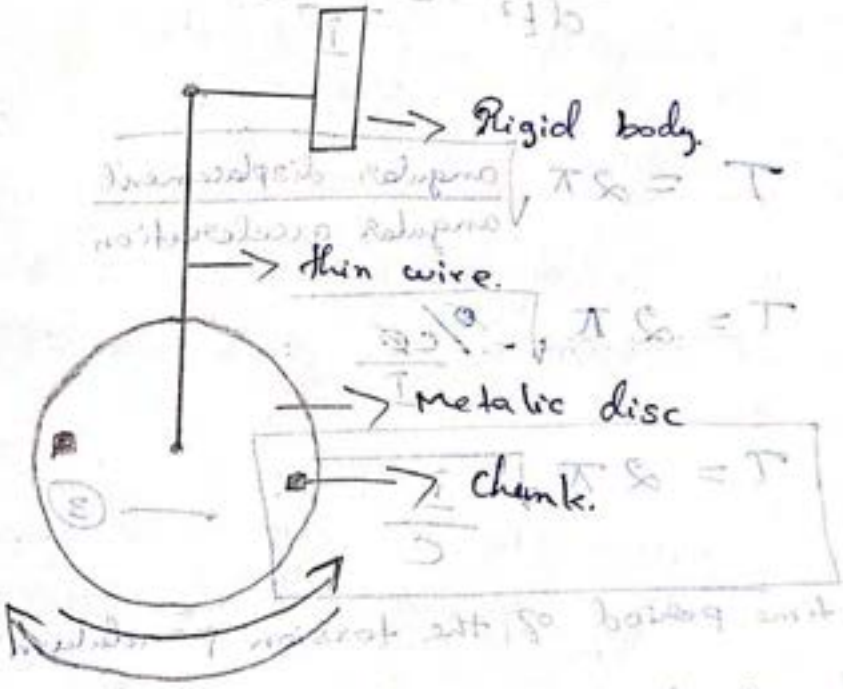
(i) Electrical pumping
(ii) Mechanical pumping.
(iii) Chemical pumping.

Part - B

6. (b)

Torsion pendulum:-

* A metalic circular disc is conected to the thin wire. which produces the torsional oscillation by twisted is known as torsion pendulum.



Theory:

* A metalic thin wire is connected to rigid body at one end and the metalic circular at the other end. To twisted it to produce the torsional oscillation.

* The couple set up for the oscillation is

$$= -C\theta \quad \text{—} (1)$$

* The applied couple is $= I\frac{d^2\theta}{dt^2}$ —— (2)

Compare (1) & (2)

$$I\frac{d^2\theta}{dt^2} = -C\theta$$

$$\frac{d^2\theta}{dt^2} = \frac{-C}{I}\theta.$$

$$T = 2\pi\sqrt{\frac{\text{angular displacement}}{\text{angular acceleration}}}$$

$$T = 2\pi\sqrt{-\frac{\theta}{C\theta}}$$

$$\boxed{T = 2\pi\sqrt{\frac{I}{C}}} \quad \text{—} (3)$$

The time period of the torsion pendulum is $\boxed{T = 2\pi\sqrt{\frac{I}{C}}}$

Determination of Rigidity modulus of the wire:

Squaring eqn (3) on both sides:

$$T^2 = \frac{4\pi^2 I}{C}$$

we know,

$$\boxed{C = \frac{\pi n r^2 l}{2l}}$$

∴ Retort

$$\therefore T^2 = \frac{8\pi^2 I l}{\pi n r^2}$$

$$T^2 = \frac{8\pi I l}{n r^2}$$

$$I = \frac{n T^2 r^2}{8\pi l}$$

$$n = \frac{8\pi I l}{T^2 r^2}$$

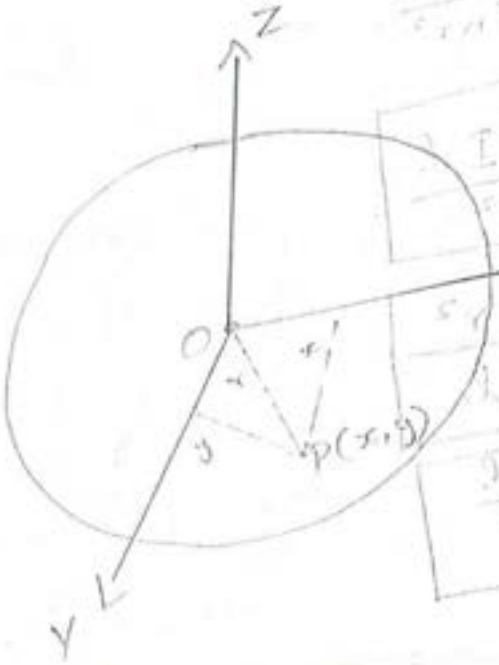
7. (a) Theorem of Parallel and perpendicular axis:-

(i) ~~Radial~~ Perpendicular axis:

* It is applicable only on planar body.

Theory:

* The moment of inertia of a planar body about an axis perpendicular to its plane and is passing through the point of intersection of the two mutualy perpendicular axes is equal to the sum of the moment of inertia of the two mutualy perpendicular axes.



$$I_z = I_x + I_y$$

* Let I_x and I_z be the moment of Inertia of the body

* A particle 'p' at the distance 'r' from the origin 'O'. Which coordinate as $p(x,y)$

which gives, $r^2 = x^2 + y^2$ ——— (1)

* The moment of Inertia of the particle 'p' about an axis OZ is

$$OZ = mr^2 \quad \text{——— (2)}$$

* The moment of Inertia of the whole body about an axis OZ is

$$I_z = \Sigma mr^2 \quad \text{——— (3)}$$

* The moment of Inertia of the whole body about an axis OX is

$$I_x = \Sigma mx^2 \quad \text{——— (4)}$$

* The moment of Inertia of the whole body about an axis OY is

$$\therefore \text{Retort}$$

$$\boxed{\bar{I}_y = \Sigma m y^2} \quad \text{---} (5)$$

(3) $\Rightarrow \bar{I}_z = \Sigma m r^2$

Sub eqn (1) $\Rightarrow \bar{I}_z = \Sigma m (x^2 + y^2)$

$$\bar{I}_z = \Sigma m x^2 + \Sigma m y^2$$

$$\boxed{\bar{I}_z = \bar{I}_x + \bar{I}_y}$$

$\therefore$ Hence the ~~parallel~~ Perpendicular axis theorem is proved.

(ii) **Parallel axis theorem:-**

* It is applicable for any ~~sp~~ shape of body.

Theory:-

* The moment of inertia of a rigid body is about any axis is equal to the ~~sum~~ Sum of the moment of Inertia of the axis is passing through the Centre of gravity and product of the mass of the body and the Square of the distance between two parallel axes.

$$\boxed{\bar{I} = \bar{I}_{G_1} + Mr^2}$$

* Let ~~xy~~ xy be the axis passing through the gravity. 'x' be the distance of the particle from ~~gravity~~ centre of gravity.
* Let 'r' be the distance ~~of the particle~~ between the two parallel axes.
* The moment of inertia of the particle from the axis AB

$$AB = m(r+x)$$

* The moment of inertia of the whole body about the axis AB

$$I = \Sigma m(r+x)^2 \quad \text{---} (1)$$

$$I = \Sigma m(r^2+x^2+2rx)$$

$$I = \Sigma mr^2 + \Sigma mx^2 + 2\Sigma rx \quad \text{---} (2)$$

We know, $\boxed{\Sigma m = M}$ —③

*The moment of Inertia of the particle about the axis xy

$$\bar{I}_{G_1} = m x$$

*The moment of Inertia of the whole body about an axis xy

$$\boxed{\bar{I}_G = \Sigma m x^2} \quad \text{——} \quad ④$$

Sub ④ and ③ in eqn ②

$$\bar{I} = Mr^2 + \bar{I}_G + 2\Sigma r x.$$

Force acting on a particle.

$$\boxed{F = mg.}$$

* The moment of force acting on the particle 'p' about xGx

$$= Mgx$$

* The moment of force acting on the whole body about xGx

$$= \Sigma Mgx.$$

∴ The Sum of the moment of any force is acting on the centre of gravity is zero.

$$\bar{I} = M^2 + \bar{I}_{G_1} = 0.$$

$$\therefore \boxed{\underline{I} = \underline{I}_G + Mr'^2}$$

Hence the parallel axis theorem also proved.

---

9 (b) Electromagnetic waves in terms of Electric and Magnetic

~~Plane electromagnetic waves in vacuum:-~~

* Maxwell's Equations:-

(i) $\nabla \cdot \vec{E} = 0$ ——— (1)

(ii) $\nabla \cdot \vec{B} = 0$ ——— (2)

(iii) $\nabla \times \vec{B} = \varepsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}$ ——— (3)

(iv) $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ ——— (4)

(i) Electromagnetic waves in terms of Electric field:

(4) $\Rightarrow \nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

taking curl on both sides

$\nabla \times \nabla \times \vec{E} = \nabla \times -\frac{\partial}{\partial t}(\nabla \times \vec{B})$ ——— (5)

~~$\nabla \times \nabla \times \vec{E} = -\frac{\partial^2 \vec{E}}{\partial t^2}$~~

By the properties:

$(\nabla \cdot \vec{E}) - \nabla^2 = -\frac{\partial}{\partial t} \varepsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}$

$(\nabla \cdot \vec{E}) - \nabla^2 = -\varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}}{\partial t^2}$ ——— (6)

~~Sub eqn ① in ⑥~~

$$\nabla \times \nabla \times \vec{E} = -\mu_0 \epsilon_0 \frac{\partial^2 \vec{E}}{\partial t^2} \quad \text{——⑥}$$

Compare ⑤ & ⑥

$$-\frac{\partial}{\partial t}(\nabla \times \vec{B}) = -\mu_0 \epsilon_0 \frac{\partial^2 \vec{E}}{\partial t^2}$$

By the property:

$$-\frac{\partial}{\partial t}(\nabla \times \vec{B}) = (\nabla \cdot \vec{E}) - \nabla^2 \vec{E}$$

$$-\frac{\partial}{\partial t}$$

Co.

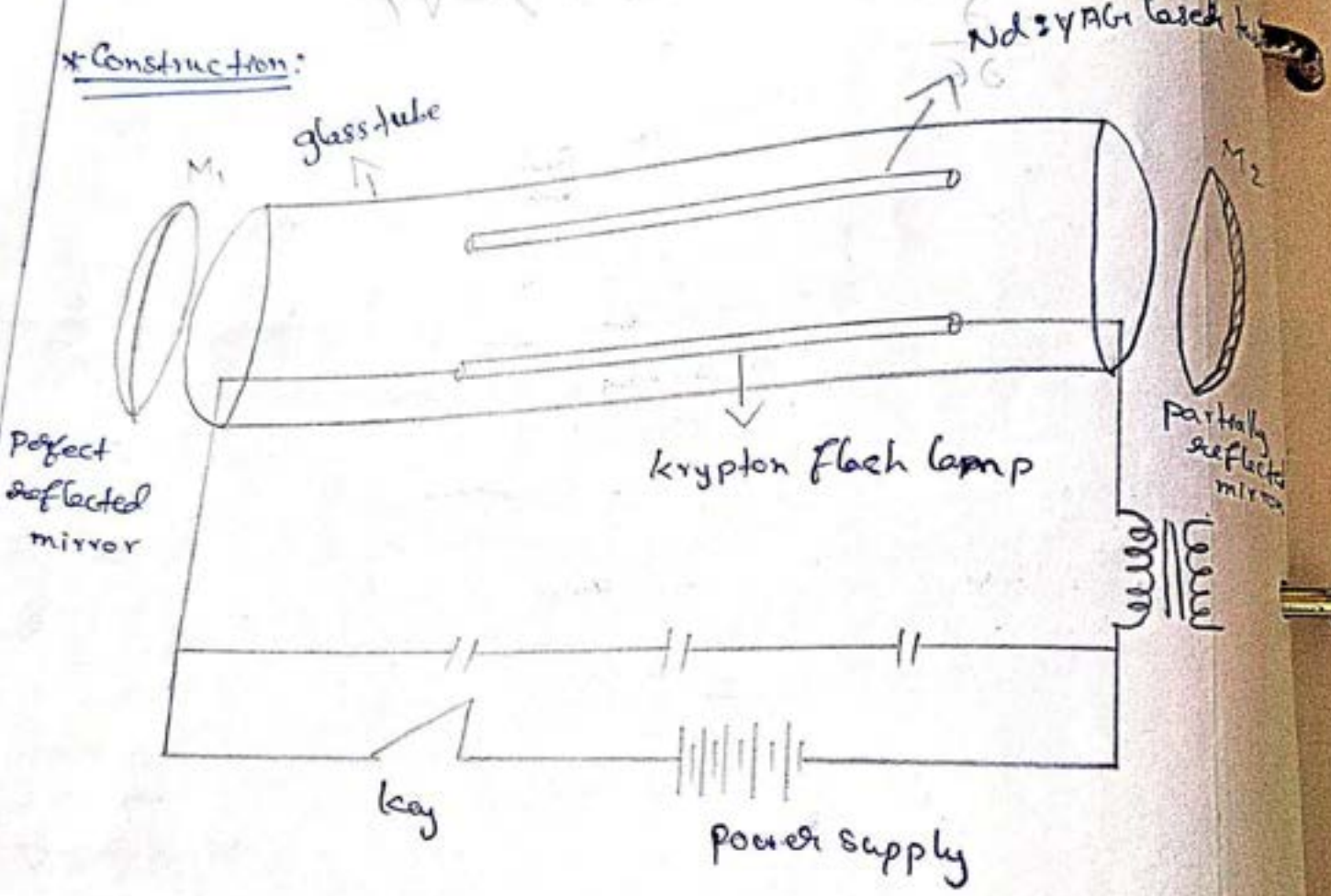
Nd:YAG Laser:

* Nd: YAG laser is four layer laser.

Principle:

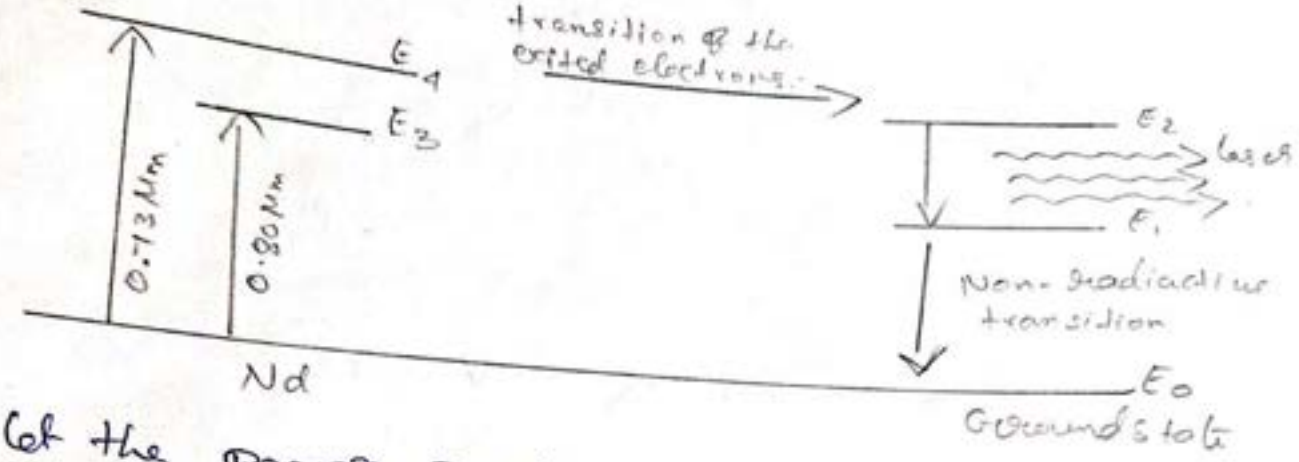
* It is based on the excited Nd^{3+} electrons exciting to the Higher energy state.

*Construction:



* Let the Quartze dishange tube is Setup for the Nd: YAG laser.
* Let M_1 and M_2 are the reflecting mirrors placed at the two ends of the tube
* The power supply is place at the bottom to supply the power to excite the electrons. inside the

* Working:



* Get the power supply is applied ~~to the glass to~~ accross to the glass tube.
* The Nd electrons are excited to move to the higher energy states E_4 and E_3.
* Then it moves to the second higher energy state E_2.
* ~~Then it moves down to~~
* Then the laser is produced between the electrons move ~~from~~ the E_2 to the E_1.

* Characteristics:

Active medium	-	Nd^3 electrons.
Active centre	-	Nd.
Pumping method	-	Mechanical pumping and Electrical pumpi
Out put nature	-	Pulsed (or) Continuous.
optical resonant	-	The reflecting mirrors are placed o the end of the quartz tube.
output power	-	10kw.

V. Sivanathan

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Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District - 629 202

Name of the Exam: INT. EXAM- I ✓ | INT. EXAM- II

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Register Number: 2 3 R U M E 0 4 7

College Code	9635		
College Name	Stella Mary's college of Engineering		
Degree/ Branch	B.E. Mechanical	Semester	
Subject Code	PH3151	Date & Session	7.11.23
Subject Title	Engineering physics	No. of Pages used	
Question Paper Code	17140	All particulars given are verified	Signature of the Hall Superintendent with date
Internal Assessment Examination Co-ordinator Signature / Fascimile		Name of the Hall Superintendent	G. Uthanya

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Subject Code / Title : PH3151 Engineering physics

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				b									
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				b									
3	✓	1	8	a		—					—		
				b									
4		—	9	a		—					—		03
				b									
5		—	10	a	✓	01					01		GRAND TOTAL (IN NUMBERS)
				b									
TOTAL	01										02		

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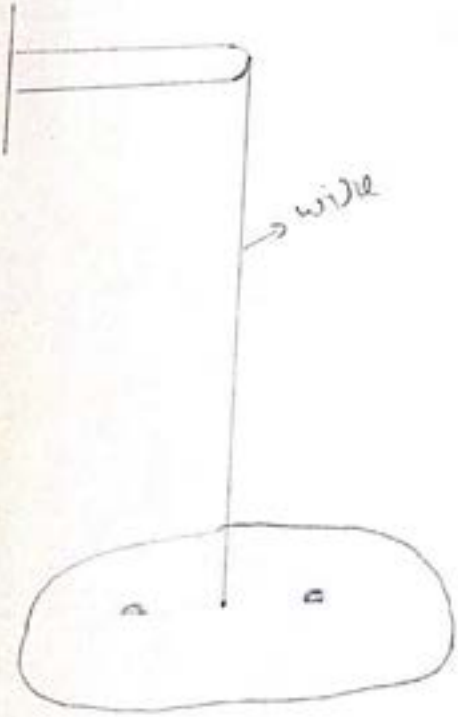
Name of the Examiner | Signature of the Examiner

Internal exam 1 - Retest

Part - A.

3) * speed
+ orientation
+ Amplitude.
* phase.

6) Torsion pendulum.



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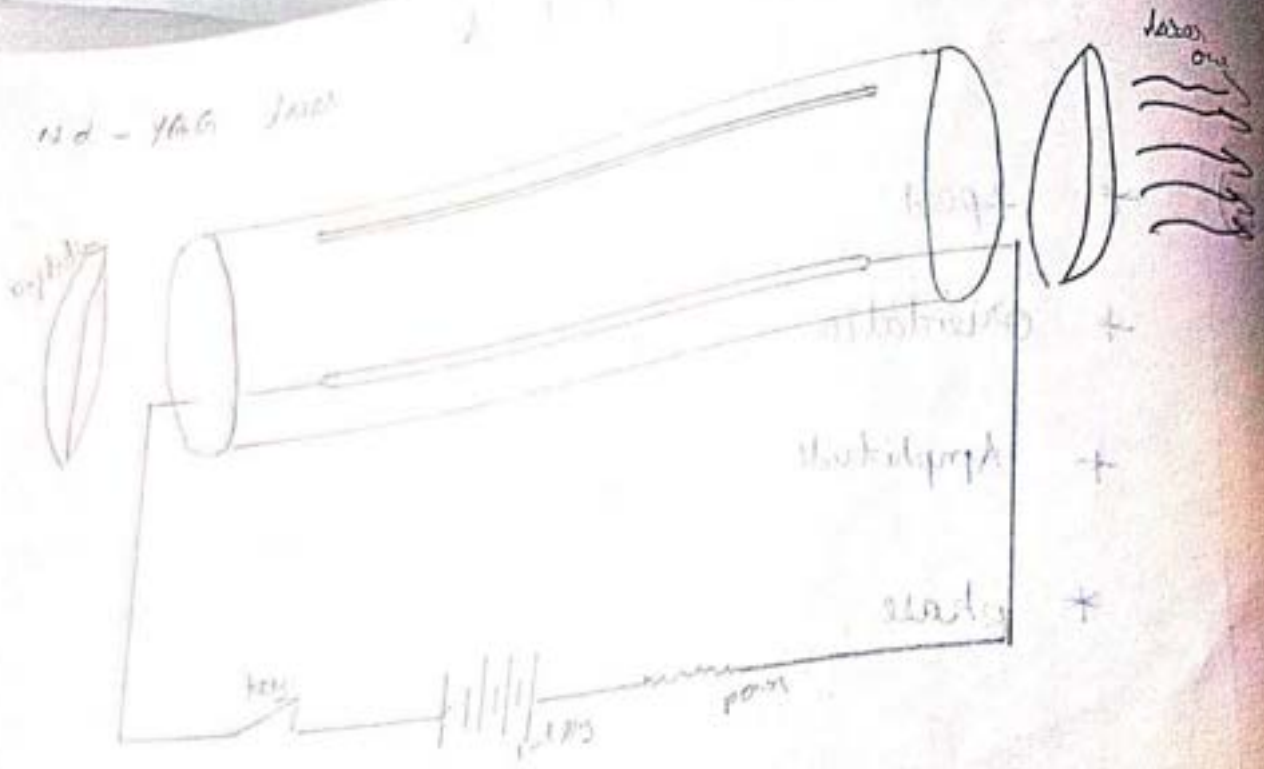

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Register Number: 963523RUME041

College Code	9635		
College Name	Stella Mary's College of Engineering		
Degree/ Branch	B.E Mechanical	Semester	I
Subject Code	PH3151	Date & Session	11/12/23 - FN
Subject Title	Engineering physics	No. of Pages used	12
Question Paper Code	17287	All particulars given are verified	Signature of the Hall Superintendent with date
Internal Assessment Examination Co-ordinator Signature / Facsimile		Name of the Hall Superintendent: M. JASMINE MARY	

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Subject Code / Title : PH3151 Engineering physics

Question paper Code : 17287 No. of Pages used : 12

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				b										
2		2	7	a										
				b		06	✓				06			
3		0	8	a		03					03			
				b										
4		2	9	a										36
				b		08					08			
5		2	10	a		05					05			GRAND TOTAL (IN NUMBERS)
				b										
TOTAL		08									28			

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12/12/23 Date	Dr. L. MARY NIVEDHA Name of the Examiner	Signature of the Examiner

Part-A

1.

Parameter	Standing Wave	Travelling waves
Frequency	The part of the wave is in the same frequency	The part of the wave is in the same frequency
Energy	Energy translation	Energy translation in the direction of wave
Waveform	Does not move forward	Moves forward

2. Significance of wave function

* It is, Complex function Variation in matter wave
* The wave function of density of wave statistically.
* ψ the probability of the wave is gives the which place at the i of time.

3) kinetic energy 400V

$$\lambda = \frac{h}{\sqrt{2mk}} = \frac{6.06 \times 10^{-34}}{\sqrt{2 \times 1.9 \times 10^{-31} \times 1.6 \times 10^{19}}}$$

$$= 0.06 \text{ nm}$$

4. Bloch theorem

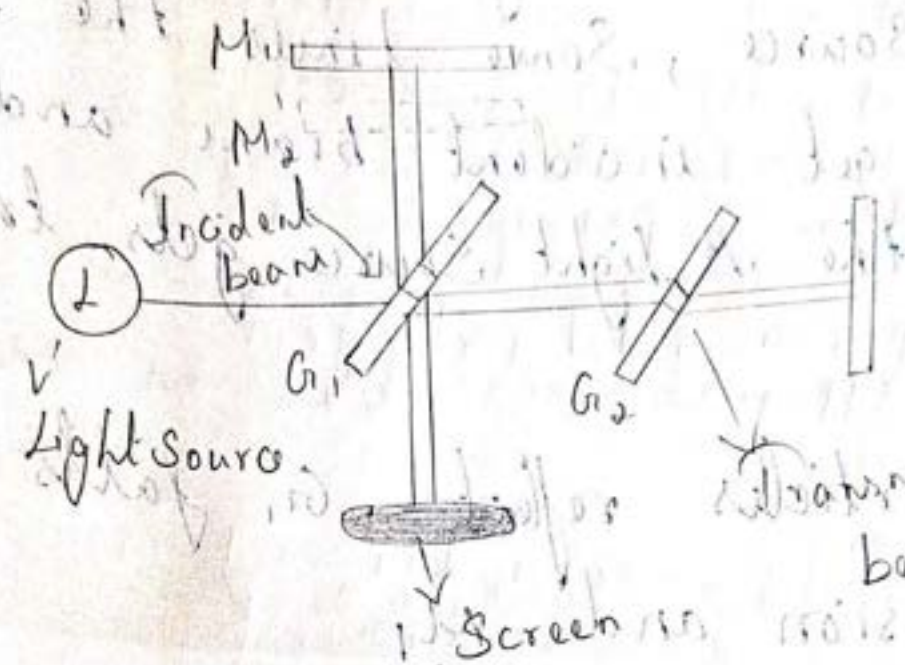
The equation of which given eige function for an electron moving in Perfectly periodic potential is kno as Bloch theorem

5. Applications of resonant diode

* High Speed electronic device
* Optical Communication
* Terhertz

Part - B

6)
a) Michelson Interferometer



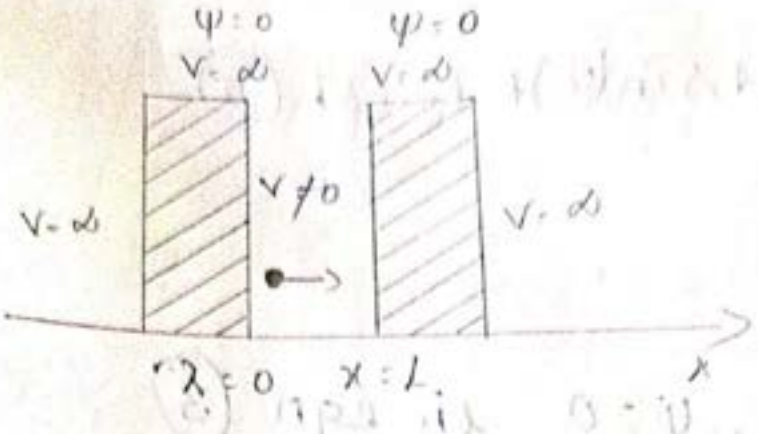
Construction:

* M_1 is a Movable Mirror.
* M_2 is a Fixed Mirror
* Two glass plates are G_1 and G_2.
* L is the light source of the Particles
* The rear glass plate of G_1 is semi. G_2 be the transmitted

Working:

* Monochromatic light is form of Light Source, Some times the Light Source get incident beam and some time the Light Source gets tran on it.
* The particles reflect, G, falls o transmission and M_1
* M_1 and M_2 reflects the sour Particles a_1
* It get, dark and bright. Ligh Sources.

Internal exam I - Retest



Let us Consider the particle of electron mass m and One dimensional Crystal length L.

$$\left.\begin{array}{l} V = \infty \text{ at } x = 0 \\ V = \infty \text{ at } x = L \\ \text{and } V \neq 0 \text{ at } x < L \end{array}\right\} \rightarrow (1)$$

Then

$$\left.\begin{array}{l} \psi = 0 \text{ at } x \leq 0 \\ \psi = 0 \text{ at } x \geq L \end{array}\right\} \rightarrow (2)$$

Schrodinger equation

$$\nabla^2\psi + \frac{8\pi^2 m}{h^2} E\psi = 0$$

$$k^2 = \frac{8\pi^2 mE}{h^2}$$

Boundary Condition

$$\psi = A \sin kx + B \cos kx \rightarrow (3)$$

Put $x=0$ in eqn (3)
$\psi=0$

$0 = A\sin k(0) + B\cos k(0)$

$A \neq 0$

$B = 0$

Put $x = L$, $\psi = 0$ in eqn (3)

$0 = A\sin kL + B\cos kL$

$0 = A\sin kL$

$\sin kL = 0$

(1) $kL = n\pi$

$k = n\pi/L$ $\therefore n$ is integer.

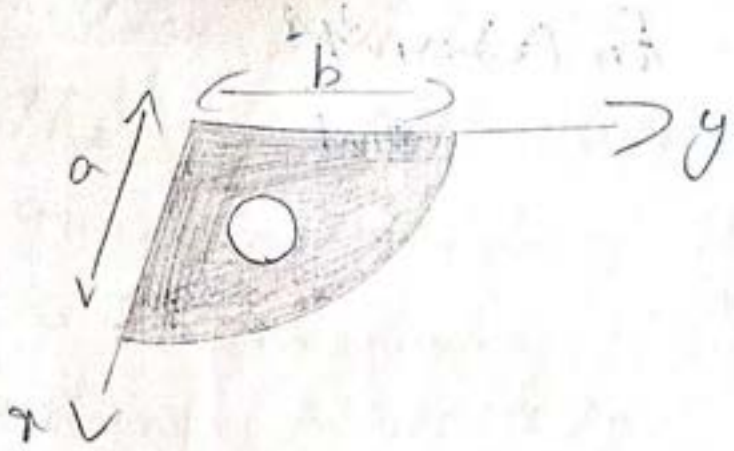
(2) $k^2 = \dfrac{8\pi^2 mE}{h^2}$

$E_n = \dfrac{k^2h^2}{8\pi^2 m}$

$= \dfrac{n^2\pi^2h^2}{8\pi^2mL^2}$

$E_n = \dfrac{n^2h^2}{8mL^2}$

8)



$$\frac{\hbar}{2m}\frac{d^2\psi(x)}{dx}V(x)\psi(x) = E\psi(x)$$

$$\frac{\hbar}{2m}\left(\frac{\partial^2\psi(x)}{\partial x}\frac{\partial^2\psi(y)}{\partial y}\right)V(x,y)\psi(x,y) = E\psi(x,y)$$

$$V(x,y) = 0$$

$$\psi(x,y) = \alpha$$

$$\frac{\hbar}{2m}\left(\frac{\partial^2\psi_x(x)}{\partial x}\frac{\partial^2\psi(y)}{\partial y}\right) = E\psi(x,y)$$

$$\frac{\hbar}{2m}\frac{d^2\psi_x(x)}{dx} = E\psi(x,y)$$

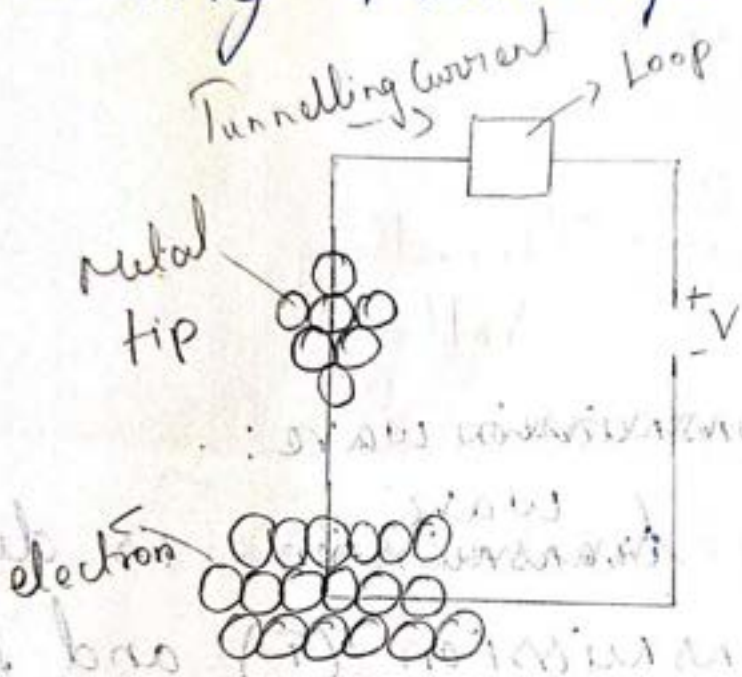
$$\psi_x(x) = \frac{n^2 x \pi^2}{a^2}$$

$$\psi_y(y) = \frac{n^2 y \pi^2}{b^2}$$

Internal exam 1 - Q.No.1

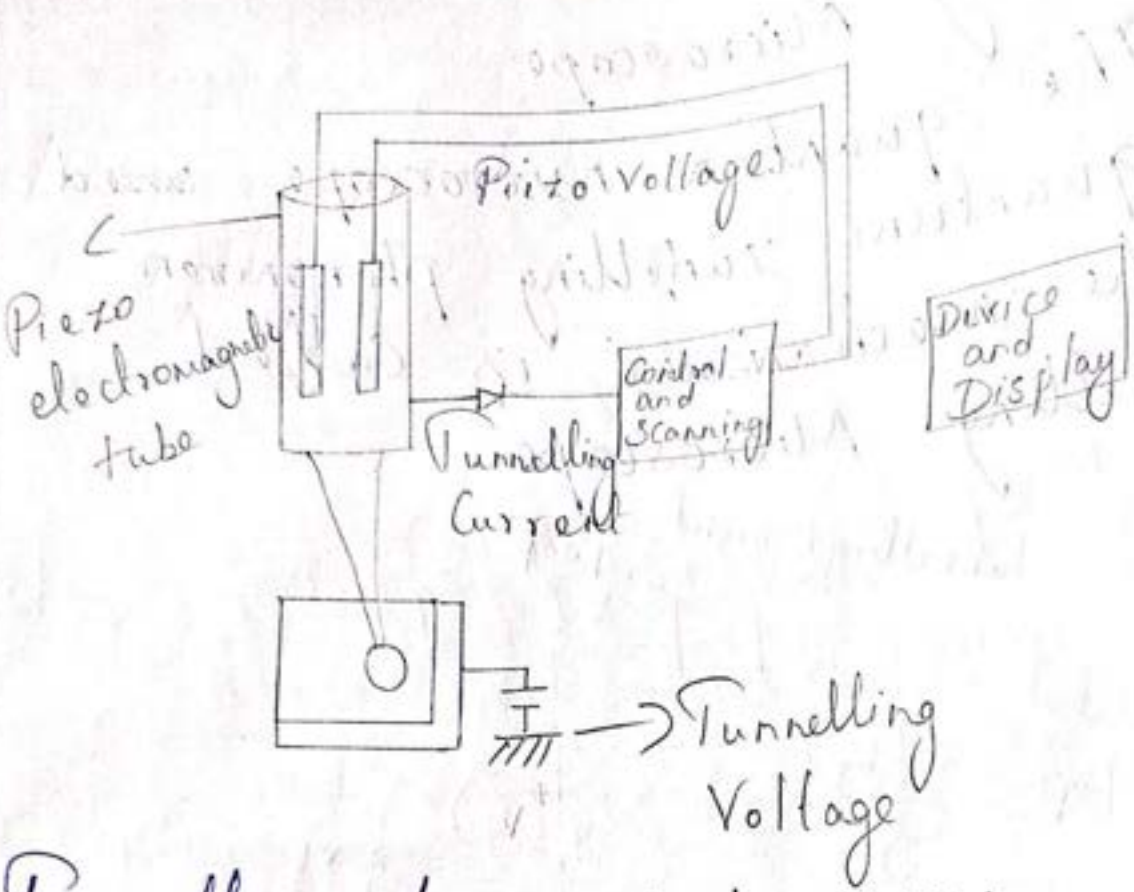
9) Tunnelling Microscope

The quantum microscope used in quantum Tunelling phenomenon of the mechanism is called Tunnelling Microscope.



Construction:

1. Piezoelectromagnetic
2. Control and Scanning
3. Device and Display
4. Transmitted Tunnelling Current Amplitude



Tunnelling transmission wave:

Tunnelling wave transmission is due to Consists transmission (T) and Resista (R)

$$\psi(\text{tunnelling wave}) = Te^{-i\beta} + Re^{i\beta}$$

β is the wave number

T is the transmitted

R is the resistance

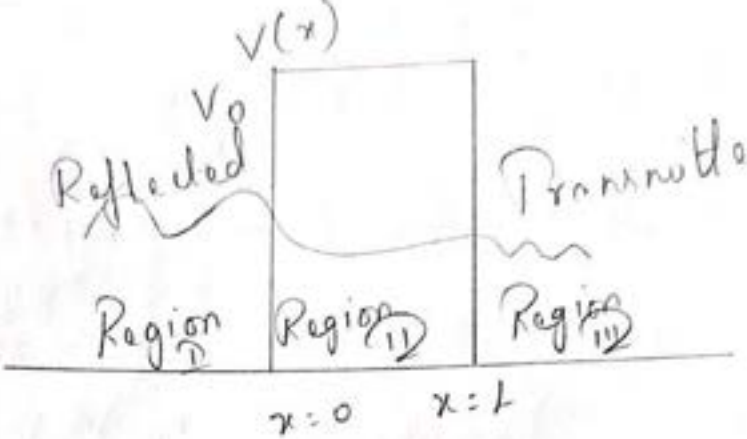
$$\boxed{T + R = 1}$$

$T = 2e^{-i\beta}$

β is the wave number decreases with the increase

10)

a) Barrier penetration and quantum tunnelling



Principle :

The quantum is depends upon the between

$0 < x < a$

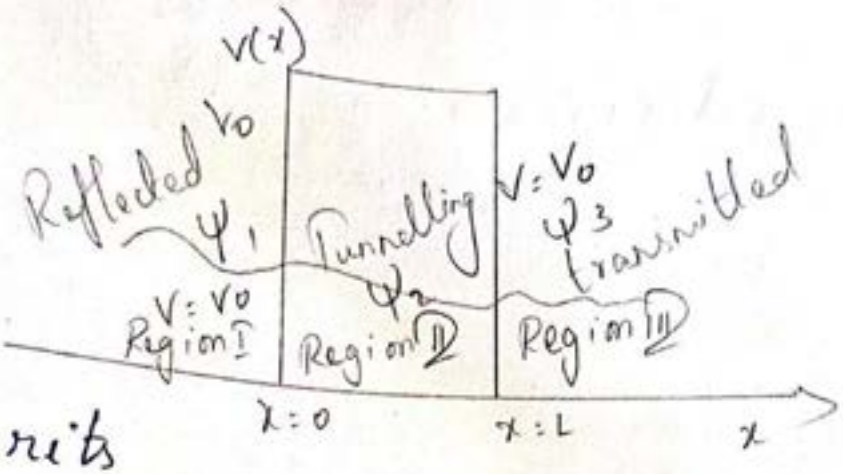
$0 < y < b$

$x = 0 \quad , x = L$

The potential enclosed the quantum which gives V_0 is greater than E which Light L.

$x = 0 \; , V_0 < E$

$x = L, V_0 > E$



Merits

* The three dimensional wave
* Operate temperature

Demerits

* As well as Expensive
* Require Any stable and clean Surface and Control surface

Application

* To study the transportation molecules about to ~~create~~ Semi Conductor of micromechanisms.

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Name of the Exam: INT. EXAM- I / INT. EXAM- II ✓

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College Code	9635
College Name	S.tella mary's college of engineering
Degree/ Branch	B.E mechanical
Subject Code	PH3151
Subject Title	Engineering Physics
Semester	01
Date & Session	11/12/23 FN
No. of Pages used-	
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Internal Assessment Examination Co-ordinator Signature / Facsimile	Name of the Hall Superintendent [Dr. M. Benjamin]

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PART - A			PART - B & C									GRAND TOTAL (IN WORDS)
Question No.	✓	Marks	Question No.		i ✓	i Marks	ii ✓	ii Marks	iii ✓	iii Marks	Total Marks	
1	-	01	6	a	✓	08					08	Four One
				b								
2	-	00	7	a	-	05					05	
				b								
3	-	00	8	a								
				b	✓	10					10	
4	-	02	9	a								41
				b	✓	10					10	
5	-	02	10	a								GRAND TOTAL (IN NUMBERS)
				b		01					01	
TOTAL	07										34	

Declaration by the Examiner : Verified that all the questions attended by the student are valued and the total is found to be correct

12/12/23 Date	Dr. L. MARY NORENA Name of the Examiner	Signature of the Examiner

I - Internal exam I - Retest

Part-A

(5)

(x) High speed electronic device

(x) optical communication

(x) Terahertz generation.

---

(4) Bloch theorem state that an charged particle one dimensional periodic potential performe the Bloch oscilation to form.

$$\psi(x) = U(x) \cos kx$$

---

(1) Standing wave

* Do not move forward.
* Twice distance between the adjacent of modes.

---

waves are not deflected by electrical or magnetic field

Travelling wave:

* move forward
* the distance between time adjesent

Perter.

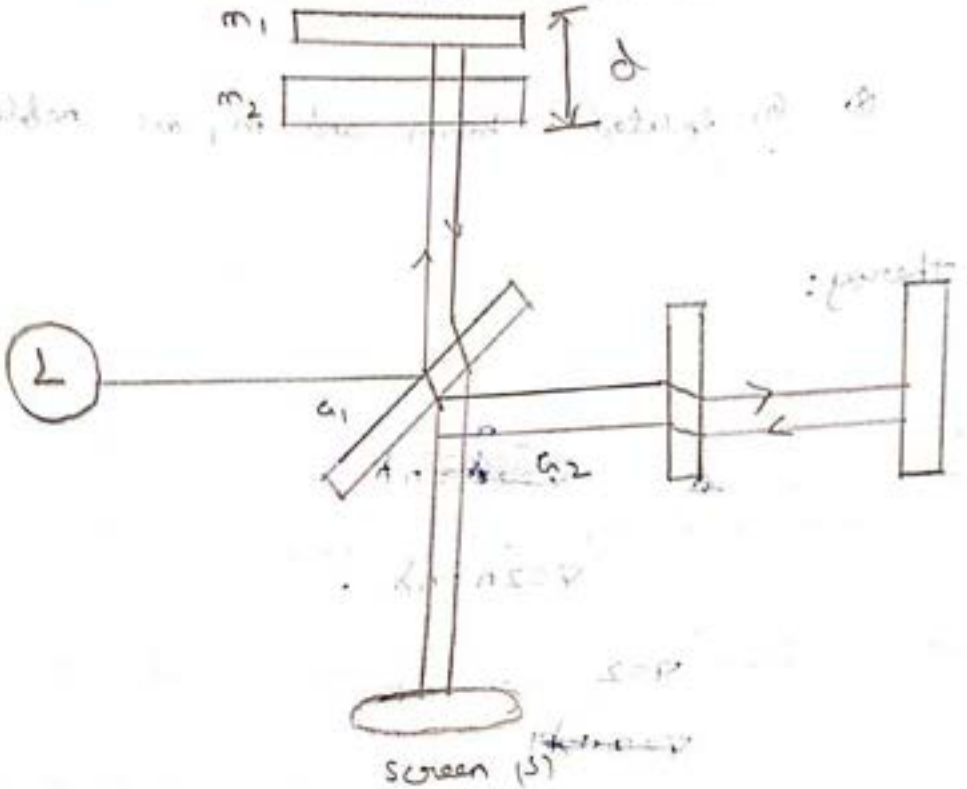
Part - B

(6) (a)

Michelson interferometer is ~~linear~~ device used for formation and study of interference fringes of a monochromatic light.

Principal:

(a) Producing a pattern of spliting a light beam into two part. By reflective fraction and ~~refractional~~ reforation fraction.



(*) It is consist of movable mirror m_1 and a fixed mirror m_2 are polished the glass plate.

(*) G_1 are semi silver are polished by the glass plate

(*) G_1 and G_2 are parallel to each other.

Working:

(*) Light source (L) fall on the beam a some part ~~reflected~~ get reflective and some part get transmited.

(*) G_1 and G_2 are parallel to each other.

(*) A movable mirror m_1 and a fixed mirror m_2 are polished the glass plate.

* m_1 and m_2 are back toward a beam splited G_2

* G_1 splited a beam and m_1 are reflected.

theory:

$\nabla = n\lambda$

$\nabla = 2n = n\lambda$

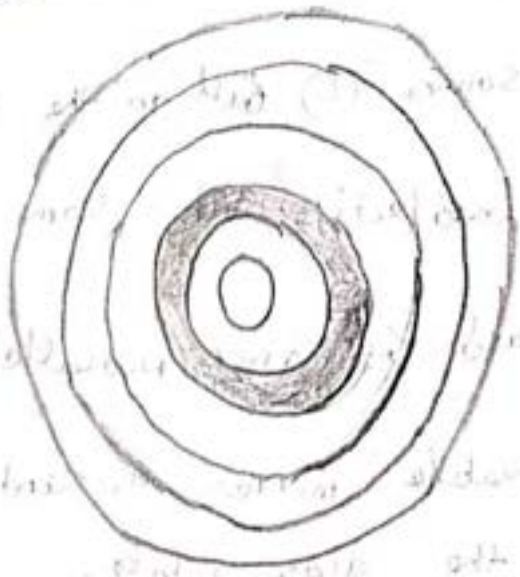
$\nabla = 2$

$\nabla = \frac{2n}{2\lambda}\lambda n$

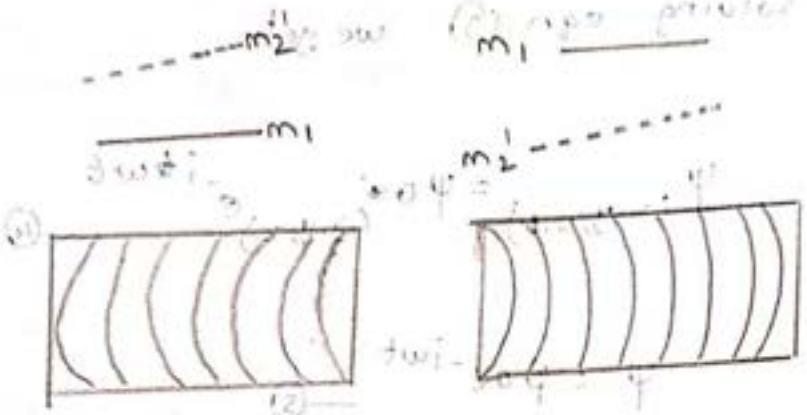
$\nabla = \frac{(2n+1)\lambda}{2\lambda}$

Types of fingers:

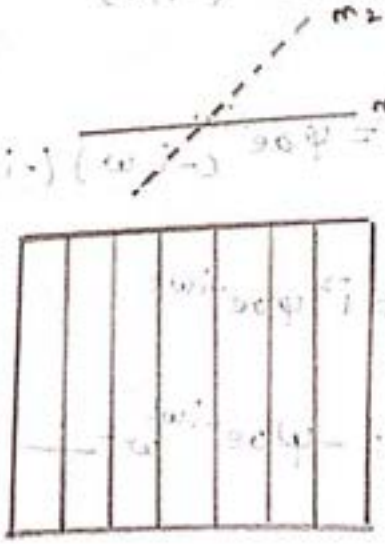
m_1 and m_2 Parallel to each other. circular fingers are observed. the circular fingers is known as inclined.



m_1 and m_2 are inclined the sharpe edge are observed.



m_1 and m_2 ~~times~~ Interferometer is result depent on distance between monoelectronic



---

(1) (a)

$$\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2} = \frac{1}{v}\frac{\partial^2\psi}{\partial t^2} \quad \text{——— (1)}$$

$$\frac{\partial^2\psi}{\partial t^2} = v^2\left[\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}\right] \quad \text{——— (2)}$$

$$\frac{\partial^2 \psi}{\partial t^2} = v^2 \nabla^2 \psi \quad \text{—③}$$

on solving eqn ③ we get

$$\psi_{(x,y,z,t)} = \psi_0 e^{(x,y,z)} e^{-i\omega t} \quad \text{—④}$$

$$\psi = \psi_0 e^{-i\omega t} \quad \text{—⑤}$$

diff eqn ⑤ twice respective time

$$\frac{\partial^2 \psi}{\partial t^2} = \psi_0 e^{-i\omega} (-i,\omega)$$

$$\frac{\partial^2 \psi}{\partial t^2} = \psi_0 e^{-i\omega} (-i,\omega)(-i,\omega)$$

$$= i^2 \psi_0 e^{-i\omega t}$$

$$\frac{\partial^2 \psi}{\partial t^2} = -\psi_0 e^{-i\omega t} \omega^2 \quad \text{—⑥}$$

$$\frac{\partial^2 \psi}{\partial t^2} = -\omega^2 \psi \quad \text{—⑦}$$

$$\frac{\partial^2 \psi}{\partial t^2} = \frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} = \left(\frac{-\omega^2}{v}\right) \psi$$

$$v^2\left[\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}\right]\psi=\frac{1}{v}\left(\frac{\partial^2\psi}{\partial t^2}\right)$$

$$\frac{\partial^2\psi}{\partial t^2}=\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}+\left(\frac{\omega^2}{v^2}\right)\psi=0 \quad -(8)$$

we known.

$$\omega=\frac{v}{\nu}$$

$$\nu=\frac{v}{\lambda}$$

$$\omega=2\pi\nu$$

$$\omega=2\pi\frac{v}{\lambda}$$

$$\frac{\omega}{v}=\frac{2\pi}{\lambda}$$

$$\frac{\omega^2}{v^2}=\frac{4\pi^2}{\lambda^2} \quad -(10)$$

sub een (10) & (9)

$$\nabla^2\psi+\frac{4\pi^2}{\lambda^2}\psi=0 \quad -(11)$$

$$\lambda=\frac{h}{p}$$

$$\lambda=\frac{h}{mv}$$

$$\nabla^2\psi+\frac{4\pi^2}{\left(\frac{h}{mv}\right)}\psi=0 \quad -(12)$$

$$E=K.E+P.E$$

$$E=\frac{1}{2}mv^2+V$$

affected by electric

$(E-V) = \frac{1}{2} mv^2$ $\quad 2(E-V) = mv^2$

multiple (m) on both side

$2m(E-V) = m^2v^2$

$\nabla^2\psi + \frac{2m(E-V)\,4\pi^2}{h^2}\psi = 0$

$\nabla^2\psi + \frac{8\pi^2 m(E-V)}{h^2}\psi = 0$

$\hbar = \frac{h}{2\pi}$

$h = \hbar 2\pi$

$h^2 = \hbar^2 4\pi^2$

$\nabla^2\psi + \frac{8\pi^2 m(E-V)}{\hbar^2}\psi + \nabla^2\psi + \frac{2m(E-V)4\pi^2}{\hbar^2}\psi = 0$

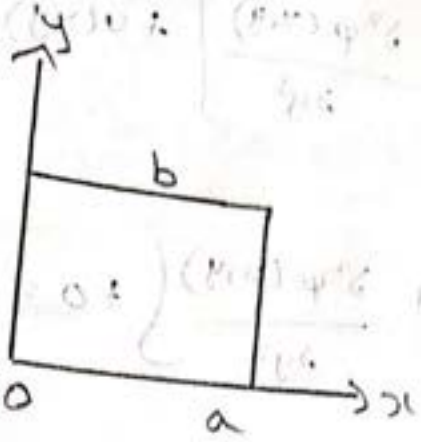
~~for V=0~~

for energy level $V=0$

for $V=0$

$\nabla^2\psi\left[\frac{2mE}{\hbar^2}\right]\psi = 0.$

(8) (b)



the rectangle of electron wave function as a free particle.

$$V(x,y)=0$$

the wall are impenetable of the box

$$\psi(x,y,t)=0$$

out side box is equation

$$\psi(x,y)=0 \quad \text{---} ①$$

$$-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{d(x)}+V(x)\psi(x)=E\psi(x) \quad \text{---} ②$$

$$\frac{-\hbar^2}{2m}\left[\frac{\partial^2\psi(x,y)}{\partial x^2}+\frac{\partial^2\psi(x,y)}{\partial y^2}\right]+U(x,y)\,\psi(x,y)=E\psi(x,y) \quad -①$$

$$\frac{-\hbar^2}{2m}\left[\frac{\partial^2\psi(x,y)}{\partial x^2}+\frac{\partial^2\psi(x,y)}{\partial y^2}\right]+0=E\psi(x,y) \quad -②$$

$$\frac{-\hbar^2}{2m}\left[\frac{\partial^2\psi(x,y)}{\partial x^2}+\frac{\partial^2\psi(x,y)}{\partial y^2}\right]=E\psi(x,y) \quad -④$$

$$\frac{-\hbar^2}{2m}\frac{\partial^2\psi(x,y)}{\partial x^2}=E_x\psi_x(x) \quad -⑤$$

$$\frac{-\hbar^2}{2m}\frac{\partial^2\psi(x,y)}{\partial y^2}=E_y\psi_y(y) \quad -⑥$$

ψ_{xy} eqn ⑥ & ⑤.

$$\psi_x(x)=\sqrt{2/a}\sin\left(\frac{n_x\pi_x}{a}\right)$$

$$\psi_y(y)=\sqrt{2/b}\sin\left(\frac{n_y\pi_y}{b}\right)$$

$$E_{nx}=\frac{n_x^2\hbar^2}{8ma^2}$$

$$E_{ny} = \frac{n_y^2 h^2}{8mb^2}$$

$$E_{nx} \cdot E_{ny} = \frac{h^2}{8m}\left[\frac{n_x}{a} + \frac{n_y}{b}\right]$$

~~[illegible]~~ $n_x, n_y = 1$

the serial of comparision of same energy eigen value but different eigen.

such a state is called degenerated state

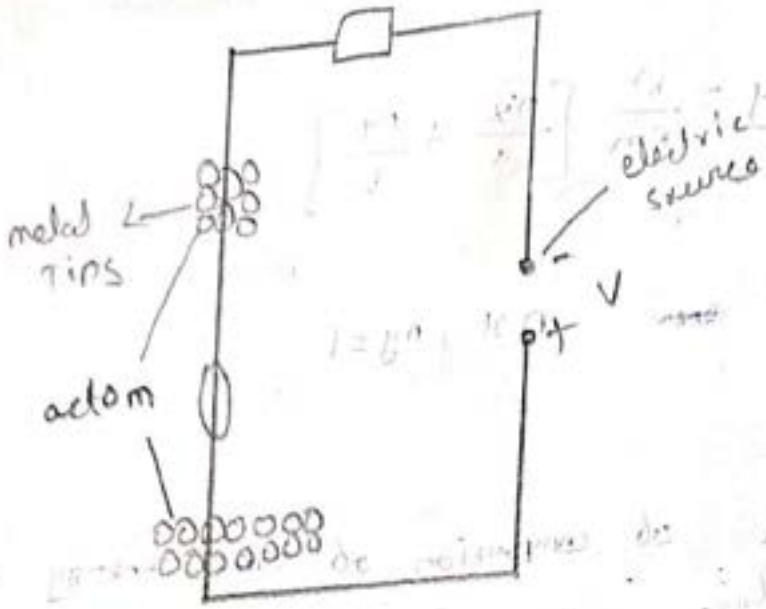
The corerponding of same energy eigen value state is called non-degenerated state.

(a) (b)

Tunneling microscope is used for microelectronic is also known as tunneling microscope.

are not deflected by electrical or magnetic field.

Read book

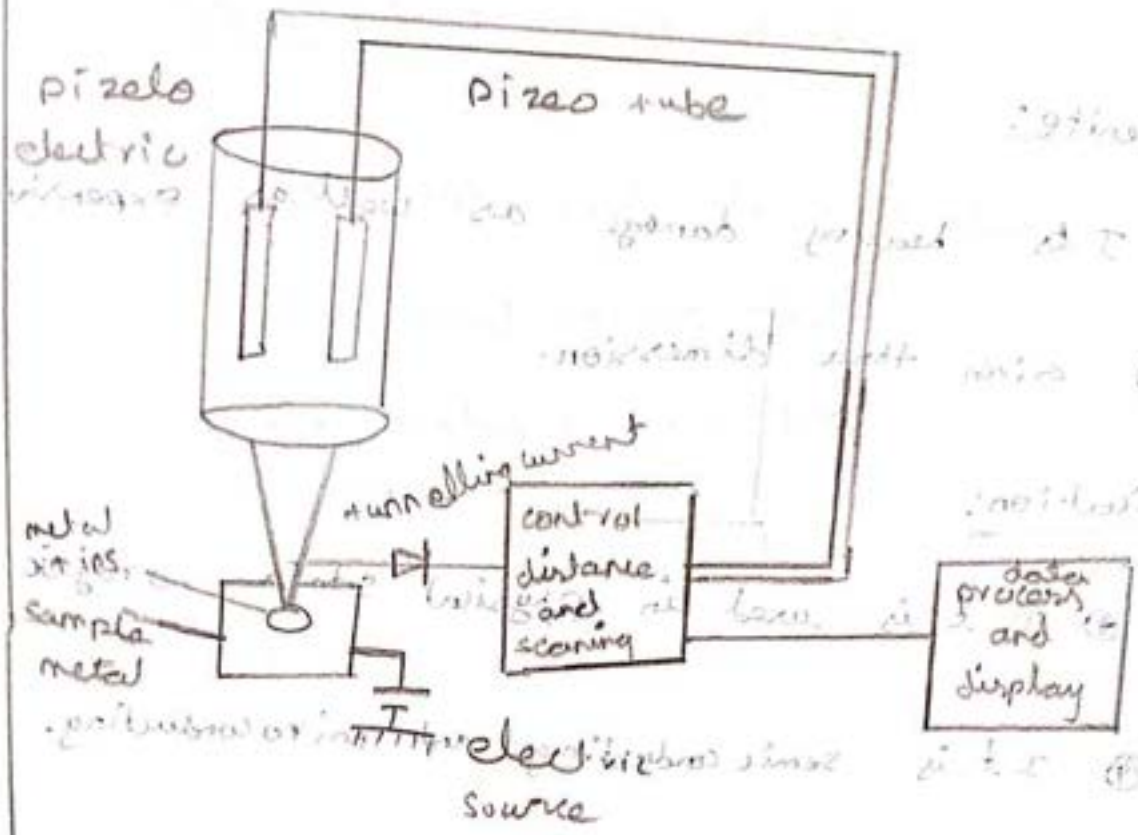


Principle:

If by applied a voltage becaus a consumede in a vacuum and air, water can be metal tips and surface. It is tunelling result depen on distance between wave function.

Construction:

(1) pizeoelectric
(2) data ~~data~~ procers and display
(3) controled distance and unit and scanning unit.



working:

To pass electric current in to sample metal and metal tips. Sharp edge distance to sample metal is few distance. To created pizeo electric and pass pizeo tube. control distance and scaning the tunelling current. to check the data process and display.

net merits:

(1) given three dimension

(*) It is used in physical state, orogric chemistry.

Demerits:

(*) It is heavy damage as well as expensive.

(*) Given three dimension.

Application:

(*) It is used in physical state, orogric chemistry

(*) It is semiconducting and miroconducting.

Part - A

(2) (*) The wave function related a particle are wave satisfied.

(*) The move a particle motions and its beacheion. and a wave function.

---

(3) $\lambda = \frac{h}{p}$

$\lambda = \frac{h}{mv^2}$

$\lambda = \frac{2ik\,h}{mv^2}$

(10) (b)

Types of resonant diode:

- High speed electronic device
- optical comunication
- Terahertz generation.

Internal Exam 1 - Retest

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthengaṇvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District - 629 202

V. Anish

Name of the Exam: INT. EXAM- I | INT. EXAM- II (Tick the appropriate box)

Read the instructions given overleaf carefully before filling in the title page. (To be filled by the candidate)

Register Number: 23RUME009

College Code	9635		
College Name	Stella mary's College of Engineering		
Degree/ Branch	B.E mechanical	Semester	1st
Subject Code	PH 3151	Date & Session	11/12/2023
Subject Title	Engineering Physics	No. of Pages used	9
Question Paper Code	17287	All particulars given are verified	Signature of the Hall Superintendent with date
Internal Assessment Examination Co-ordinator Signature / Fascimile		Name of the Hall Superintendent	[Dr. M. Benjamin]

DO NOT WRITE THE REGISTER NUMBER, COLLEGE CODE AND THE NAME IN ANY OTHER PART OF THE ANSWER BOOK

(To be filled in by the candidate)

Date : 11/12/2023 Session : F.N

Subject Code / Title : PH 3151 Engineering Physics

Question paper Code : 17287 No. of Pages used : 9

To be filled in by the candidate

Date : 11/12/2023 Session : F.N Question paper Code : 17287

Subject Code / Title : PH 3151 Engineering Physics

Instruction to the Candidate : Put a tick mark (✓) for the questions attended in the tick mark column against each question in V-I

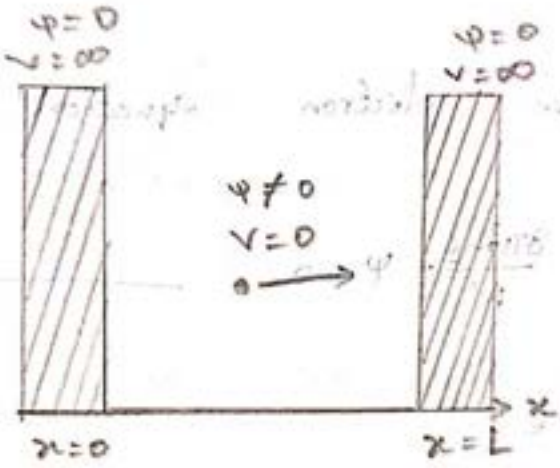
PART - A			PART - B & C										GRAND TOTAL (IN WORDS)
Question No.	✓	Marks	Question No.		i ✓	i Marks	ii ✓	ii Marks	iii ✓	iii Marks	Total Marks		
1		2	6	a	✓	08	✓				08		Three Two
				b									
2		—	7	a									
				b	✓	10					10		
3		—	8	a									
				b	✓	10					10		
4		—	9	a	✓	06					02		32
				b									
5	✓	02	10	a		✓							GRAND TOTAL (IN NUMBERS)
				b									
TOTAL		02									30		

Declaration by the Examiner : Verified that all the questions attended by the student are valued and the total is found to be correct

12/12/23	Dr. L. Mary Nonga	
Date	Name of the Examiner	Signature of the Examiner

Part - B

7) (6)



Consider the diagram there have a free electron the 'm' represent the mass of the electron in side the Potetial Potetial box

in side the box Potential energy is 0 'V' is 0

out side the box Potetial box is 'V' is infinite

$$\left.\begin{array}{l} V = 0 \quad \text{at} \quad x \geq 0 \\ V \neq 0 \quad \text{at} \quad x \leq L \\ V = \infty \quad \text{at} \quad 0 \geq x \geq L \end{array}\right\} \text{---} (1)$$

Then the 'ψ' boundrys are

$\psi = 0$ at $x = \infty$
$\psi = 0$ at $x = L$ } — (2)

Schrodinger free electron equation is

$$\nabla^2\psi + \frac{8\pi^2 mE}{h^2}\psi = 0 \quad \text{— (3)}$$

There we take

$$\frac{8\pi^2 mE}{h^2} = k^2 \quad \text{— (4)}$$

Sub eqn (4) in (3)

$$\nabla^2\psi + k^2\psi = 0 \quad \text{— (5)}$$

then the one dimension equation having one eqn

$$\psi = \sin x KA + \cos x KB$$
~~$\psi = \sin KA + \cos KB$~~ — (6)

where

$\psi = 0$ ~~at~~ $x = 0$

$$0 = \sin K + B$$
$$= \sin kB$$

$\therefore B = 0$ so we assume $x = B$ then we get

$$= \sin kL \quad \text{— (7)}$$

$$KL = \frac{n\pi}{L} \quad \text{—— (8)}$$

Sub eqn 8 in (7)

$$= \sin\left(\frac{n\pi}{L}\right)$$

Then we take eqn (4) & get E value

$$K^2 = \frac{8\pi^2 mE}{h^2}$$

$$E = \frac{h^2}{8\pi^2 mk^2} \quad \text{—— (9)}$$

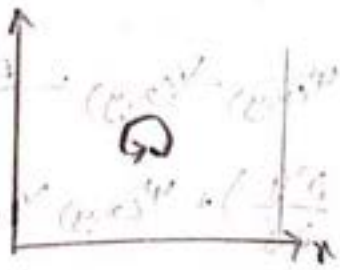
$$KL = n\pi \Rightarrow K = \frac{n\pi}{L} \quad \text{—— (10)}$$

Sub eqn (10) in (9)

$$E = \frac{h^2}{8\pi^2 mk^2} \qquad E = \frac{h^2 n^2 \pi^2}{8\pi^2 m L^2}$$

$$E = \frac{n^2 h^2}{L^2 8m}$$

8) (b) Particle in two dimensional Potential well



are not

Consider the two dimension the free moving electron are freely moven inside the Potential well

$$V_{(x,y)} = 0 \quad \text{---} (1)$$

Then the wave length of free moving elect. In potatial well

$$\psi_{(x,y,t)} = 0$$

In two dimension not we take t soon

$$\psi_{(x,y)} = 0 \quad \text{---} (2)$$

Schrodinger equation in one dimension

$$-\frac{\hbar^2}{2m}\frac{\partial^2 x}{\partial x^2} + \psi_x V_x = E\psi_{(x)} \quad \text{---} (3)$$

in two dimension

$$\frac{\hbar^2}{2m}\frac{\partial^2 x}{\partial x} + \psi_{(x,y)} V_{(x,y)} = E\psi_{(x,y)}$$

$$-\frac{\hbar^2}{2m}\left(\frac{\partial^2 x}{\partial x^2} + \frac{\partial^2 y}{\partial y^2}\right) + \psi_{(x,y)} V_{(xy)} = E\psi_{(xy)}$$

In this two dimension

$$\psi_{(x,y)} = 0 \quad , \quad V_{(x,y)} = 0$$

$$-\frac{\hbar^2}{2m}\left(\frac{\partial^2 x}{\partial x^2} + \frac{\partial^2 y}{\partial y^2}\right) + 0 = E\psi_{(x,y)} \quad \text{—— (5)}$$

to take eqn (5) seperably

respectly take x

$$-\frac{\hbar^2}{2m}\frac{\partial^2 x}{\partial x^2} = E\psi_{(x)} \quad \text{— (6)}$$

respectly take y

$$-\frac{\hbar^2}{2m}\frac{\partial^2 y}{\partial y^2} = E\psi_{(y)} \quad \text{— (7)}$$

~~xly this eqn (6) & (7) then the two dimension eqn having one eqn is~~

~~$= \sqrt{2/a}\ \text{Sin}$ $= \sin\sqrt{2/a}$~~

~~$= \sin\sqrt{2/b}$~~

Adding both eqn (6) & (7)

$$E\psi_{(x)}\, E\psi_{(y)} = \left[\frac{\hbar^2}{2m}\frac{\partial^2 x}{\partial x^2} + \frac{\hbar^2}{2m}\left\{\frac{\partial^2 y}{\partial y^2}\right]\right.$$

$$= \frac{\hbar^2}{2m}\left[\frac{\partial^2 x}{\partial x^2} + \frac{\partial^2 y}{\partial y^2}\right] \quad \text{— (8)}$$

Then the two dimension eqn having one eqn is

$= \sin \sqrt{2}/a$

$= \sin \sqrt{2}/b$

then we take $n\pi$ in eqn (8)

$$E_{n,x} = \frac{h^2}{2m}\left[\frac{n_x^2 \pi_x}{a} + \frac{n_y \pi_y}{b}\right]$$

$$E_{n,x} = n_x \pi_x + n_y \pi_z$$

So the Eiga values of two dimension is fraction and the Eiga function of this dimension ready

6) (a)

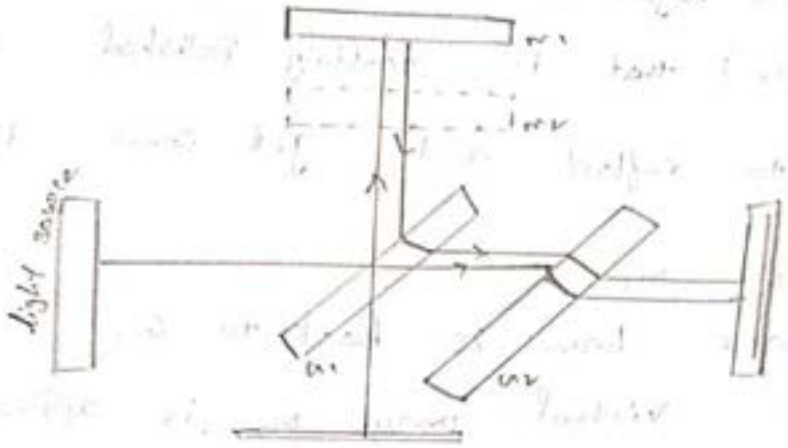
Interferometer is a fringes it is a study of monochromatic light

Principle:

Amplitude division: If Interferm the fringes on two light on two step by Partial reflaction and Partial refraction :

Mid-term exam I - Retest

Construction



* There Have moveable mirror $m_{2,1}$ and fixed mirror m_2 they are highly Polished

* There have G_1 (beam glass Plate) and G_2 (Compation glass Palate) they are Plased Parallel between each other The glass Plate angle is 45°

* Interferometer has monoGomic light source

* The G_1 and G_2 glass Plate Semi-Polished that reflact. Some beam and refract some beam

Working

* Monochromic light source 'L' is passed at G_1, (beam glass plate) that is partialy polished that get some light to reflact and get some light to transmited to M_1
* The same beam is back to G_1
* then the virtual image M_2 is appear
* then the ~~tran~~ M_1 is reflacted back to G_1, the fringes are ~~op~~ pressed

Theory:

The distance between M_1 and virtual image M_2

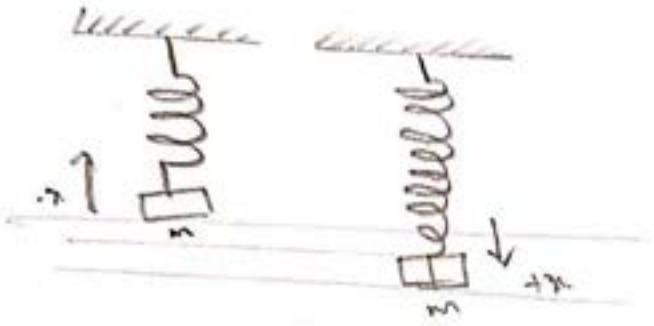
$$\Delta = 2\lambda$$

i) $v = 0$

ii) ~~$\frac{2P}{n}$~~

iii) ~~$v = \frac{2P}{n}$~~

9)



~~F ∝ x~~

There the harmonic oscillation of is Force is directly propotional to x

$$F \propto x$$

$$F = -kx$$

Part- A

5)
* high speed electronics
* ~~optical fibres~~ optical communication
* ~~Terahertz~~ generation

4) The ~~the~~ energy is not energalize worth this is known as Bloch theorem

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District - 629 202

46

Name of the Exam **MODEL EXAM** 65 R. Siva Keerthika

Read the instructions given overleaf carefully before filling in the title page. (To be filled by the candidate) **Register Number**

College Code	9 6 3 5	9 6 3 5 2 3 1 1 4 0 4 7

College Name	Stella Mary's College of Engineering		
Degree/ Branch	B.E / Mechanical	Semester	I
Subject Code	PH3151	Date & Session	02/01/24 - F.N
Subject Title	Engineering Physics	No. of Pages used	

Question Paper Code	All particulars given are verified	Signature of the Hall Superintendent with date
Internal Assessment Examination Co-ordinator Signature / Facsimile		Name of the Hall Superintendent

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(To be filled in by the candidate)

Date : 02/01/2023 Session : F.N

Subject Code / Title : PH3151 Engineering Physics

Question paper Code :

No. of Pages used :

To be filled in by the candidate

Date : 02/01/2023 Session : F.N Question paper Code :

Subject Code / Title : PH3151 Engineering Physics

Instruction to the Candidate : Put a tick mark (✓) for the questions attended in the tick mark column against each question in V-I

PART - A			PART - B & C										GRAND TOTAL (IN WORDS)
Question No.	✓	Marks	Question No.		i ✓	i Marks	ii ✓	ii Marks	iii ✓	iii Marks	Total Marks		
1		2	11	a		13					13		Sixty Five
2		2		b									
3		2	12	a		12					12		
4		2		b									
5		2	13	a		13					13		
6		2		b									
7		2	14	a		07					07		
8		2		b									
9		2	15	a									
10		2		b									
TOTAL		20	16	a									GRAND TOTAL (IN NUMBERS)
				b									
											45		65

Declaration by the Examiner : Verified that all the questions attended by the student are valued and the total is found to be correct

2/1/24 Date	Dr. L. Mary Shenba Name of the Examiner	Signature of the Examiner

Internal exam I - Retest

Part-A

1. Multi Particle dynamics

The study of Motion of the group of Particle with negligible distance between the Particle is called Multi-Particle dynamics

2. Application of Gyroscope:

1. The large Gyroscope are used as ship stabilizer and counteract rolling
2. An Atomatic steerings are usede in aroeplanes and Misillies.
3. In gyrocompass, the directional instument in the ships.

3. Poynting Vector.

The Vector with the amount of energy passes through the unit area per second in the Perpendicular direction of Propagation in Electromaghetic waves Per Second is called poynting Vector.

$$S = E \times H$$

waves are not deflected

4. Applications of Maxwell equations.

1. Provides the Mathametical model of electrical, optical, and radio technologies.

2. Applied in the study of Power generation, electric motors, wireless communication, radar, TV transmission etc.

5. Critical angle

When light travells from denser to rarer medium, the angle of ~~incidence~~ incident ray(θ_i) increases, the angle of refracted(θ_r)ray also increases until it becomes $\theta_r = 90°$

The angle of incidence, which the refracted ray becomes 90°

$\theta_i = \theta_c$, $\theta_r = 90°$

6. Characteristics of SHM

* The motion must be Periodic.

* The body must have inertia

* The acceleration of a body is directly Propotional to its displacement.

* The body must be elastic

7. Doppler Effect

The apparent change in frequency and wavelength of a sound wave due to the relative motion between the Same of the Sound and the observer

8. Commonly used for Pumping action?

* Optical Pumping
* Thermal Pumping
* chemical pumping
* Electric Discharge Pumping.

9. Transmission co-efficient.

The probability of a particle pass through the barrier is called Transmission Co-efficient.

Transmission coefficient = $\frac{\text{The Probability of the transmitted wave}}{\text{The Probability density of the density of}}$

$T_e = \frac{\text{The Probability of transmitted wave}}{\text{The Probability density of incident wave}}$

$T_e = e^{-2\beta L}$

10. Eigen values:

The energy Processed by Particle of Paticular energy level is called Eigen values

Eigen function:

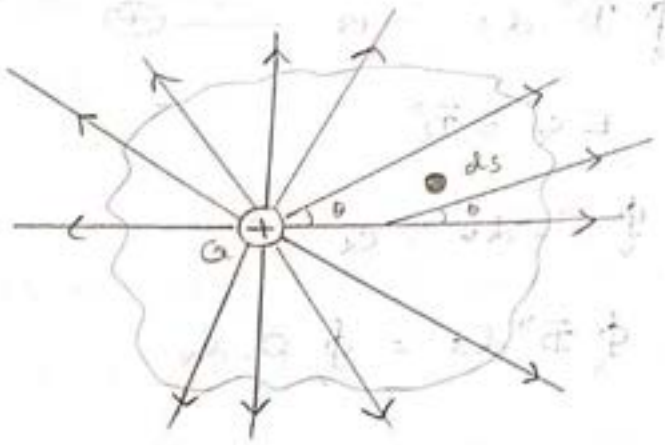
The wave function of the particle by Paticular energy level is called Eigen function.

Part - B.

18.a) Maxwell's equation:

Maxwell's First equation:

It is taken from gauss's law of Electrostatics



where

Q —> charge

P —> charge density

ds —> closed surface

Equation :

$$\nabla \cdot \bar{D} = P$$

Proof :

$$\oint_s \bar{E} \cdot ds = Q/\varepsilon_0 \quad \text{—— (1)}$$

$$\oint_s \bar{E} \varepsilon_0 \, ds = Q \quad \text{—— (2)}$$

$$\varepsilon = \varepsilon_0 \varepsilon_r$$

ε_r —> Relative Permitivity

$$\varepsilon_r = 1$$

$$\Rightarrow \varepsilon = \varepsilon_0$$

$$\oint_s \bar{E} \varepsilon \, ds = Q \quad \text{—— (3)}$$

$$\oint_S \bar{D}' \cdot ds = Q \quad \text{—— (4)}$$

$$E\,\varepsilon_0 = \bar{D}'$$

$$\oint_V \rho \cdot dv = Q$$

$$\oint_S \bar{D}' ds = \oint_V \rho \cdot dv$$

Gauss's divergence equation

$$\oint_V \bar{D}' dv \cdot \bar{\nabla}' = \oint_V \rho \cdot dv$$

$$\bar{\nabla}' \cdot \bar{D}' = \rho$$

Maxwells' Second Equation

It is taken from Gauss's law of Magnelo statics

Equation:

$$\bar{\nabla}' \cdot \bar{B}' = 0$$

Proof:

$$\phi = 0 \quad \text{—— (1)}$$

$$\oint_S \bar{B}' ds = \phi \quad \text{—— (2)}$$

$$\oint_S \bar{B}' ds = 0 \quad \text{—— (3)}$$

Surface integral to volume integral

$$\oint \vec{\nabla} \cdot \vec{B}\, dv \quad \text{—— (4)}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \quad \text{—— (5)}$$

Since, there is no Magnetic flux source and magnetic lines always closed upon themselves. It says no monopoles exists that is number of magnetic lines entering into a surface is equal to the number of magnetic lines leaving that the surface

Maxwell's Third Equation

It is taken from the Faraday's law of Magnetic Induction.

Equation:

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

Proff:

$$\varepsilon = \frac{-d\varphi}{dt}$$

ε —> electromotive force

φ —> Magnetic flux

$$\varphi = \oint_s \vec{B} \cdot ds$$

$$\varepsilon = \oint_s \vec{E} \cdot dl$$

$$\oint_s \vec{E} \cdot dl = -\frac{d}{dt}\left(\oint_s \vec{B} \cdot ds\right)$$

$$\oint_s dl = \oint_s -\frac{d.\vec{B}}{dt} ds$$

$$\oint_s \vec{\nabla} \times \vec{E} \, ds = \oint_s -\frac{d\vec{B}}{dt} ds$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

Maxwell's Fourth Equation:

It is taken from Ampere's Circuital law.

It states that the line integral of a magnetic field insert 'H' on any closed Path is equal to the current enclosed by the Path.

$$\oint_l \vec{H} \cdot dl = I \quad \text{—①}$$

Current density, $J = \frac{I}{s}$

$$J = \frac{dI}{ds}$$

$$J\,ds = dI$$

$$I = \int_s J \, ds \quad \text{——} (2)$$

$$(1) \Rightarrow \oint_l \vec{H} \cdot dl = \oint_s J \, ds$$

$J_c \rightarrow$ Conductivity Current density

$J_D \rightarrow$ Displacement Current density

$$\oint_l \vec{H} \, dl = \oint_s (J_c + J_D) \, ds \qquad J = \sigma E$$

$$\oint_l \vec{H} \cdot dl = \oint_s \left(\sigma E + \frac{\partial D}{\partial t} \right) ds$$

$$\oint \vec{H} \cdot dl = \oint_s \left(J + \frac{\partial D}{\partial t} \right) ds$$

$$\oint_s \vec{\nabla} \times \vec{H} \, ds = \oint_s \left(J + \frac{\partial D}{\partial t} \right) ds$$

$$\vec{\nabla} \times \vec{H} = J + \frac{\partial D}{\partial t}$$

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District - 629 202

Name of the Exam **MODEL EXAM** 45 S. Thangapaja

Read the instructions given overleaf carefully before filling in the title page. (To be filled by the candidate) **Register Number**

College Code	9335	963523114051
College Name	Stella Mary's College of Engineering	
Degree/ Branch	BE Mechanical Engineering	Semester: 1st
Subject Code	PH3151	Date & Session: 02/1/24 / FN
Subject Title	Engineering physics	No. of Pages used:

Question Paper Code		All particulars given are verified	Signature of the Hall Superintendent with date
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Date : 02/1/24 Session : FN

Subject Code / Title : PH3151 Engineering physics

Question paper Code :

No. of Pages used :

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Date : 02/1/24 Session : FN Question paper Code :

Subject Code / Title : PH3151 Engineering physics

Instruction to the Candidate : Put a tick mark (✓) for the questions attended in the tick mark column against each question in V-I

PART - A			PART - B & C										
Question No.	✓	Marks	Question No.		i ✓	i Marks	ii ✓	ii Marks	iii ✓	iii Marks	Total Marks	GRAND TOTAL (IN WORDS)
1		2	11	a		15					15	
2		2		b								
3		2	12	a								
4		2		b								
5		2	13	a		15					15	fifteen zero
6		2		b								
7		2	14	a								
8		2		b								
9		2	15	a								
10		2		b								
16	a											
	b											
TOTAL		20									30	80

GRAND TOTAL (IN NUMBERS)

Declaration by the Examiner : Verified that all the questions attended by the student are valued and the total is found to be correct

2/1/24 Date	Dr. L. Mary Gleeta Name of the Examiner	Signature of the Examiner

(...) This waves are not reflected by the

Part A :

1. The study of the motion of the group particles negligible between the particles is called multi particle dynamics.

2. The large Gyroscope are used as ship stabilizes and counteract rolling An Atomatic steerings are used in aeroplanes and Missilies.

3. The vector with the amount of energy passes through the unit area per second in the perpendicular direction of propogation is electromagnetic wave per second is called poynting Vector.

4. provides the mathematical model of electrical, radio and optical.
Applied is the study of power generation wireless communication. Electric motor.

(iii) This waves are not deflect

5. when light travels from denser to raser medium, the angle of incident ray increases, the angle of refract ray also increased until it becomes $\theta_0 = 90°$ The angle of incident which the refracted ray becomes 90°.

$\theta i = \theta c$, $\theta r = 90°$.

6. * The body must have inertia
* The body must be elastic
* The acceleration of the body is directly proportional to its displacement.

7. The apparent change in ~~proporti~~ frequency and wavelength of sound wave due to the relative motion between the source of the sound and observer is called Doppler effect.

8. * optical pumping
* thermal pumping
* chemical pumping
* electric discharge pumping

9. The probability that the particle through the barrier is called Transmission co-efficient.

$$T = e^{-2\beta L}$$

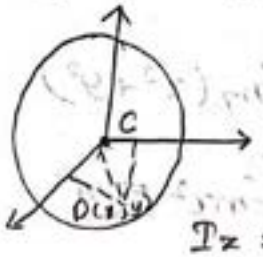
10. The energy possessed by a particle particular energy level defined as the Eigen Value

The wave function of a particle particular energy level defined as Eigen function.

(i) perpendicular axis

Statement:

The moment of inertia of a planar body about an axis perpendicular its plane and passing through the point of intersection of two mutually perpendiculars.



$$I_z = I_x + I_y$$

Let I_x, I_y, I_z be the moment of inertia of planar body along three mutually $\perp^{r}$ axes passing through Point O. The axis Oz is perpendicular to planar body.

(iii) This waves are not deflected

A particle at P at distance r from O has coordinates P(x,y) which gives

$$r^2 = x^2 + y^2 \rightarrow (1)$$

$$I_z = mr^2 \rightarrow (2)$$

$$I_z = \Sigma mr^2 \rightarrow (3)$$

$$I_x = \Sigma mx^2 \rightarrow (4)$$

Moment of inertia of the whole planar body Oy is

$$I_y = \Sigma my^2 \rightarrow (5)$$

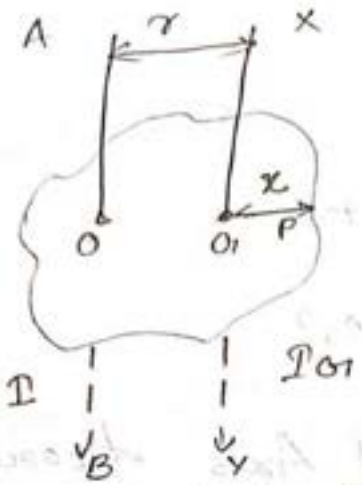
$$(3) \Rightarrow I_z = \Sigma m(x^2+y^2)$$

$$I_z = \Sigma mx^2 + \Sigma my^2$$

$$I_z = I_x + I_y$$

(ii) Parallel axis

The moment of inertia of a Rigid about any axis equal to sum of moment of inertia about parallel axis through in Center of gravity.



Consider a rigid body of mass m whose center of gravity is at g.

$$AB = m(x+x^2) \rightarrow (1)$$

$$I = \Sigma m(r+r)^2$$

$$I = \Sigma m(r^2+x^2+2rx)$$

$$I = \Sigma mr^2 + \Sigma mx^2 + 2\Sigma mr^2 \rightarrow (2)$$

we know,

$$\Sigma m = M \rightarrow (3)$$

$$I_g = mx^2$$

$$I_g = \Sigma mx^2 \rightarrow (4)$$

$$(2) \Rightarrow I = Mx^2 + I_g + 2\Sigma mr^2 \rightarrow (5)$$

Force acting on the Particle

$$F = mg.$$

$\phi_{um} = \Sigma mgx$

(b) $\Rightarrow I = Mr^2 + I_g + 0$

$\therefore I = I_g = Mr^2$

$\therefore$ Hence parallel Axis theorem is proved.

13,

(a) Electrical and Mechanical System are Set to be analogous to each other.

In spring mass system their exists their Mechanical oscillation.

In LCR are circuit there exist electrical oscillations.

Similarly there are two forms of energy in LCR circuit such as magnetic energy and electrical energy.

proof:

i) Mechanical oscillation in spring Mass System

Restoring force

$F_1 \propto -y$

$F_1 = -ky \rightarrow (1)$

damping force

$F_2 \propto -v$

$f_2 = -bv \rightarrow (2)$

where,

k is the force constant

y is the displacement

b is the damping constant

v is the velocity

By F is the force recovered to Acceleration the mass m to make mechanical oscillation

$F = ma \rightarrow (3)$

we know,

$ma = -ky - bv$

$ma + ky + bv = 0 \rightarrow (4)$

Velocity, $v = dy/dt$

Acceleration, $a = \frac{d^2y}{dt^2}$

(4) $\Rightarrow \frac{m d^2y}{dt^2} + b\frac{dy}{dt} + ky = 0 \longrightarrow (5)$

Eqn (5) represent second order differential equation for mechanical oscillation

(ii) Electromagnetic oscillation in LCR circuit.

Consider an LCR circuit and the current flows in anticlockwise direction

Let 'q' represents charge stored.

According to loop's law

$q/C + IR + L\, dI/dt = 0 \longrightarrow (6)$

Current $I = dq/dt \longrightarrow (7)$

$\frac{dI}{dt} = \frac{d}{dt}\frac{dq}{dt} \longrightarrow (8)$

put (7) & (8) in (6)

$$q/c + dq/dt\ R + \frac{L d^2q}{dt^2} = 0$$

$$\frac{L d^2q}{dt^2} + R\frac{dq}{dt} + q\,1/c = 0 \rightarrow (9)$$

Equation (9) represents 2nd differential

21-11-23

Engineering physics

M. Maluthappa.
No: 29.
Mechanical

39/45

I 1. Define Centre of Mass?

Ans:

*The Centre of mass of the body or System of a particle is defined as the point at which the whole mass of the body are appear to be concentrated

*for a simple rigid body, the Centre of mass is located at the centroid.

2. what is called non-linear oscillation? Give example?

Ans:

~~*Oscillation is everywhere~~

*oscillation existing everywhere. Most of them are inherently, non-linear. Strictly Speaking all the physical system are non-linear.

eg: simple harmonic oscillation. $f_1 = \frac{1}{P}$

3. Properties of electromagnetic waves?

Ans:

(i) Electromagnetic waves are transverse in nature.
(ii) The waves are propagates in vaccum with speed of light.
(iii) This waves are not deflected by electrical or magnetic field.

(iv) Electromagnetic waves does not have any medium for propagate.

---

1. What is radiation pressure?

Ans:

* The force per unit area exerted electromagnetic waves when they are encounter the surface area of an object called as radiation pressure.

---

5. What are the methods commonly used for pumping action?

Ans:

* The phenomenon of archieving the population inversion in the active medium is known as pumping.

eg: * The various pumping methods are,

(i) Electrical pumping.

(ii) Chemical pumping

(iii) optical pumping.

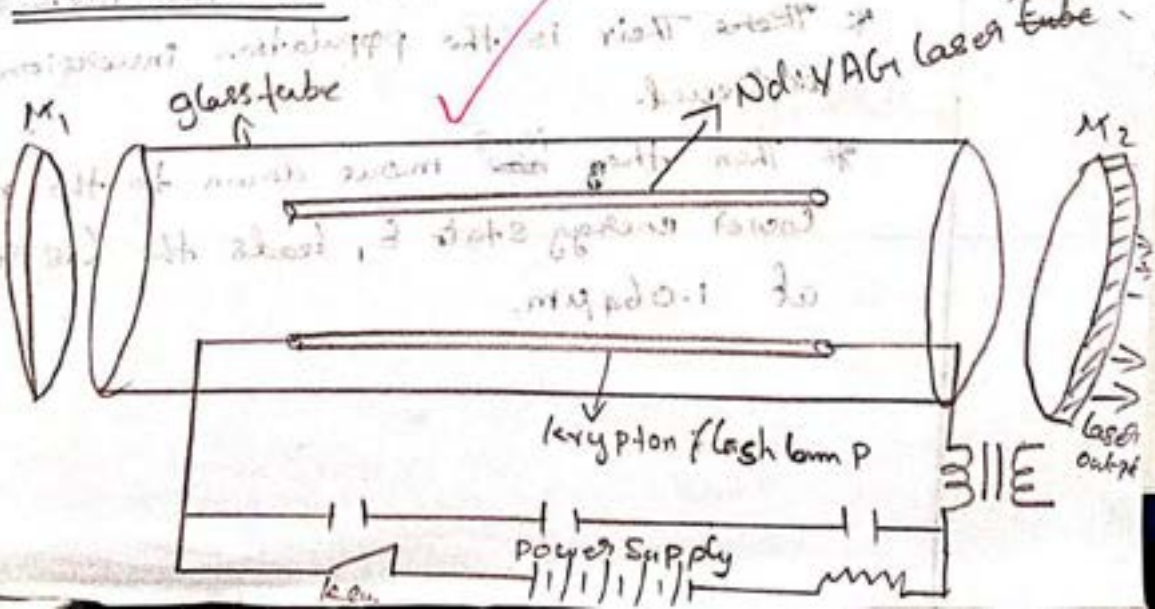
1. Nd: YAG Laser.

* It is the four level laser.
* In this laser Nd: stands for "Neodymium and YAG stands for yttrium Aluminium Garnet

Principle:

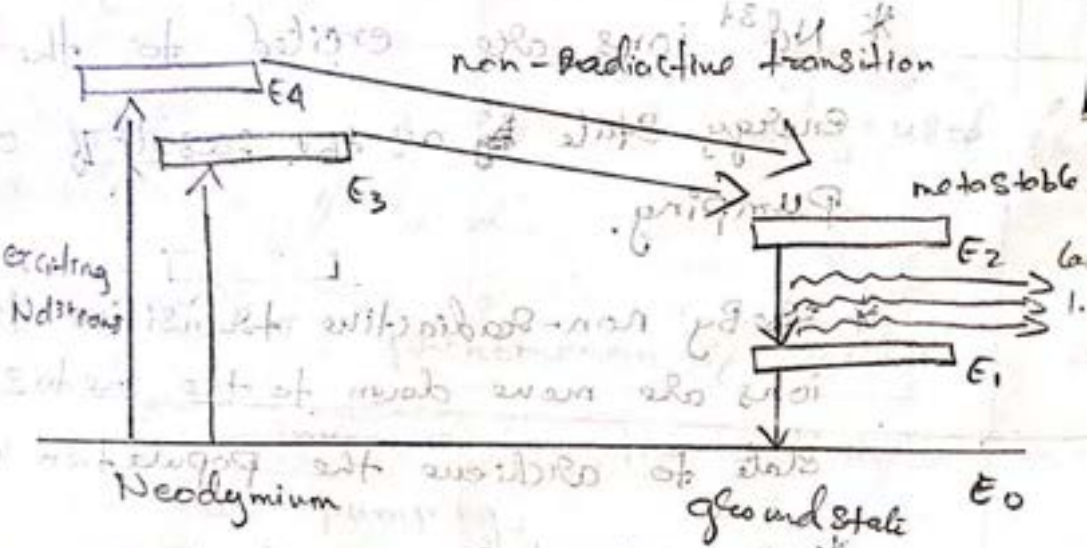
* Nd^{3+} ions are excited to the higher energy state as the result of optical pumping.
* By non-radiactive transition the excited ions are move down to the metastable state to archieve the population inversion.
* The ions are moved to the next lower energy state leads the laser output at 1.064 μm.

Construction:



* The Nd:YAG Crystal rod is kept the glass tube.
* The Optical resonators M_1 and M_2 Mir are placed at the end of the tube.
* Power supply is assemble to exciting the ions.

Working:



* By applying power supply the Nd^{3+} ion are excited to its higher energy states E_4
* Then by non-radiactive transition excited io are move down to the metastable st
* Their is the population inversion is achieved.
* Then the ions move down to the next lower energy state E_1, leads the laser out put at 1.064 μm.

...racteristic:

Active medium - Nd:YAG Crystal rod.

Active centre - Nd^{3+} ions

optical resonator - The ends of the glass tube is polished and silvered.

nature of output - pulsed (or) Continuous.

wave length of output - 1.064 μm

Power output - 1.2×10^4 watt.

*Merits

* High laser output.
* Easy to achieve population inversion
* required lower threshold voltage.

*Demerits:

* power of Nd^{3+} ions are Complicated.

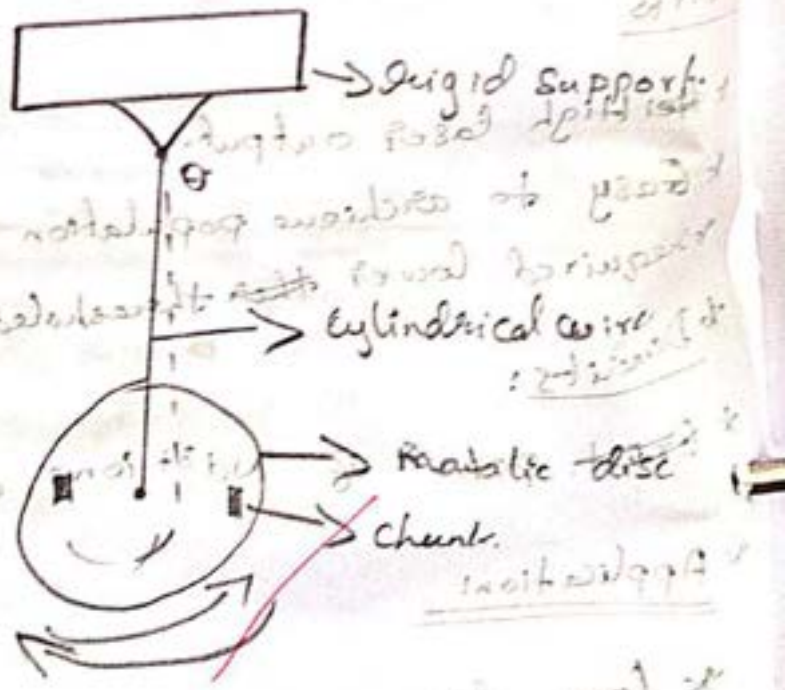
*Applications

* long distance Conversation
* Engineering works like welding, cutting, drilling.

Torsion pendulum:

Statement:

Torsion pendulum consist of a thin wire connected to the rigid support and the other end is connected to the circular metalic disc which exist torsional oscillation due to twisting and releasing the circular disc



Restoring couple set up in wire. $= -C\theta$ ——→ (1)

Applying couple $= I\frac{d^2\theta}{dt^2}$ ——→ (2)

Equating (1) & (2)

$$I\frac{d^2\theta}{dt} = -C\theta$$

$$\frac{d^2\theta}{dt} = -\left(\frac{C}{I}\right)\theta$$

$$T = \sqrt{\frac{\text{angular displacement}}{\text{Angular acceleration}}}$$

$$T = 2\pi\sqrt{\frac{\phi/C\phi}{I}}$$

$$T = 2\pi\sqrt{\frac{I}{C}} \quad \text{——— (3)}$$

The Time period $T = 2\pi\sqrt{I/C}$.

Squaring $T^2 = \frac{4\pi^2 I}{C}$.

For a cylindrical wire couple / twist

$$C = \frac{\pi n r^4}{2l}$$

$$\Rightarrow T^2 = \frac{4\pi^2 I}{\frac{\pi n r^4}{2l}}$$

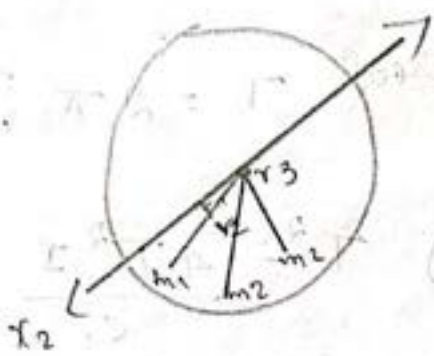
$$T^2 = \frac{4\pi I (2l)}{n r^4}$$

$$T^2 = \frac{8\pi I l}{n r^4}$$

$$I = \frac{n T^2 r^4}{8\pi l}, \quad n = \frac{8\pi I l}{T^2 r^4}$$

3. Relation between Rotational kinetic energy:

* Consider a rigid body consist of large no. number of particles rotating about a fixed axis XOX.



Let m_1, m_2, m_3 be the mass of the particles situated at distance r_1, r_2, r_3 from the fixed axis. A particle of mass m_1 located at distance from r_1 from the axis of rotation has kinetic energy given by $\boxed{\frac{1}{2} m_1 v_1^2}$

$$K = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 + \frac{1}{2} m_3 v_3^2 + \dots$$

Each particles of body moves in a circle with linear velocity given by general form.

$$\boxed{v = r\omega}$$

$$\therefore v_1 = r_1\omega_1,\ v_2 = r_2\omega_2,\ v_3 = r_3\omega_3 = v_n r_n \omega_n \quad \text{---(2)}$$

Eqn (2) $\Rightarrow$

$$K = \frac{1}{2} m_1 r_1^2 \omega_1^2 + \frac{1}{2} m_2 r_2^2 \omega_2^2 + \frac{1}{2} m_2 r_2^2 \omega + \dots + \frac{1}{2} m_n r_n^2 \omega_n^2 \quad \text{---(3)}$$

So that $k = \sum_{i=1}^{n} \frac{1}{2} m_i r_i^2 \omega_i^2$ — (4)

$$k = \frac{1}{2}\omega^2 \sum_{i=1}^{n} m_i r_i^2 \quad \text{— (5)}$$

~~tot wg di.~~

$$I = \sum_{i=1}^{n} m_i r_i^2 \quad \text{— (6)}$$

Kinetic energy rotating body return

$$k = \frac{1}{2} I \omega^2$$

Retest Internal - I

Engineering Physics

32/60

K.N.Nithish

I St year (Mechanical)

Roll No : 38

1) Centre of mass of a body is defined as the point at which the whole mass of the body is supposed to be concentrated

For example : For simple ridid body the centre of mass of body is located in the centre of Centroid

2) Oscillation exist everywhere. most of them are inherently non-linear. Strictly Speaking all the physical systems are non-linear

In non-linear oscillation basic building blocks are called harmoics which are simple sine waves with frequency integer multiples to the lowest frequency

$$f_1 = \frac{1}{P}$$

3) * electromagnetic wave requires both electric and magnetic field propogate and copropagate

* The wave travel is mutualy perpendicular to the both E and B and propogation direction is defined by direction

$$S = E \times B$$

* Both E and b and C ~~are~~ are base velocity of wave

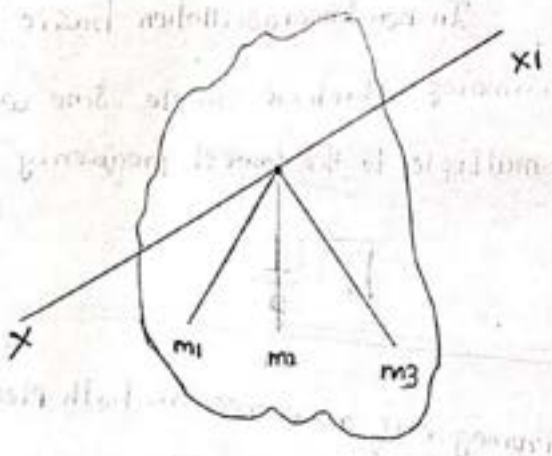
4) electromagentic waves encountre the surface at an object the force will be executed as a surface result of the momentum force per unit area exerted by wave is called Radioative pressure

5) process of which rises the atom to lower state to the higer state is called pumping

(i) Optical pumping
(ii) inelastic atom-atom collosion
(iii) Electric discharged pumping
(iv) Thermal pumping.
(v) Chemical pumping.

Part-B

6) Consider a rigid body consits of large number of particles rotating about an axis 'xox'



let m_1, m_2, m_3 etc, be the mass of the particles at distance r_1, r_2, r_3 etc from the axis for particle

mass = m
Velocity = v_1

$\therefore$ kinetic energy = $\frac{1}{2} m_1 r^2$ — (1)

for particle 2

mass = m_2
Velocity = v_2

$\therefore$ kinetic energy = $\frac{1}{2} m_2 r^2$ — (2)

Total kinetic energy =

$= 1/2\ m_1 v_1 + 1/2\ m_2 v_2 + \ldots + 1/2\ m_n v_n$

$V = r\omega$ — (4)

(1) in (3)

(3) ⇒ Kinetic energy

$1/2\ m_1 r^2 \omega_1^2 + 1/2\ m_2 r_2^2 \omega^2 + \ldots + 1/2\ m r_n^2 \omega_n^2$

kinetic energy $= \sum_{i=1}^{n} 1/2\ m_i' r_1^2 \omega_1^2$ — (5)

For rotating rigid body each particle rotates with an same angular velocity

Kinetic energy $= 1/2\ \omega^2 \Sigma i\ m_i r^2$ — (6)

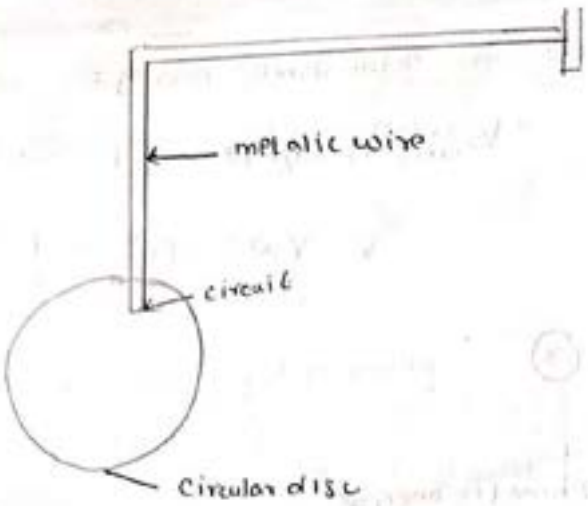
---

11) **Torisonal pendulum** A circul. Metalic disc suspended by a thin wire which produces torsional pendulum oscillation due to twisting at the other end is called torsional pendulum

theory :

A Torsion pendulum consits of metal wire connected to a rigid support at one end and a heavy circular disc at other end.

A disic is twisted and released a disc oscillate back and forth and produce simple harmonic motion



Rotating couple setup in wire $= -C\theta$ — (1)

Applied couple $= I \frac{d^2\theta}{dt^2}$ — (2)

Equating (1) & (2)

$$-C\theta = I \frac{d^2\theta}{dt^2}$$

$$\frac{d^2\theta}{dt^2} = \left(\frac{C}{I}\right)\theta \quad -(3)$$

$$T = 2\pi \sqrt{\frac{\text{Angular displacement}}{\text{Angular acceleration}}}$$

Time period $T = 2\pi \sqrt{\frac{\theta}{\frac{C\theta}{I}}}$

$$T = 2\pi \sqrt{\frac{I}{C}} \quad -(4)$$

Determination of rigidity modulus of wire

Time period $T = 2\pi \sqrt{I/C}$

Squaring $T^2 = \frac{4\pi^2 I}{C}$ — (5)

For cylindrical wire couple/twist

$$C = \frac{\pi n^2 y}{2L} \quad -(6)$$

(5) $\Rightarrow T^2 = \frac{4\pi I}{\frac{\pi n^2 y}{2L}} = \frac{8\pi IL}{n^2 y}$

$$I = \frac{nT^2 r^4}{8\pi L}, \quad n = \frac{8\pi IL}{T^2 r^4}$$

V. Sivanathan
Mechanical
Roll. No : 47

35/60

Retest.

Engineering physics.

1) center of mass of a body or system of a particle is defind as the point at which the whole mass of the body for appear to be concentrated.

3) * Electromagnetic waves in transverse in nature.
* Electromagnetic waves travel in ~~vacuum~~ of light with a speed of light.
* Electromagnetic waves produced by accelerated charge
* Not deflected by electric or magnetic field.

4) the force per unit area exerted by the electromagnetic waves when they encounter the surface of an object is called radiation pressure.

2

5) + optical pumping.

* Electric discharge pumping.

+ chemical pumping.

* Thermal pumping.

* Inelastic atom atom pumping. (collision)

2

2) Oscillation exists everywhere. Most of them are internally non-linear, strictly speaking all physical system are non-linear

$$f_1 = \frac{1}{\rho}$$

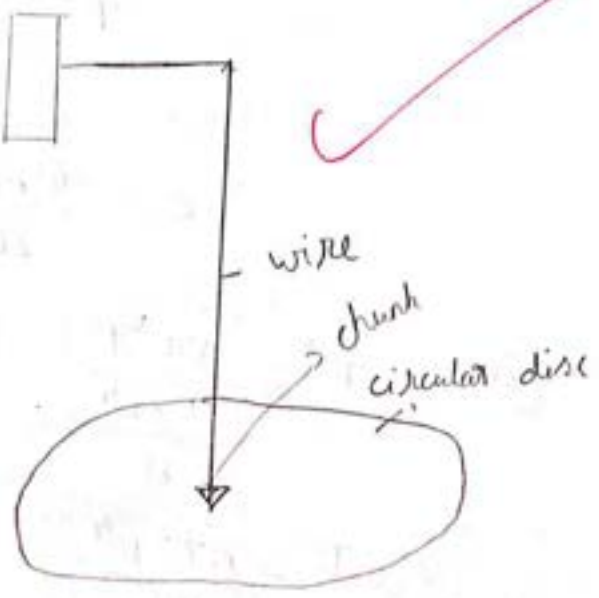
1) Torsional pendulum.

Definition:

A circular metallic is susponded by thin wire which produces torsional oscillation due to twisting at the other end.

Theory:

A torsional pendulum consist of metal wire connected to a rigid support at one a end and a heavy circular at the other end.



Restoring couple setup in wire $= -C\theta$ — (1)

Applied couple $= I \frac{d^2\theta}{dt^2}$

eq (1) and (2)

$$-C\theta = I\frac{d^2\theta}{dt^2}$$

$$\frac{d^2\theta}{dt^2} = -\left(\frac{C}{I}\right)\theta \quad \text{— (3)}$$

$$T = 2\pi \sqrt{\frac{\text{angular displacement}}{\text{acceleration}}}$$

Time period $T = 2\pi \sqrt{\frac{\theta}{C\theta/I}}$

$$T = 2\pi \sqrt{\frac{I}{C}} \quad \text{—}$$

Determination of Rigidity modulus of the wire

Time period $T = 2\pi\sqrt{\frac{I}{C}}$

$$T^2 = \frac{4\pi^2 I}{C} \quad \text{— (4)}$$

$$C = \frac{\pi n r^4}{2l}$$

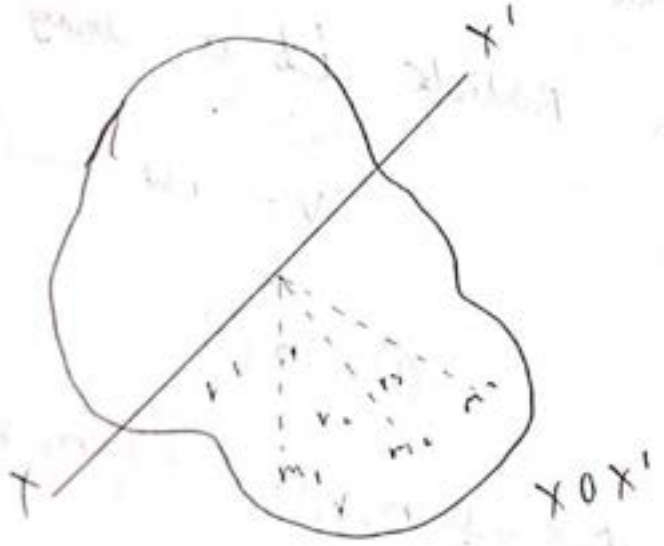
$$(4) \Rightarrow T^2 = \frac{4\pi^2 I}{\frac{\pi n r^4}{2l}} = \frac{8\pi I l}{n r^4}$$

$$I = \frac{nT^2 r^4}{8\pi l}$$

$$n = \frac{8\pi I l}{T^2 r^4}$$

(2) Rotational kinetic energy.

consider a rigid body consisting of large number of particles rotating about an axis XOX'



consider a rigid body consisting of large number of particles Rotating about an axis XOX

For particle 1

mass = m_1

velocity = v_1

$K.E = \frac{1}{2} m_1 v_1^2$ — (1)

For particle 2.

Mass $= m_2$

$$K.E = \frac{1}{2} m_2 v_2^2 \quad \text{—— (2)}$$

Total kinetic energy $= \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 + \ldots + \frac{1}{2}$

each particle is a body with linear vel

$$v = r\omega \quad \text{—— (4)}$$

(4) in (3)

$$\text{(3)} \Rightarrow K.E = \frac{1}{2} m_1 r_1^2 \omega_1^2 + \frac{1}{2} m_2 r_2^2 \omega_2^2 + \ldots + \frac{1}{2} m_n^2$$

$$K.E = \sum_{i=1}^{n} \frac{1}{2} m_i r_i^2 \omega_i^2 \quad \text{—— (5)}$$

$$K.E = \frac{1}{2} \omega^2 \sum_i m_i r_i^2 \quad \text{—— (6)}$$

$K.E = \frac{1}{2} \omega^2 I$, I = moment of inertia, $I = mr^2$

Einstein's coefficient

$$R(ab) = B_{12} N_1 P \quad \text{— (1)}$$

$$R(spt) = A_{21} N_2 \quad \text{— (2)}$$

$$R(st) = B_{21} N_2 P \quad \text{— (3)}$$

At terminal equilibrium

$$R(a,b) = R(spt) + R(st)$$

$$B_{12} N_1 P = A_{21} N_2 + B_{21} N_2 P$$

$$B_{12} N_1 P = B_{21} N_2 P = A_{21} N_2$$

$$P = \frac{A_{21} N_2}{B_{12} N_1 - B_{21} N_2} \quad \text{— (4)}$$

$$P = \frac{\frac{A_{21} \cancel{N_2}}{B_{21} \cancel{N_2}}}{\frac{B_{12} N_1}{B_{21} N_2} - \frac{B_{21} N_2}{B_{21} N_2}}$$

$$P = \frac{A_{21}}{B_{21}} \times \frac{1}{\frac{B_{12}}{B_{21}} \cdot \frac{N_1}{N_2}} \quad \text{— (5)}$$

By Boltzmann distribution

$$\frac{N_1}{N_2} = e^{\frac{h\nu}{kT}} \quad \text{— (6)}$$

put (6) in (5)

$$\Rightarrow P = \frac{A_{21}}{B_{21}} \times \frac{1}{\frac{B_{12}}{B_{21}} e^{\frac{h\nu}{kT}}} \quad \text{— (7)}$$

By plank's radiation

$$P = \frac{8\pi h \nu^3}{c^3} \frac{1}{(e^{h\nu/kT} - 1)} \quad \text{— (8)}$$

8

compare (7) and (8)

$$\frac{A_{21}}{B_{21}} = \frac{8\pi h \nu^3}{c^3}$$

$$\frac{B_{12}}{B_{21}} = 1 \quad ; \quad B_{12} = B_{21} = B$$

A and B are called Einstein

Internal Exam - II

PH3151 - Engineering Physics

Part - A

Rishni. V.J
MECH
No: 41

55/60

1. Standing waves	Travelling waves
Maximum at antinode and Zero at nodes	The same for all Parts of the wave
Twice the dis distance between nodes	The distance between two adjecent peaks
Does not move forward	Move forward

2. * The wave function (ψ) gives the Probability of finding a particle at a given phase at a particular instant of time.
* The wave function relates the Particle and the wave

4. Bloch theorem states that a charged Particle Confined in a periodic potential Performs Bloch Oscillations and has Eigen functions of the form.

5. * High Speed electronic devices
* Optical Communications
* Terahertz generation

Part - B

6. a) Describe the Constructions and working of Michelson Interferometer.

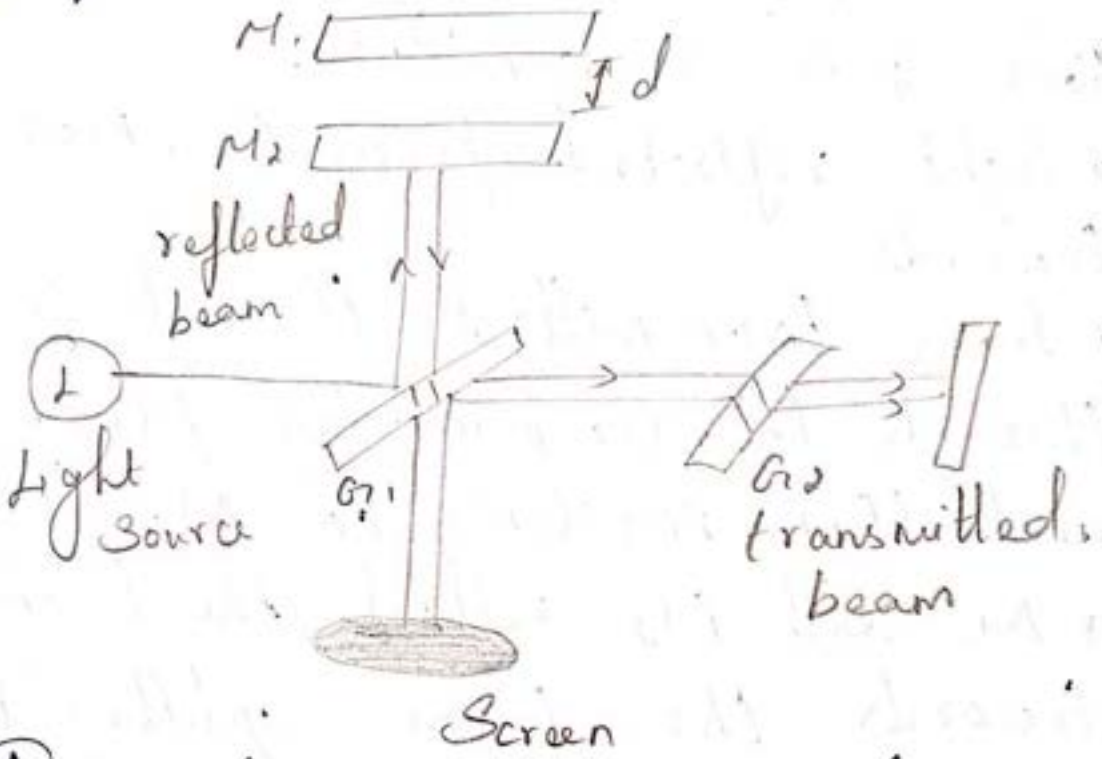
Principle:

Amplitude division: producing interference pattern by Splitting a light beam into two by Partial reflection and partial Refraction then after they have travelled different Optical Paths.

Construction:

It Consists of a movable mirror M_1 and a fixed mirror M_2. both are

highly polished.



* Two glass plates G_1 and G_2 are placed parallel to each other between the mirrors at an angle of 45°.
* The rear side of glass plate G_1 is semi-silvered to make it as Partially reflective glass plate.

Working:

* Monochromatic light from the light source L falls on the beam splitter glass plate G_1.
* Since G_1 is partially polished, some part of the light gets reflected and some part of the light

gets reflected and some part of the light gets transmitted.

* Light reflected from G_1, move towards

* Light transmitted through G_1, passes through the Compensating plate G_2 and then incident on M_2

* M_1 and M_2 reflect the beams back towards the beam splitter to the screen and the ray reflected from M_2 is reflected again by the beam splitter to the screen.

* Because An interference pattern of dark and bright rings or fringes are observed on the viewing screen at S.

Theory:

Fringes are formed by the light reflected from mirror M_1 and M_2.

Since the two interfering beams of light were initially in phase

$$\Delta = 2d = n\lambda$$

i) $\Delta = 0$ (no path difference and hence, no interference pattern)

ii) $\Delta = \frac{2n\lambda}{2} = n\lambda$ (Constructive interference and maximum intensity - Bright fringes)

iii) $\Delta = \frac{(2n+1)\lambda}{2}$ (destructive interference and minimum intensity - Dark Fringes)

b) For atomic transitions derive Einstein relations and hence deduce the expressions for the ratio of spontaneous emission rate to the stimulated emission rate.

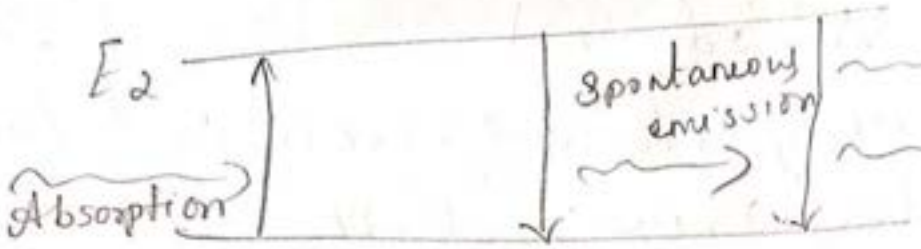
Theory:

When a electromagnetic signal is incident on an atom, three different processes occur.

They are i) Induced absorption

ii) Spontaneous emission

iii) Stimulated emission:



The atom in lower energy states absorption energy to make transition to higher emission state. The atoms then make transition to lower energy state either by Spontenous emission or by stimulated emission.

i) Absorption Process

Let $R_{12}(ab)$ be the rate of absorption of light from E_1 to E_2 which is proportional to the number of atoms (N_1) in the ground state E_1 and the energy density (P) of incident photons.

$$R_{12}(ab) = B_{12} N_1 P \longrightarrow (1)$$

Emission Process

Now, atoms in excited state E_2 return to the ground state E_1 by the emission of energy either by

Spontaneous emission.

ii) Spontaneous emission

Let $R_{21}(sp)$ be the rate of Spontaneous emission from E_2 to E_1 which proportional to the number of atoms (N_2) in the excited state E_2 and is independent of energy density ρ of the incident photons.

$$R_{21}(sp) = A_{21} N_2 \longrightarrow (2)$$

iii) Stimulated Emission

Let $R_{21}(st)$ be the rate of Stimulated emission from E_2 to E_1 which is proportional to the number of atoms (N_2) in the excited state E_2 and the Energy density (ρ) of incident photons.

$$R_{21}(st) = B_{21} N_2 \rho \longrightarrow (3)$$

The rate of absorption = The rate of two emission process

At thermal equilibrium

$$R(a,b) = R(spt) + R(st)$$

$$B_{12}N_1\rho = A_{21}N_2 + B_{21}N_2\rho$$

$$B_{12}N_1\rho - B_{21}N_2\rho = A_{21}N_2$$

$$\rho(B_{12}N_1 - B_{21}N_2) = A_{21}N_2$$

$$\rho = \frac{A_{21}N_2}{B_{12}N_1 - B_{21}N_2} \longrightarrow (4)$$

÷ Num & denominator by $B_{21}N_2$

$$\rho = \frac{\frac{A_{21}N_2}{B_{21}N_2}}{\frac{B_{12}N_1}{B_{21}N_2} - \frac{B_{21}N_2}{B_{21}N_2}}$$

$$\rho = \frac{A_{21}}{B_{21}} \times \frac{1}{\frac{B_{12}}{B_{21}}\cdot\frac{N_1}{N_2} - 1} \longrightarrow (5)$$

By Boltzman distribution law:

$$N_1/N_2 = e^{h\nu/kT} \longrightarrow (6)$$

Put (6) in (5)

$$\rho = \frac{A_{21}}{B_{21}} \times \frac{1}{\frac{B_{12}}{B_{21}} \times e^{h\nu/kT} - 1} \longrightarrow (7)$$

By plancks radiation

$$\rho = \frac{8\pi h\nu^3}{c^3} \times \frac{1}{(e^{h\nu/kT} - 1)} \longrightarrow (8)$$

Compare (7) & (8)

$$\Rightarrow \frac{A_{21}}{B_{21}} = \frac{8\pi h\nu^3}{c^3}$$

$$\frac{B_{12}}{B_{21}} = 1, \quad B_{12} = B_{21} = B$$

$A_2 B$ are called Einstein Coefficients

7)

a) Derive an expression for schrodinger's time independent wave equation and hence deduce the schrodinger time dependent wave equation.

Describe the motion and behaviour of particles of atomic dimension, Erwin Schrodinger an Austrian physicist, in 1926 develop the wave equation in terms of a function called wave function. This wave.

1. Schrodinger Time independent wave Equation: Consider a System of

Stationary wave associated with a moving particle of mass 'm' and velocity 'v'

Let x, y, z be the Coordinates of the particles and ψ, the wave displacement for the de Broglie ware at any instant of time t

$$\frac{\partial^2\psi}{\partial t^2} \times \frac{1}{v^2} = \frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}$$

$$\frac{\partial^2\psi}{\partial t^2} = v^2\left[\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}\right] \rightarrow (1)$$

$$\nabla^2 = \left[\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right]$$

$$\frac{\partial^2\psi}{\partial t^2} = v^2\nabla^2\psi$$

On solving eqn (2)

$$\psi(x, y, z, t) = \psi_0(x, y, z)\, e^{-i\omega t}$$

Eqn (3) $\psi = \psi_0 e^{-i\omega t} \rightarrow (3)$

Diff eqn (4) w.r.t to time

$$\partial^2\psi/\partial t^2 = -\omega^2\psi_0 e^{-i\omega t} \rightarrow (5)$$

Sub eqn (4) in (5)

$$\frac{\partial^2\psi}{\partial t^2} = -\omega^2\psi$$

Sub eqn (1) in (6)

$$v^2\left[\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}\right] = -\omega^2\psi$$

$$\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2} = \left(-\frac{\omega^2}{v^2}\right)\psi$$

$$\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2} + \frac{\omega^2}{v^2}\psi = 0 \longrightarrow (7)$$

We know

$$\omega = 2\pi\nu$$

$$\omega = 2\pi\,(\nu/\lambda)$$

$$\omega/\nu = 2\pi/\lambda \longrightarrow (8)$$

Sub eqn (8) in (7)

$$\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial x^2} + \left(\frac{4\pi^2}{\lambda^2}\right)\psi = 0$$

$$\nabla^2\psi + \left(4\pi^2/\lambda^2\right)\psi = 0 \longrightarrow (9)$$

de Broglie wavelength

$$\lambda = h/p \Rightarrow \lambda = h/mv \longrightarrow (10)$$

Sub (10) in eqn (9) :

$$\nabla^2\psi + \left(\frac{4\pi^2 m^2 v^2}{h^2}\right)\psi = 0 \longrightarrow (10)$$

Total energy = kinetic energy + potential energy

$$E = \frac{1}{2}mv^2 + V$$

$$E - V = \frac{1}{2}mv^2$$

$$2(E-V) = mv^2$$

x'ly 'm' on both side

$$2m(E-V) = m^2v^2 \longrightarrow (12)$$

Sub: eqn (12) in (10)

$$\nabla^2\psi + \left(\frac{4\pi^2}{h^2} 2m(E-V)\right)\psi = 0$$

$$\nabla^2\psi + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0 \Rightarrow (13)$$

Sub $\hbar = h/2\pi$ in eqn (13)

$$h = \hbar 2\pi$$

$$h^2 = \hbar^2 4\pi^2$$

$$\nabla^2\psi + \frac{8\pi^2 m}{\hbar^2 4\pi^2}(E-V)\psi = 0$$

$$\nabla^2\psi + 2\pi/\hbar^2(E-V)\psi = 0$$

For Free particle

Potential energy $V = 0$

$$\nabla^2\psi + \frac{2mE}{\hbar^2}\psi = 0$$

ii) Schrodinger Time dependent wave Equation

(4) $\Rightarrow \psi = \psi_0 e^{-i\omega t}$

Diff eqn (4) w.r to time 't'

$$\frac{\partial \psi}{\partial t} = -i\omega \psi_0 e^{-i\omega t}$$

We know

$\omega = 2\pi\nu$, $\psi = \psi_0 e^{-i\omega t}$

$$\frac{\partial \psi}{\partial t} = -i(2\pi\nu)\psi_0 e^{-i\omega t}$$

$$\frac{\partial \psi}{\partial t} = -i(2\pi\nu)\psi \rightarrow (11)$$

Sub $E = h\nu$ in eqn (11)

$\nu = E/h$

We get $\partial\psi/\partial t = -i\left[2\pi\left(E/h\right)\right]\psi \rightarrow (15)$

Sub, $\hbar = h/2\pi$ in eqn (15)

$h = 2\pi\hbar$

We get

$$\frac{\partial \psi}{\partial t} = -i\left[2\pi\left(E/2\pi\hbar\right)\right]\psi$$

$$\frac{\partial \psi}{\partial t} = -i\left[E/\hbar\right]\psi \rightarrow (16)$$

Since, $i^2 = -1$

$$\frac{\partial \psi}{\partial t} = i\left(E/\hbar\right)\psi$$

$$E\psi = i\hbar\left(\frac{\partial \psi}{\partial t}\right) \rightarrow (17)$$

The Schrodinger time-independent wave equation:

$$\Rightarrow \nabla^2\psi + 2m/\hbar^2 (E-V)\psi = 0$$

$$\nabla^2\psi + 2m/\hbar^2 (E\psi - V\psi) = 0$$

$$\nabla^2\psi = -\left[2m/\hbar^2 (E\psi - V\psi)\right] \rightarrow (18)$$

Sub (17) in (18)

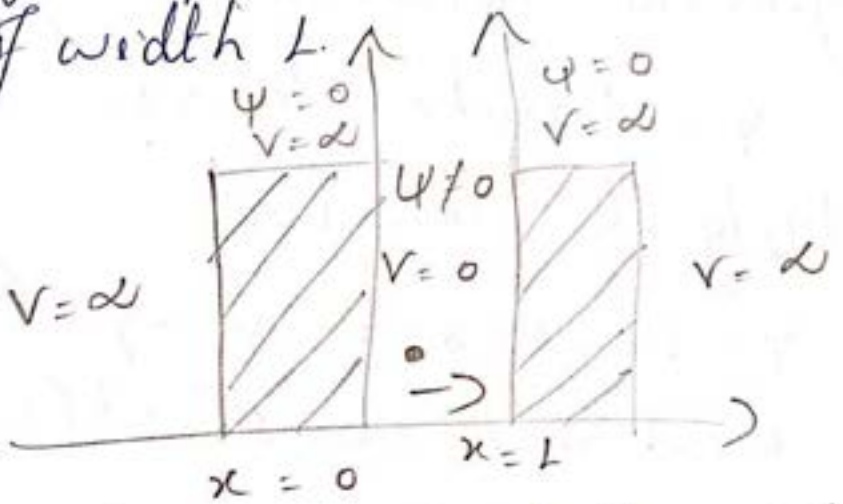
$$\nabla^2\psi = -\left[2m/\hbar^2 \left(i\hbar \frac{\partial \psi}{\partial t} - V\psi\right)\right]$$

$$-\left(\hbar^2/2m\right)\nabla^2\psi = i\hbar\, \partial\psi/\partial t - V\psi$$

$$-\left(\hbar^2/2m\right)\nabla^2\psi + V\psi = i\hbar\, \partial\psi/\partial t$$

$$\left[-\left(\hbar^2/2m\right)\nabla^2 + V\right]\psi = i\hbar\, \partial\psi/\partial t$$

b) Solve the schrodinger equation wave equation for allowed energy values in case of a particle in One dimensional box of width L.



Consider a particle like electron of mass 'm' which moves in a one dimensional box of length 'L'.

$$\left.\begin{array}{l} V = 0 \text{ at } x \geq 0 \\ V = 0 \text{ at } x \leq L \\ V = \infty \text{ at } 0 \geq x \geq L \end{array}\right\} \rightarrow (1)$$

$$\left.\begin{array}{l} \psi = 0 \text{ at } x = 0 \\ \psi = 0 \text{ at } x = L \end{array}\right\} \rightarrow (2)$$

Eqn (1) & (2) are known as boundary Condition for free electron

$$\nabla^2\psi + \frac{8\pi^2 m}{h^2} E\psi = 0 \rightarrow (3)$$

Sub, $\frac{8\pi^2 m}{h^2} = k^2$ in eqn (3)

$$\nabla^2\psi + k^2\psi = 0 \quad \rightarrow (4)$$

General Solution of equation

$$\psi = A\sin kx + B\cos kx \rightarrow (5)$$

Apply the boundary

$\psi = 0$ at $x = 0$ in eqn (5)

$$0 = A\sin k(0) + B\cos k(0)$$

$$0 = B \Rightarrow B = 0$$

$\psi = 0$ at $x = L$

$$0 = A\sin kL$$

$$A \neq 0$$

But, $\sin kL = 0$

$$kL = n\pi \rightarrow (6)$$

Sub k value in eqn (5)

$$\psi_n(x) = A\sin\left(\frac{n\pi x}{L}\right) \rightarrow (7)$$

We know $k^2 = \frac{8\pi^2 mE}{h^2}$

$$E_n = \frac{k^2 h^2}{8\pi^2 m}$$

We know, $k = n\pi/L$

$$E_n = \frac{n^2\pi^2\hbar^2}{L^2 8\pi^2 m}$$

$$E_n = \frac{n^2\hbar^2}{8mL^2}$$

Normalization of wave function

$$\int_0^L \psi\,\psi^* dx = 1$$

Therefore

$$A^2 \int_0^L \sin^2\left(\frac{n\pi x}{L}\right) dx = 1$$

$$A^2\left[\int_0^L dx/2 - 1/2 \int_0^L \cos\left(2\pi nx/L\right)\right] = 1$$

$$\left(A^2/2\right)\int_0^L dx = 1$$

$$\left(A^2/2\right)(x)_0^L = 1$$

$$\left(A^2/2\right) L = 1$$

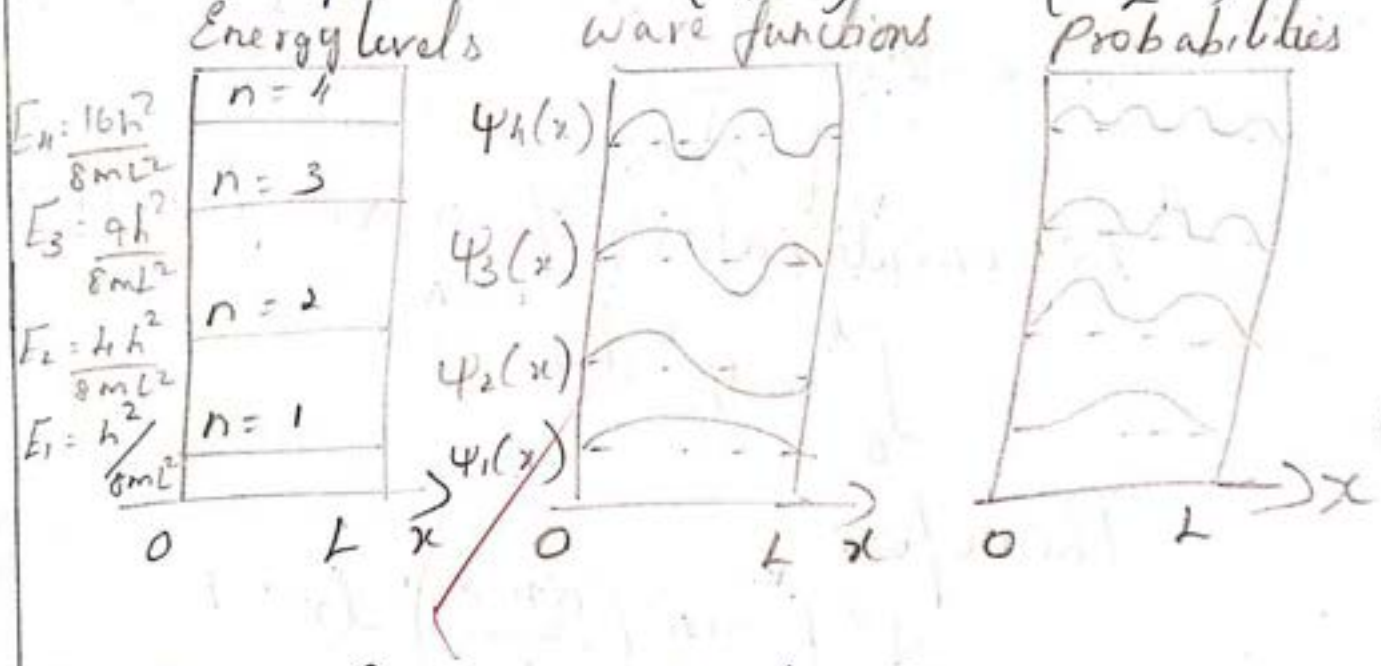
$$A^2 = 2/L$$

$$A = \sqrt{2/L}$$

$$\psi_n(x) = \sqrt{2/L} \sin\left(\frac{n\pi x}{L}\right)$$

Also

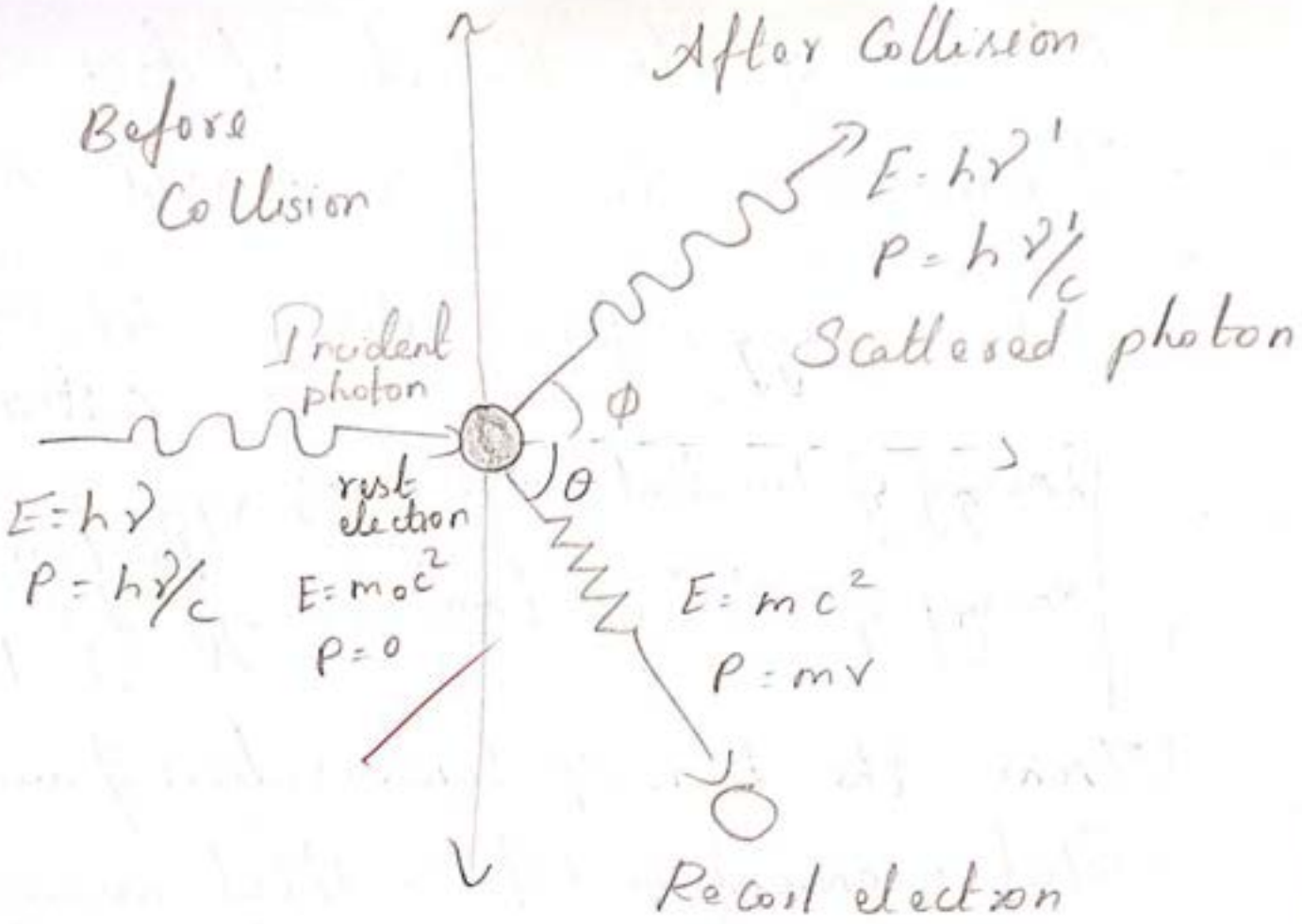
$$|\psi_n(x)|^2 = \left(\frac{2}{L}\right) \sin^2\left(\frac{n\pi x}{L}\right)$$



8a) Define Compton effect? Derive an expression for the wavelength of scattered photon.

Statement:

The phenomenon of change in wavelength of an X-Ray photon after scattering by a target material is known as Compton effect.



Derivation of Compton wavelength

Before Collision

Energy of the incident photon = $h\nu$

Moment of incident photon = $h\nu/c$

Rest energy of the electron = m_0c^2

Moment of the electron = 0

After Collision

Energy of the scattered photon = $h\nu'$

Moment of the scattered photon = $h\nu'/c$

Energy of the Recoil Electron = mc^2

Moment of the Recoil Electron = mv

From the law of Conservation of Energy

Total energy before Collision = Total Energy After Collision

[Energy of Incident photon + Energy of Rest electron] = [Energy of scattered photon + Energy of Recoil electron]

From the law of Conservation of momentum

Total momentum before Collision = Total momentum After Collision

[momentum of incident photon + momentum of Rest electron] = [momentum of scattered photon + momentum of Recoil Electon]

$$h\nu/c + 0 = h\nu'/c + mv$$

Direction	Momentum before Collision		Momentum After Collision	
	Incident photon	Rest Electron	Scattered Photon	Recoil Electron
x-Component momentum	$h\nu/c$	0	$h\nu'/c \cos\phi$	$mv\cos\theta$
Y-Component momentum	0	0	$h\nu'/c \sin\phi$	$-mv\sin\theta$

X - Component momentum

Momentum Before Collision = momentum After Collision

$$\frac{h\nu}{c} + 0 = \frac{h\nu'}{c}\cos\phi + mv\cos\theta \rightarrow (2)$$

y - Component momentum

momentum before Collision = momentum after Collision

$$0 + 0 = \frac{h\nu'}{c}\sin\phi - mv\sin\theta$$

$$0 = \frac{h\nu'}{c}\sin\phi - mv\sin\theta \rightarrow (3)$$

x'ly eqn (2) & (3) by 'c'

$$(2) \Rightarrow h\nu = h\nu'\cos\phi + mvc\cos\theta \rightarrow (4)$$

$$(3) \Rightarrow 0 = h\nu'\sin\phi - mvc\cos\theta \rightarrow (5)$$

$$(4) \Rightarrow mvc\cos\theta = h\nu - h\nu'\cos\phi$$

$$(5) \Rightarrow mvc\cos\theta = h\nu'\sin\phi \rightarrow (7)$$

Squaring and adding eqn (6) & (7)

$$\left[\begin{matrix} m^2v^2c^2\cos^2\theta \\ + \\ m^2v^2c^2\sin^2\theta \end{matrix}\right] = \left[\begin{matrix} h^2(\nu - \nu\cos\phi)^2 \\ + \\ h^2\nu^2\sin^2\phi \end{matrix}\right]$$

$$m^2v^2c^2(\cos^2\theta + \sin^2\theta) = h^2[\nu^2 + \nu'^2\cos^2\phi - 2\nu\nu'\cos\phi] + h^2\nu^2\sin^2\phi$$

$m^2v^2c^2 = h^2(\nu^2 + \nu'^2\cos^2\phi - 2\nu\nu'\cos\phi + \nu\sin^2\phi)$

$m^2v^2c^2 = h^2(\nu^2 + \nu'^2(\cos^2\phi + \sin^2\phi) - 2\nu\nu'\cos\phi$

$m^2v^2c^2 = h^2(\nu^2 + \nu'^2 - 2\nu\nu'\cos\phi) \rightarrow (8)$

Rewrite eqn (1)

$(1) \Rightarrow h\nu + m_oc^2 = h\nu' + mc^2$

$mc^2 = h\nu - h\nu' + m_oc^2$

$mc^2 = h(\nu - \nu') + m_oc^2$

Squaring on both sides

$m^2c^4 = [h(\nu - \nu') + m_oc^2]^2$

$m^2c^4 = h^2(\nu - \nu')^2 + 2h(\nu - \nu')m_oc^2 + m_o^2c^4$

$m^2c^2c^2 = h^2(\nu^2 - \nu'^2 - 2\nu\nu') + 2h(\nu - \nu')m_oc^2 + m_o^2c^4$

Sub eqn (8) & (9) $\rightarrow (9)$

$(8) \Rightarrow m^2c^2v^2 = h^2(\nu^2 - 2\nu\nu'\cos\phi + \nu'^2)$

$(9) \Rightarrow m^2c^2c^2 = h^2(\nu^2 + \nu'^2 - 2\nu\nu') + 2h(\nu - \nu')$
$m_oc^2 + m_o^2c^4$

$m^2c^2c^2 - m^2c^2v^2 = h^2\nu^2 + h^2\nu'^2 - h^2 2\nu\nu' + 2h\nu m_oc^2$
$- 2h\nu' m_oc^2 + m_o^2c^4 - h^2\nu^2 - h^2\nu'^2 + 2h\nu'\cos\phi h^2$

$m^2c^2[c^2 - v^2] = -2h^2\nu\nu'[1 - \cos\phi] + 2h m_oc^2(\nu - \nu') +$
$m_oc^2c^4 \rightarrow (10)$

By using theory of Relativity

$m = \frac{m_o}{\sqrt{1 - v^2/c^2}} \rightarrow (11)$

Squaring the above equation

$$m^2 = \frac{m_0^2}{1 - v^2/c^2}$$

$$m^2\left(1 - v^2/c^2\right) = m_0^2$$

$$m^2\left(\frac{c^2 - v^2}{v^2}\right) = m_0^2$$

$$m^2(c^2 - v^2) = m_0 c^2$$

x'y by c^2 on both side

$$m^2c^2(c^2 - v^2) = m_0^2 c^4 \longrightarrow (12)$$

Sub eqn (12) in eqn (10)

(10) $\Rightarrow$ $m_0^2c^4 = -2h^2\nu\nu'(1 - \cos\phi) + 2h(\nu - \nu')$

$$m_0c^2 + m_0^2c^4$$

$$2h(\nu - \nu')m_0c^2 = 2h^2\nu\nu'(1 - \cos\phi)$$

$$(\nu - \nu')m_0c^2 = h\nu\nu'(1 - \cos\phi)$$

$$\frac{\nu - \nu'}{\nu\nu'} = h/m_0c^2\,(1 - \cos\phi)$$

$$\nu/\nu\nu' - \nu/\nu\nu' = h/m_0c^2\,(1 - \cos\phi)$$

$$\lambda' - \lambda = h/m_0c^2(1 - \cos\phi)$$

$$\Delta\lambda = h/m_0c^2(1 - \cos\phi)$$

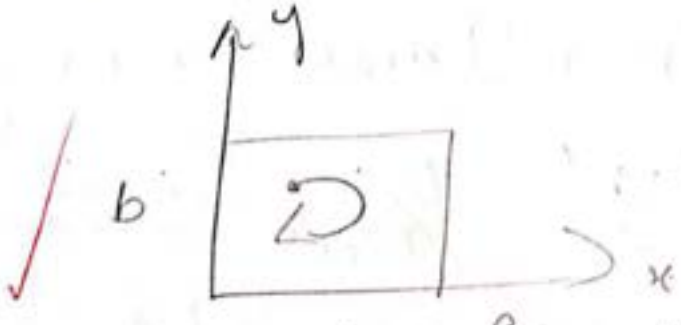
Conclusion:

i) Is independent of the incident photon wavelength (λ)

ii) Depends Only on the Scattering angle

b) Find the eigen function and eigen values for a particle in 2D Potential well of infinite height and discuss the solutions

Consider Schrodinger equation for an electron Confined in a 2-dimensional box.



In this rectangle, Electron wave function behaves as a free particle

$$V(x,y) = 0$$

Physics Model Exam

Rishu V.J
MECH
NO: 41

75/100

Part - A

1. Define multi-particle dynamics.

The study of motion of group of particles with negligible distance between the particle is known as multi particle dynamics.

2. * Large gyroscope are used in ship stabilizer to counteract rolling.
   * Automatic steering system, such as those used in airplanes and missiles.

3. The vector specifies amount of energy passing through unit area per second in perpendicular direction of propagation of electromagnetic waves per second is known as poynting vector.

$$S = E \times H$$

4. * Provides Mathematical Model for electric Optical and radio technologies.
   * Applied in the study of power

generation and wireless Communication.

5. Light travel form denses to rarer medium and if angle of incidence (θ_i) is increased angle of refraction (θ_r) also increased until it reaches 90°.

The angle of incidence at which angle of refraction becomes 90° is called Critical angle (θ_i)

$\theta_i = \theta_c$, $\theta_r = 90°$

6. * The motion must be periodic
* The body must have inertia
* The body must be elastic

7. Doppler effect refers to the change in wave frequency during the relative motion between a wave source and its observer.

8. * Optical pumping
* Chemical pumping
* Thermal pumping

9) The probability that particle gets through a potential barrier is called transmission Coefficient (T)

$T = e^{-2\beta L}$

10. The energy possessed by a particle at a particular energy level is defined or Eigen value (E_n).

The wave function of particle at Particular energy level is defined as Eigen functions (ψ_n).

Part - B

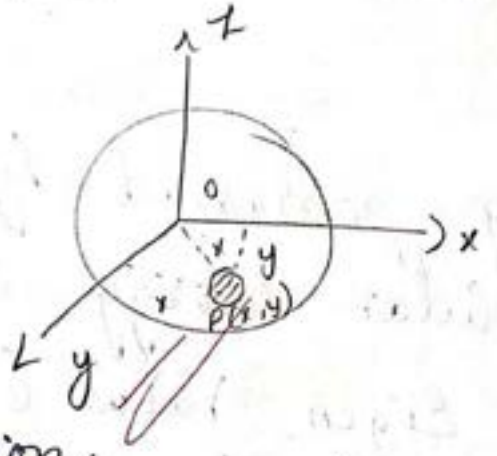
11.

a) Perpendicular axis statement

The moment of inertia of a Planar body about an axis perpendicular its plane and passing through the Point of intersection of two mutually Perpendicular axes is equal to

Sum of moment of inertia about the two mutually perpendicular axes lying in the same line

Proof:



Explanation:

Let I_x, I_y and I_z be the moment of inertia

$$I_z = I_x + I_y$$

A particle at P at distance r from O has Coordinates P(x,y) which gives

$$r^2 = x^2 + y^2 \rightarrow (1)$$

$$\Theta z = mr^2$$

$$I_z = \Sigma m r^2 \rightarrow (2)$$

$$I_x = \Sigma m x^2 \rightarrow (3)$$

$$I_y = \Sigma m y^2 \rightarrow (4)$$

eqn ① and ② Written

$$I_z = \Sigma m(x^2 + y^2)$$

$$I_z = \Sigma m x^2 + \Sigma m y^2$$

$$I_z = I_x + I_y$$

Hence Perpendicular axis theorem Proved

Parallel axis theorem

The moment of inertia of a Rigid body about any axis is equation Sum of moment of inertia about parallel axis through its Center of gravity and product of mass of the body and Square of distance between two parallel axis

Explanation:

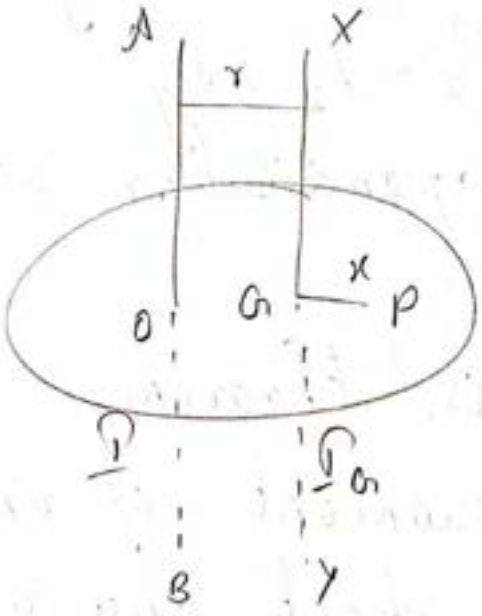
I be the moment of inertia of the body about any axis

I_G be the moment of inertia through Centre of gravity.

'r' be the perpendicular distance between the two axis.

$$I = I_G + Mr^2$$

Proof:



$$AB = (r + x)$$

$$AB = m(r + x)^2$$

$$I = \Sigma m(r + x)^2$$

$$I = \Sigma m(r^2 + x^2 + 2rx)$$

$$I = \Sigma mr^2 + \Sigma mx^2 + 2r\Sigma mx \rightarrow (1)$$

$$\Sigma m = M$$

$$\Sigma mx^2 = I_G$$

eqn (1) becomes

$$I = Mr^2 + I_G + 2r\Sigma mx \rightarrow (2)$$

$$\Sigma mg\,x = 0$$

$$g \neq 0$$

$$\Sigma mx = 0$$

$$\therefore \Sigma m x = 0 \longrightarrow (3)$$

eqn (3) in eqn (2)

$$I = I_G + Mr^2 \longrightarrow (4)$$

Eqn (4) Hence Parallel axis Theorem Proved

13)

b) Semiconductors lasers are classified in two types as follows

i) Homojunction Semiconductor laser

ii) Heterojuction Semiconductor laser

i) Homojunction Semiconductor laser

Principle

Stimulated recombination - Electrons in the Conduction band recombines with holes in the Valance band and releases energy in the form of light photons.

Characteristics:

Active medium - PN junction

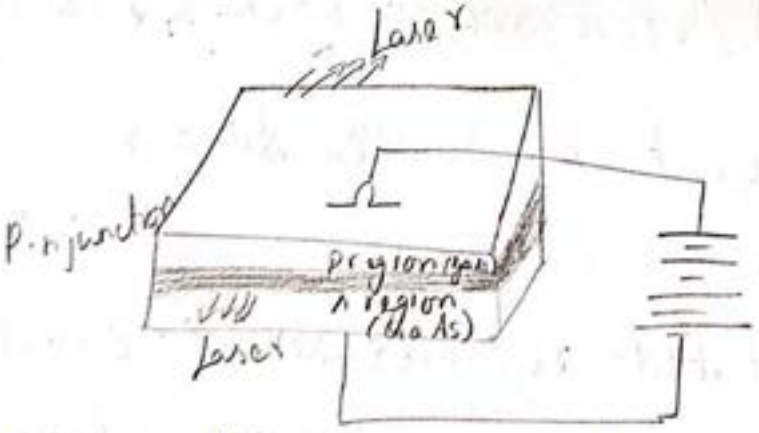
Active Centre - Electron - hole recombination

Pumping method - Direct Conservation.
Optical resonated - Polished end faces of PN junctions

Power Output - 1 mW
Nature of Output - Pulsed
Wave length of Output - 8400 Å - 8600 Å
Band gap - 1.44 eV

Construction :

* The diode is made from Semi-conductor material Gaas.



* The battery provides the necessary bias to the diode.

Working

* The pn junction is forward biased with large applied Voltage.
* The recombination of electrons

and holes at the junction produces light emission.

Merits

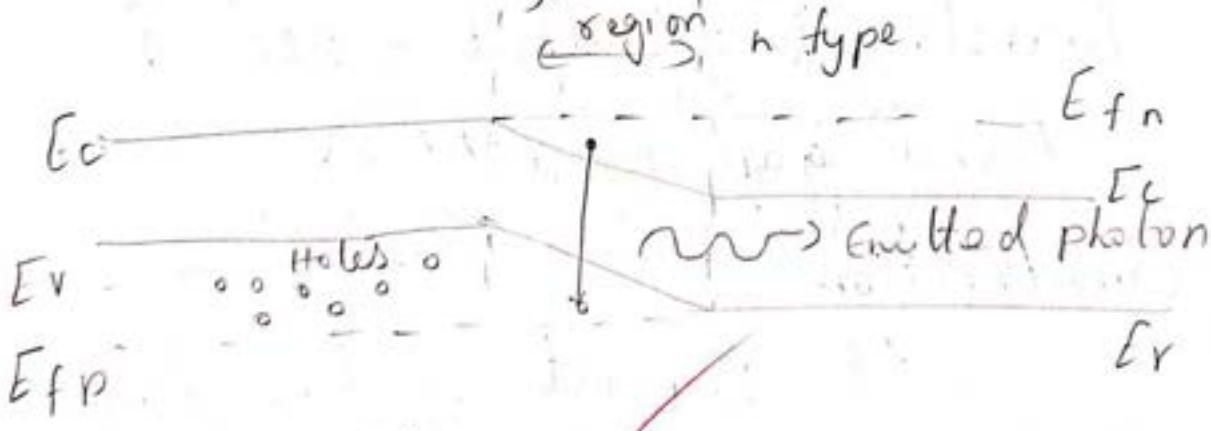
* High power Output
* High Coherence
* High stability

Demerits

* High Cost
* Large divergence

Applications

* Data storage
* Laser Printing



ii) Hetrojunction Semiconductor diode Laser

Principle

Stimulated recombination. Electrons in the conduction band recombines

with holes in the Valence band and releases energy in the form of light photons.

Characteristics:

Active medium - PN junction

Active Centre - Electron - hole recombination

Pumping method - Direct Conversion

Optical resonator - polished end faces of PN junction

Power Output - 10 mW

Nature of Output - Continuous wave

Wavelength of Output - 8000 Å

Band gap - 1.55 eV

Construction

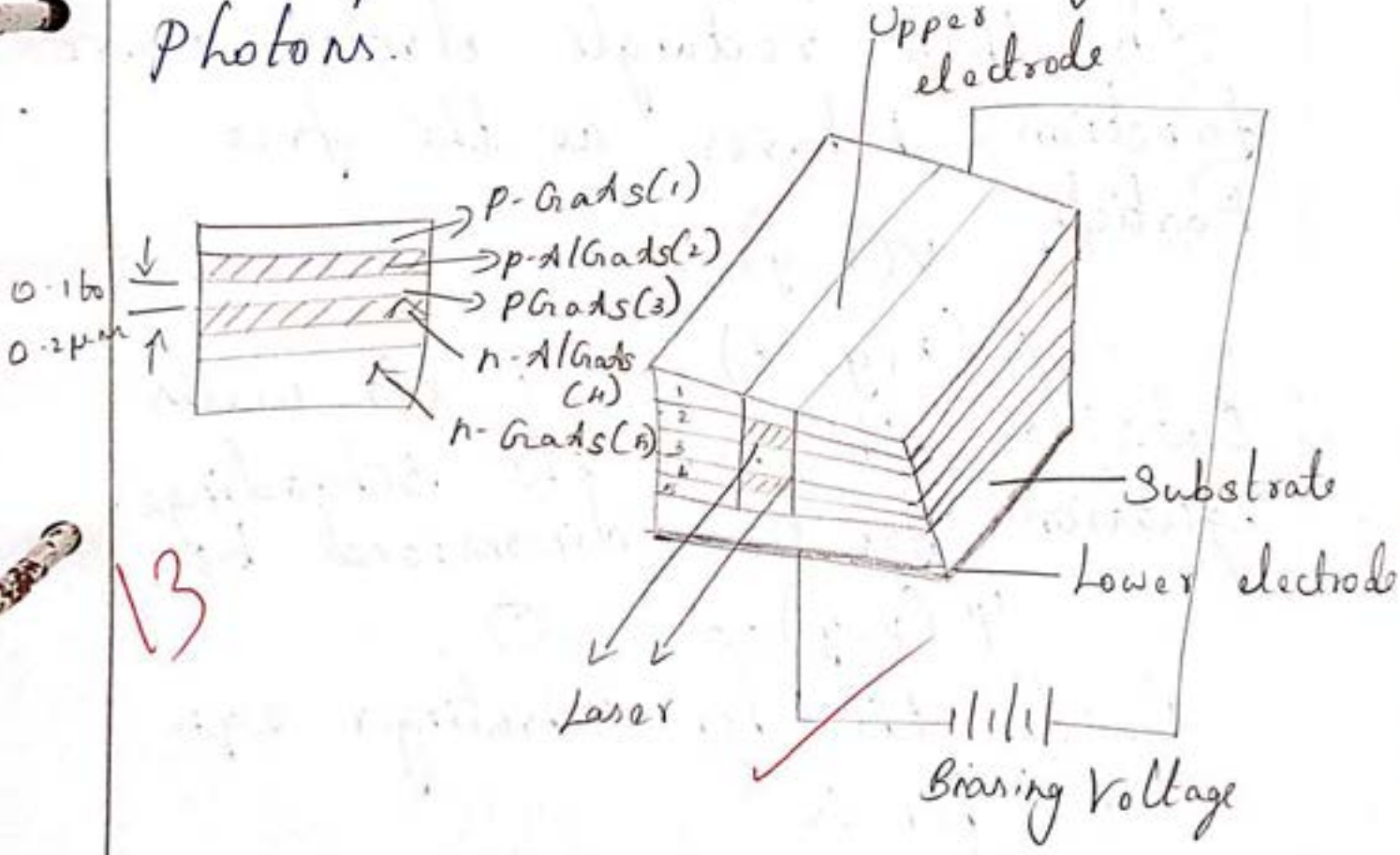
It Consists of five layers

A layers of GaAs p-type having narrow band gap as an active region

This 3rd layer is sandwiched between the 2nd layer and 4th layer

Working:

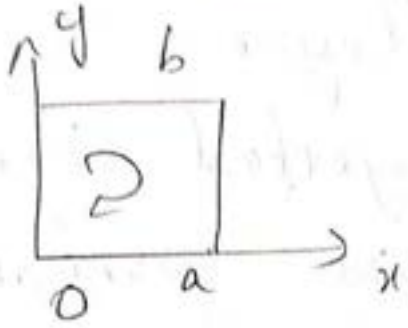
* The diode is forward biased and hence charge are produced in the band gap layer.
* These injected carriers combine and produces spontaneously emitted photons.



13

14)

b) Schrodinger equation for an electron confined in a 2D box



In this rectangle electron wave function behaves as the free Particle

$$V(x,y) = 0$$

$\psi(x,y,t) = 0$ at the walls

Outsides the box the schrodinger equation for one dimensional box

$$\psi(x,y) = 0 \rightarrow (1)$$

Inside the box schrodinger eqn 1 d box is

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi(x)}{\partial x^2} + V(x)\psi(x) = E\psi(x) \rightarrow (2)$$

extending 2D now the eqn

$$\frac{-\hbar^2}{2m}\left(\frac{\partial^2\psi(x,y)}{\partial x^2} + \frac{\partial^2\psi(x,y)}{\partial y^2}\right) + V(x,y)\psi(x,y)$$

$= E\psi(x,y)$ → (3)

Boundary Condition

$V(x,y) = 0$ within the box
$V(x,y) = \infty$ Outside box } (4)

Put (4) in (3) We get

$$\frac{-\hbar^2}{2m}\left(\frac{\partial^2\psi(x,y)}{\partial x^2} + \frac{\partial^2\psi(x,y)}{\partial y^2}\right) + 0 = E\psi(x,y)$$

$$\frac{-\hbar^2}{2m}\frac{\partial^2\psi(x,y)}{\partial x^2} + \frac{\partial^2\psi(x,y)}{\partial y^2} = E\psi(x,y) \longrightarrow (5)$$

$$\frac{-\hbar^2}{2m}\frac{\partial^2\psi(x)}{\partial x^2} = E_x\psi_x(x) \longrightarrow (6)$$

$$\frac{-\hbar^2}{2m}\frac{\partial^2\psi(y)}{\partial y^2} = E_y\psi_y(y) \longrightarrow (7)$$

xy eqn (6) & (7)

$$\psi_x(x) = \sqrt{2/a}\sin\left(\frac{n_x\pi x}{a}\right) \longrightarrow (8)$$

$$\psi_y(y) = \sqrt{2/b}\sin\left(\frac{n_y\pi y}{b}\right) \longrightarrow (9)$$

$$E_{nx} = \frac{n_x^2 h^2}{8ma^2}$$

$$E_{ny} = \frac{n_y^2 h^2}{8mb^2}$$

$$E_{nx} \cdot E_{ny} = \frac{h^2}{8m}\left[\frac{n_x^2}{a^2} + \frac{n_y^2}{b^2}\right]$$

$n_x = n_y = 1$

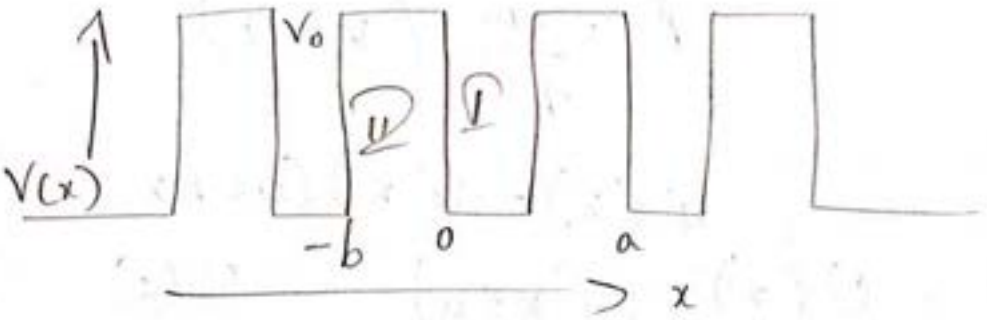
For several combination of quantum numbers same energy eigen value but different eigen function

Such a state of energy levels is called degenerate state.

Suppose only one wave function corresponds to same energy eigen values the state is said to be called non degenerate state.

15)
b) The Kronig Penney Model

The study of essential behavior of electrons by approximating the potentials inside a crystal to the shape of rectangular steps is called Kronig penney model of potentials



$V(x) = V_0$ for $-b < x < 0$

and

$V(x) = 0$ for $0 < x < a$

Period of potential $(a+b)$

Schrodinger eqn

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E-V)\psi = 0$$

Region I $\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E)\psi = 0$ for $0 < x < a$

[Since V = 0] → (1)

Region II $\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E-V_0)\psi = 0$ for $-b \leq x < 0$

[Since V = 0] → (2)

$$\frac{d^2\psi}{dx^2} + \alpha^2\psi = 0 \quad \text{for } 0 < x < a \rightarrow (3)$$

$$\frac{d^2\psi}{dx^2} - \beta^2\psi = 0 \quad \text{for } -b < x < 0 \rightarrow (4)$$

$$\alpha^2 = \frac{2mE}{\hbar^2}$$

$$E_{nx} \cdot E_{ny} = \frac{h^2}{8m}\left[\frac{n_x^2}{a^2} + \frac{n_y^2}{b^2}\right]$$

$n_x = n_y = 1$

For several combination of quantum numbers same energy eigen value but different eigen function

Such a state of energy levels in called degenerate state.

Suppose Only One wave function corresponds to same energy eigen values the state is said to be called non degenerate state.

15)
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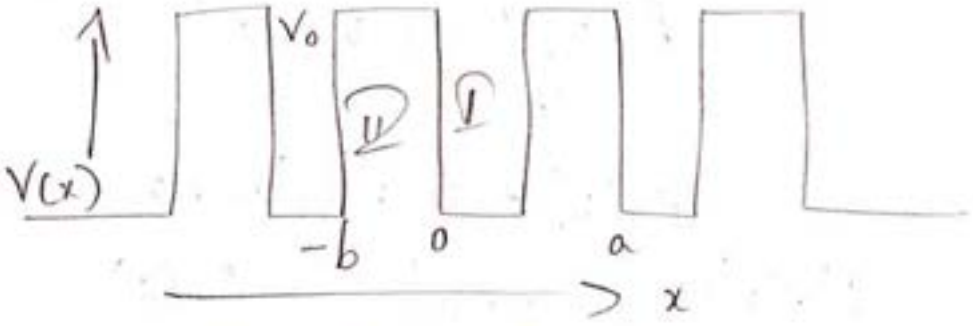


$V(x) = V_0$ for $-b < x < 0$

and

$V(x) = 0$ for $0 < x < a$

Period of potential $(a+b)$

Schrodinger eqn

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E-V)\psi = 0$$

Region I $\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E)\psi = 0$ for $0 < x < a$

[Since $V = 0$] $\rightarrow$ (1)

Region II $\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E-V_0)\psi = 0$ for $-b < x < 0$

[Since $V = 0$] $\rightarrow$ (2)

$$\frac{d^2\psi}{dx^2} + \alpha^2\psi = 0 \text{ for } 0 < x < a \rightarrow (3)$$

$$\frac{d^2\psi}{dx^2} - \beta^2\psi = 0 \text{ for } -b < x < 0 \rightarrow (4)$$

$$\alpha^2 = \frac{2mE}{\hbar^2}$$

$$\beta^2 = \frac{2m}{\hbar^2}(V_0 - E)$$

$$\psi(x) = U(x)\cos kx \rightarrow (5)$$

$$U(x) = U(x+a) \rightarrow (6)$$

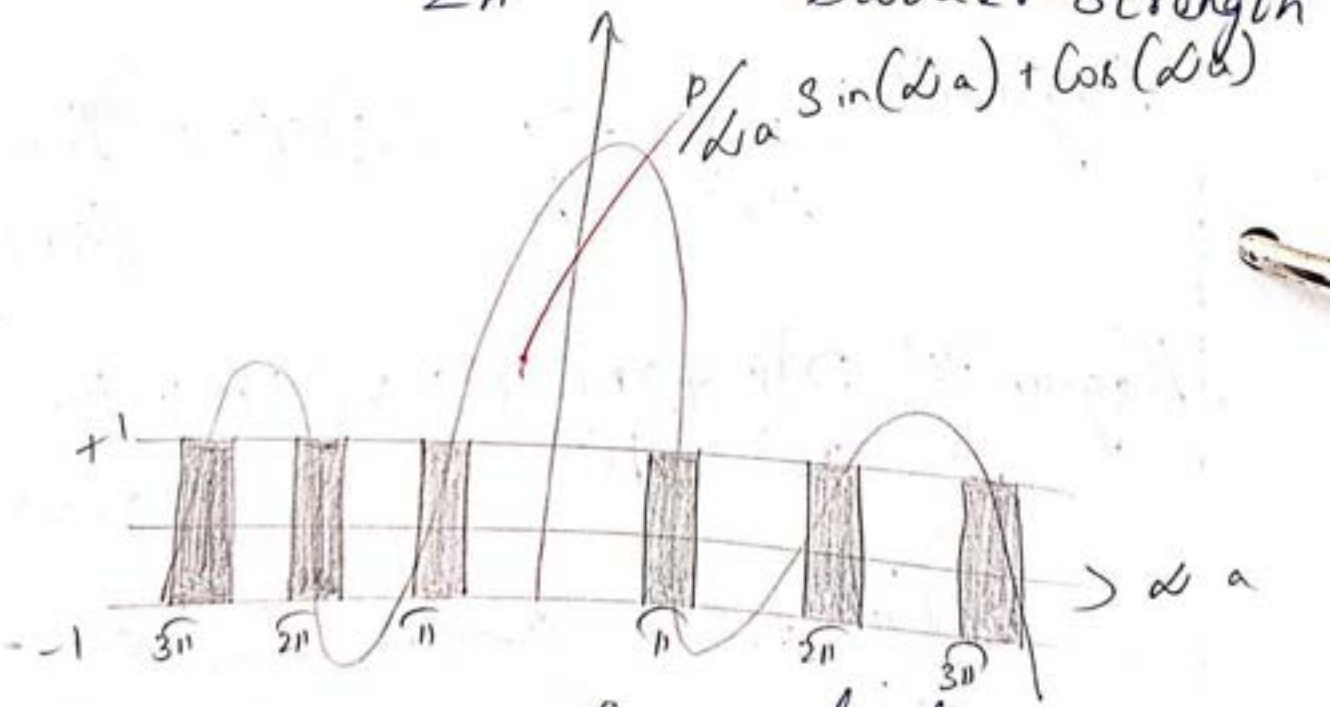
eqn (3) and (4) boundary conditions

$$\frac{8\pi^2 m V_0}{2h^2 a} b \cdot \sin(\alpha, a) + \cos(\alpha a) = \cos(ka) \rightarrow (7)$$

$$P/\alpha a \sin(\alpha a) + \cos(\alpha, a) = \cos(ka)$$

$$\rightarrow (8)$$

$$P = \frac{8\pi^2 m V_0 \alpha b}{2h^2} = \text{potential barrier strength}$$



The energies of an electron moving under a periodic lattice potential lie only in certain allowed zones other energies forbidden.

12)
b) Neither stationary charges nor steady currents can produce electro magnetic waves. Electromagnetic waves are the combination of electric and magnetic field produced by moving charges.

We know that a magnetic field will be produced in empty space if there is a changing electric field. A changing magnetic field produces an electric field that is itself changing and so on. The net result of there continuously interacting changing electric and magnetic field. Produces and electromagnetic wave Theory.

Let us consider two conducting rods which are connected to a

Source of alternating voltage. This setup will serve as an antenna for electromagnetic waves.

* The AC generator forces the charges to accelerate between the two rods.
* The antenna can be approximated and compared to an oscillating electric dipole.
* The electric field (E) surrounding the wire is produced by the charge distribution on the wire.
* Both the electric field, E and the charge distribution vary as the current charges. The changing field propagates outward at the speed of light.
* The magnetic field associated with the changing electric field form concentric circle around the antenna and are perpendicular to the electric field lines at all points.

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2023 - 2024

REWRAP TEST QUESTIONS

&

SAMPLE ANSWER SCRIPT

Stella Mary's College of Engineering

Aruthenganvilai, kallukatti Jn, AzhikalPost, KanyaKumari District629202,
Affitliated by NAAC, Approved by NBA (MECH & CSE)

REWRAP TEST -I(2023-2024 ODD)

(Common to Mech and ECE)

Year/Sem: I/I **Time: 55 Mins**

Date:05-10-2023 **Marks:20 MARKS**

PART A

(5x2=10 Marks)

1.Define Centre of mass.

2.Define radius of gyration

3. Define moment of inertia

4.Define torque

5. Give the characteristics of nonlinear oscillations

Part B

(16x1=16Marks)

1.Write the equation of kinetic energy of the system of particles.

Prepared By **Verified By** **HOD**

20/20

REWRAP Test - I

Part - A

1. **Centre of mass:**

Centre of Mass of a body or System of a Particle is defined as a point at which the Whole Mass of the body are appeared to be Concentrated.

2. **Radius of gyration:**

The root Mean Square distances of all the Particles about the axis of rotation is known as radius of gyration.

$$k = \frac{\sqrt{r_1^2 + r_2^2 + r_3^2 + \cdots r_n^2}}{n}$$

$n \rightarrow$ Total number of particles in the body

3. **Moment of Inertia:**

It is defined as the property of a rigid body by which it opposes any change in its rotational state of motion about a given axis

$$I = mr^2$$

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REWRAP TEST -II (2023-2024 ODD)

(Common to Mech and ECE)

Year/Sem: I/ I **Time: 55 Mins**

Date:13-10-2023 **Marks: 20 MARKS**

PART A

(5x2=10 Marks)

1. Indicate the applications of Maxwell's equations.

2. Write the significance of maxwell's second equation

3. State Gauss law of electrostatics.

4. Define current density

5. Define the term radiation pressure

Part B

(10x1=10 Marks)

1. Write the Maxwell's first and second equation in differential and integral form.

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REWRAP TEST - II

Part - I

20/20

1. * Provides Mathematical model for electric optical, and radio technologies.

* Applied in the Study of power generation and Wireless Communication.

2. Significance :

* Magnetic Monopole does not exist.

* Total Magnetic flux through a closed Surface is zero.

3. Gauss law of electrostatics :

It States that electric flux passing through any closed Surface is equal to $\frac{1}{\varepsilon_0}$ times the total charge enclosed by the Surface.

$$\iint E \cdot ds = \frac{q}{\varepsilon_0}$$

4. Current density :

The current per unit area of cross section of an imaginary surface held normal to the direction of current in a current carrying conductor.

$$J = \frac{I}{A}$$

5. Radiation pressure :

The force per unit area exerted by the electromagnetic wares when they encounters the surface of an object is called radiation pressure.

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REWRAP TEST -III (2023-2024 ODD)

(Common to Mech and ECE)

Year/Sem: I/ I **Time: 55 Mins**

Date: 25-10-2023 **Marks: 20 MARKS**

PART A

(5x2=10 Marks)

1. Infer the conditions for Simple harmonic oscillator.

2.Define simple harmonic motion?

3. Cite the applications of Doppler effect

4.List the properties of sound waves

5. List the characteristics of simple harmonic motion?

Part B

(10x1=10Marks)

1.Derive the expression for the properties of EMW in dielectric medium.

Prepared By **Verified By** **HOD**

REWRAP TEST - III

Part - A

20/20

1. Condition for SHM.

i) There Must be a position of Stable equilibrium.

ii) There Must be no dissipation of energy.

iii) Accelaration is always opposite directed and propotional to the displacement.

2. Simple harmonic Motion :

The osillatory motion in which the restoring force is directly propotional to the displacement And acts in the direction opposite to that of displacement.

3. * In radar and sonar.

* In medical Imaging to study development of fetus using pulse - echo technique.

* To measure of peed of an automobile.

* In Satellite communication and in astronomy.

4. * Sound is a Mechanical wave and requires a medium to propagate.
* Sound Wave are reflected and refracted like light Wave.
* They show interference and diffraction effects.

5. * The Motion must be periodic.
* The body must have inertia.
* The body must be elastic.
* The frictional forces are small enough to be ignored.

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REWRAP TEST -IV (2023-2024 ODD)

(Common to Mech and ECE)

Year/Sem: I/ I **Time: 55 Mins**

Date:3-11-2023 **Marks: 20 MARKS**

PART A

(5x2=10 Marks)

1. State Snell's law.

2.Define refractive index of a medium?

3. Cite the applications of CO_2 laser

4.List the applications of lasers in industry

5. Recognize the principal of semiconductor laser?

Part B

(10x1=10Marks)

1.Express the principal and working of Nd-YAG laser with a neat diagram.

Prepared By **Verified By** **HOD**

19/20

REWRAP TEST - IV

Part - A

1. The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for any two given medium is known as Snell's law.

$$n_1 \sin\theta_i = n_2 \sin\theta_r$$

2. The ratio between the Sin of the angle of incidence and the Sin of the angle of refraction is called the refractive index of the given medium.

3. * In Material processing like welding, cutting, drilling.
   * In remote sensing.
   * In open air communication.
   * In micro surgery, bloodless surgery, dental care.

4. * Industrial cutting.
* Industrial drilling.
* Industrial welding.
* To Scan the universal barcodes to indentify Products.
* To Take three - dimensional photography.
* In the field of fiber optic Communication.

5. Principal :

Electrons in the conduction band recombines with holes in the valence band release energy in the form of light photons.

The photons stimulate further recombine of electrons and the holes which produces laser output.

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REWRAP TEST -V (2023-2024 ODD)

(Common to Mech and ECE)

Year/Sem: I/ I **Time: 55 Mins**

Date: 9-11-2023 **Marks: 20 MARKS**

PART A

(5x2=10 Marks)

1. Infer the conditions for Simple harmonic oscillator.

2.Define simple harmonic motion?

3. Cite the applications of Doppler effect

4.Define critical angle

5. List the characteristics of simple harmonic motion?

Part B

(10x1=10Marks)

1.Derive the expression for Einstein's coefficients and hence explain the existence of stimulated emission of radiation.

Prepared By **Verified By** **HOD**

REWRAP TEST - V

Part - I.

20/20

1. Condition for SHM

* There must be a position of stable equlibrium.

* There must be a no disssipation of energy

* Acceleration is always opposite direction and Propotional to the displacement.

2. Simple hormonic motion:

The oscillatory motion in which the restoring force is directly propotional to the displacement and acts in the direction opposite to that of displacement.

3. Application of Doppler effect

* In RADAR and SONAP

* In medical imaging to study development of fetus using Pulse-echo technique

* To measure speed of a automobile

* In Satellite Communication and in astronomy.

4. Critical angle

When light travels from denser to rarer medium, and if the angle of incident (θ_i) is increased, the angle of refraction (θ_r) also increases until it reaches 90°. when $\theta_r = 90°$, the refraction ray travels along the interface

The angle of incidence at which the angle of refraction becomes 90° is called the critical angle (θ_c)

when $\theta_i = \theta_c$. $\theta_r = 90°$

5. Characteristic of SHM

* The motion must be periodic
* The body must have inertia.
* The body must be elastic
* The frictional force are small enough to be ingnored.

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Affitliated by NAAC, Approved by NBA (MECH & CSE)

REWRAP TEST -VI (2023-2024 ODD)

(Common to Mech and ECE)

Year/Sem: I/ I **Time: 55 Mins**

Date: 30-11-2023 **Marks: 20 MARKS**

PART A

(2x2=4 Marks)

1. Define wavefunction

2.Give the significance of wave function?

Part B

(16x1=16 Marks)

1.Derive Schrodinger time dependent and time independent equation

Prepared By **Verified By** **HOD**

REWRAP TEST - VI

Part - I

4/20

1. A mathematical function which represents both a particle's wave like characteristics and its uncertainity in location is known as wave function

2. * It is a complex quantity represend the variation of matter wave

* The wave function Ψ gives the probability of finding a particle at a given place at a particular instant of time

* $|\Psi|^2$ represents the probability density of the particle, which is real, positive and can be measured.

* The wave function relates the particle and the wave.

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REWRAP TEST -VII (2023-2024 ODD)

(Common to Mech and ECE)

Year/Sem: I/ I **Time: 55 Mins**

Date: 14-12-2023 **Marks: 20 MARKS**

PART A

(10x2=20 Marks)

1. Define harmonic oscillator
2. Outline the principle of scanning tunneling microscope
3. What is quantum tunneling?
4. Comment on Kronig-penny model of potential
5. Define resonant diode.
6. Define transmission coefficient.
7. What is a finite potential well.
8. Give the characteristics of potential well
9. List the advantages of resonant diode
10. Infer the conclusion of particle in a finite potential well

Prepared By **Verified By** **HOD**

Rewrap test : VII

1. Harmonic oscillator

Any oscillating system for which the net restoring force is directly proportional to the negative of the displacement is called an harmonic oscillator.

2.

Quantum tunnelling is the principle of tunnelling microscope where the electrons can tunnel through the vacuum between the atoms of the probe tip and the surface.

3. Quantum tunnelling

The ability of particles with less energy than that of a potential barrier to penetrate through it is known as quantum tunnelling

4. kronig - penny model of potential

The study of essential behaviour of electrons by approximating the potentials inside a crystal to the shape of rectangular steps is called kronig - penney model of potentials.

5. Resonant diode.

A diode with a resonant tunnelling structure that allow electrons to tunnel through various resonant states at certain energy levels is known as a resonant diode.

6. Transmission coefficient

The probability that the particle get through a potential barrier is called transmission coefficient (T)

$$T = \frac{\text{Probability density of transmitted wave}}{\text{Probability density of incident wave}}$$

7. Finite Potential well.

A box with finite potential walls in which a particle ~~get through a potential barrier is called transmission coefficient~~ (T) is confined to its is know as a finite potential well.

8 Characteristics of potential

The number of bound state energies is finite

The number of bound state increase with the width and depth of the well.

Tunnelling into the barrier is positive

Higher energy states are less tightly bound than lower ones.

A particle provided with enough energy can escape the well.

9. Advantages of resonant diode

Extremely high switching speed
Low power consumption
Room temperature operation

10. Conclusion of particle in a finite potential well.

The eigen function (ψ) are same as those of infinite well.

Even though the particle energy E, is less than potential energy V_0, there is a probability of particle found outside to the box

The particle energy is not energy to break through the walls but it can penetrate the walls.

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2023 - 2024

ASSIGNMENTS

STELLA MARY'S COLLEGE OFENGINEERING

Aruthenganvilai,KallukattiJunction,AzhikalPost,Kanyakumari District–629202

ASSIGNMENT-1

Class:Mechanical Engineering

Semester :I

Code:PH3151

Subject : Engineering Physics

Topic:Theorems of Moment of Inertia (Fast Learners)
&Gyroscope(Slow learners)

ASSIGNMENT - 1

PHYSICS

Topic: Theorems of
Moment of inertia

Submitted by,

S. Gokul

19

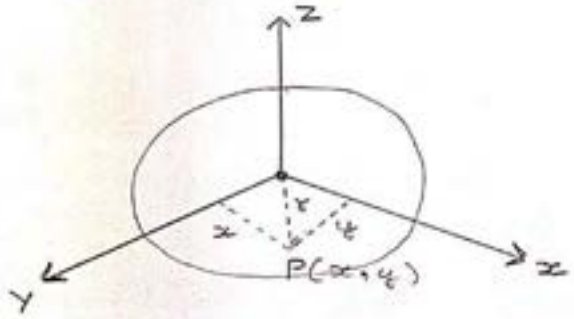
Mechanical

THEOREMS OF MOMENT OF INERTIA

1) Perpendicular axis theorem:

Statement:

The moment of inertia of a planar body about an axis perpendicular to its plane and passing through the point of intersection of two mutually perpendicular axes is equal to sum of moment of Inertia about the two mutually perpendicular axes lying in the same plane.



$$I_z = I_x + I_y$$

Let I_x, I_y, I_z be the moment of inertia of the planar body along three mutually perpendicular axes passing through point O. The axes OZ is perpendicular to the planar body.

Let the planar body be divided into large number of particles each of mass m.

A particle at P at a distance r from O has co-ordinate P(x, y) which gives,

$$r^2 = x^2 + y^2 \longrightarrow (1)$$

The moment of inertia of a particle P about the axes OZ is

$$OZ = mr^2 \longrightarrow (2)$$

∴ Moment of inertia of the whole planar about the axis OZ

$$I_Z = \Sigma mr^2 \longrightarrow (3)$$

∴ Moment of inertia of the whole planar body along the axis OX is

$$I_x = \Sigma mx^2 \longrightarrow (4)$$

Similarly, moment of inertia of the whole planar body about the axis OY is

$$I_y = \Sigma my^2 \longrightarrow (5)$$

$$(3) \Rightarrow I_Z = \Sigma m(x^2+y^2)$$

$$I_Z = \Sigma mx^2 + \Sigma my^2$$

∴ Perpendicular Axis Theorem is Proved.

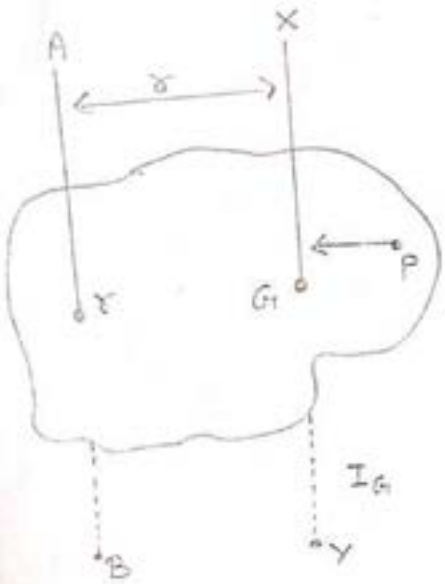
2) Parallel axis theorem:

Statement:

This theorem is applicable to all body of any shape.

The moment of inertia of a rigid body above any axis is equal to sum of moment of inertia above a parallel axis through in centre of gravity and product of mass of the body and square of the distance between two parallel axis.

$$I = I_G + Mr^2$$



Consider a rigid body with up mass M whose centre of gravity is at G

Let the body rotate above the axis AB and its moment of inertia above AB is I

Let XY be the parallel axis passing through a centre of gravity G.

The r represent the distance between the two axis. Consider a particle P with up mass m and distance of particle from axis $\underline{AB = r + x}$

Moment of inertia of a particle about the axis

$$AB = m(r+x)^2 \rightarrow (1)$$

$\therefore$ Moment of inertia of a whole body about the axis AB is

$$I = \Sigma m (r+x)^2$$

$$I = \Sigma m (r^2 + x^2 + 2rx)$$

$$I = \Sigma mr^2 + \Sigma mx^2 + 2\Sigma mrx \rightarrow (2)$$

we know, $\Sigma m = M \rightarrow (3)$

Moment of inertia of a particle P from XY axis is

$$I_{G_1} = mx^2$$

∴ Moment of inertia for the whole body from XY is $I_{G_1} \Sigma mx^2 \longrightarrow ④$

$① \Rightarrow I = My^2 + I_{G_1} + 2 \Sigma my^2 \longrightarrow ⑤$

Force, acting on the particle

$$F = mg$$

∴ Moment of force about XG_1X axis $= mg.x$

$$\text{Sum} = mgx$$

$$⑤ \Rightarrow I = my^2 + I_{G_1} + 0$$

$$\therefore I = I_{G_1} + My^2$$

Hence, Parallel axis theorem is proved.

Physics

Assignment-2

9/12 W

By
U. Nithin
1st Year MECH
Roll NO: 36

GYROSCOPE

A gyroscope is a device consisting of a wheel or disc that spins rapidly about an axis that is also free to change direction.

It is a mechanism which has a quit high spinning speed, mass and three degrees of freedom.

Principle :

The Working Principle of a gyroscope is based on Conservation of angular momentum.

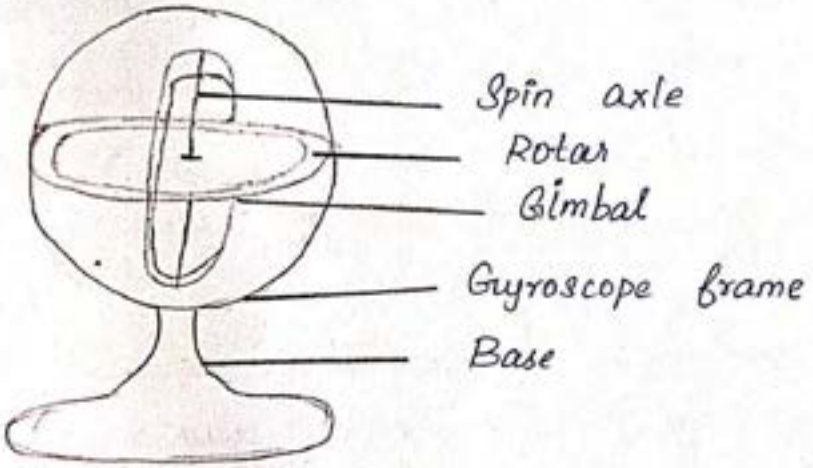
Properties :

A gyroscope has two basic properties :

1. Rigidity - The axis of rotation of the gyro wheel tends to remains in a fixed direction in space if no force is applied to it.

2. Precession - The axis of rotation has a tendency to turn at a right angle to the direction of an applied force.

Design of Gyroscope



Gyroscope.

* A gyroscope can be considered as a massive rotar that is fixed on the supporting rings known as the gimbals.
* The central rotar is isolated from the external torques with the help of frictionless bearing that are present in gimbals.
* The spin axis is defined by the axle of the spinning wheel.
* The rotar has exceptional stability at high speeds as it maintains the high speed rotation axis at the central rotar. The rotar has three degree of rotational freedom.

Working :

* The gyroscope is normally mounted so that the gimbals support the weight of the gyroscope, but cause no torques about its centre of mass.

* If the axle is initially pointing in a fixed direction, the angular momentum of the gyroscope points along the axle.

* Because the gyroscope experience no external torque, its angular momentum conserved and the axel maintains its initial orientation. This allow the gyroscope to be used as a navigational device on ships, aeroplanes, and spacecraft.

* In this situation, the gyroscope undergoes a charecteristic type of motion called precession, in which the axis of rotation swings around as if on the surface of a cone.

Applications :-

* Large gyroscopes are used in ship stabilized to counteract rolling.

* Automatic steering system, such as those used in airplanes and missiles.

* In gyroscopes, a directional instrument used on ships. unaffected by magnetic variations, its spinning axis, when brought in line with the north. South axis of the earth, provides an accurate line of reference for navigation.

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ASSIGNMENT-2

Class:Mechanical Engineering

Semester :I

Code:PH3151

Subject : Engineering Physics

Topic:Cell Phone Reception (Fast learners) &

Properties of Electromagnetic waves in dielectric medium(Slow learners)

PHYSICS
ASSIGNMENT-3.

G. Agash.
1st year MECH
Roll no: 02.

PROPERTIES OF ELECTROMAGNETIC. WAVE IN MATTER IN DIELECTRIC.

Let us apply Maxwell's electromagnetic equation to a homogeneous and isotropic dielectric medium.

there is $J = 0$, no volume distribution of charge

the charge density D is zero

There are 4 properties.

1. Speed.
2. Orientation
3. App Amplitude
4. phase

1. Speed.

Wave equation interms of Electric field

$$\nabla^2 \vec{E} - \varepsilon\mu \frac{\partial^2 \vec{E}}{\partial t^2} = 0 \quad \text{——} (1).$$

Wave equation interms of magnetic field

$$\nabla^2 \vec{B} - \varepsilon\mu \frac{\partial^2 \vec{B}}{\partial t^2} = 0 \quad \text{——} (2).$$

Single wave equation, interms of electric and magnetic field.

$$\nabla^2 f - \xi\mu \frac{\partial^2 f}{\partial t^2} = 0 \quad \text{——} (3).$$

$f \longrightarrow$ scalar function

General wave equation is

$$\nabla^2 \psi - \frac{1}{v^2} \frac{\partial^2 \psi}{\partial t^2} = 0 \quad \text{——} (4).$$

compare (3) & (4).

$$\frac{1}{v^2} = \xi\mu$$

$$v^2 = \frac{1}{\xi\mu}$$

$$v = \frac{1}{\sqrt{\xi\mu}} \quad \text{——} (5).$$

where, $\xi = \xi_0 \xi_r$.

$\mu = \mu_0 \mu_r$

$$v = \frac{1}{\sqrt{\xi_0 \xi_r \mu_0 \mu_r}}$$

$$v = \frac{1}{\sqrt{\xi_0 \mu_0}\sqrt{\xi_r \mu_r}}$$

we know,

$$\frac{1}{\sqrt{\xi_0 \mu_r}} = c = 3 \times 10^8 \text{ m/s} \quad \text{——} (6).$$

$$V = \frac{c}{\sqrt{\varepsilon_r \mu_r}} \quad \text{—— (7)}.$$

Velocity of Electromagnetic wave is less than velocity of light in dielectric medium.

from eqn (5).

sub (7) in (5).

$$\frac{c}{\sqrt{\varepsilon_r \mu_r}} = \frac{1}{\sqrt{\varepsilon \mu}}$$

squaring on both sides

$$\frac{1}{\varepsilon \mu} = \frac{c^2}{\varepsilon \mu_r}$$

$$\varepsilon \mu = \frac{\varepsilon_r \mu_r}{c^2}.$$

substitute the value of '$\varepsilon\mu$' in eqn (1) & (2).

$$(1) \Rightarrow \nabla^2 \vec{E} - \frac{\varepsilon \mu_r}{c^2} \frac{\partial^2 \vec{E}}{\partial t^2} = 0 \quad \text{—— (8)}.$$

$$(2) \Rightarrow \nabla^2 \vec{E} - \frac{\varepsilon_r \mu_r}{c^2} \frac{\partial^2 \vec{B}}{\partial t^2} = 0 \quad \text{—— (9)}.$$

2. Orientation.

Solution of wave equation.

$$\vec{E}_{(r,t)} = \vec{E}_0 e^{i(\vec{k}\cdot\vec{x} - \omega t)} \quad \text{—— (10)}.$$

$$\vec{B}_{(r,t)} = \vec{B}_0 e^{i(\vec{k}\cdot\vec{x} - \omega t)} \quad \text{—— (11)}.$$

$\vec{k}$ is a wave vector.

$\vec{\nabla} = i\vec{k}$; $\partial/\partial t = -i\omega$.

Maxwell's equation in dielectric medium

1. $\vec{\nabla}\cdot\vec{E} = 0$ —— (12).
2. $\vec{\nabla}\cdot\vec{B} = 0$ —— (13).
3. $\vec{\nabla}\times\vec{E} = -\frac{\partial\vec{t}}{\partial t}$ —— (14).
4. $\vec{\nabla}\times\vec{B} = \varepsilon\mu\frac{\partial\vec{E}}{\partial t}$ —— (15).

1. $i\vec{k}\cdot\vec{E} = 0$.

$$\vec{k}\cdot\vec{E} = 0 \quad \text{—— (16)}.$$

2. $i\vec{k}\cdot\vec{B} = 0$.

$$\vec{k}\cdot\vec{B} = 0 \quad \text{—— (17)}.$$

3. $\vec{\nabla}\times\vec{E} = 0$.

$$i\vec{k}\times\vec{E} = -(-i\omega)\vec{B}$$

4. $\vec{\nabla}\times\vec{B} = \varepsilon\mu\frac{\partial\vec{E}}{\partial t}$

$$i\vec{k}\times\vec{B} = \varepsilon\mu(-i\omega)\vec{E}.$$

$$\vec{k}\times\vec{B} = -\omega\varepsilon\mu\vec{E} \quad \text{—— (19)}.$$

Amplitude and phase.

(18) $\Rightarrow \vec{k} \times \vec{E} = \omega \vec{B}$.

$\vec{k} = k\hat{n}$, $\hat{n} \longrightarrow$ unit vector.

$\vec{k}\hat{n} \times \vec{E} = \omega \vec{B}$.

$\hat{n} \times \vec{E} = \omega/k \, \vec{B}$.

For a dielectric medium

$v = \omega/k$.

$\hat{n} \times \vec{E} = v\vec{B}$.

$\vec{B} = 1/v \, \hat{n} \times \vec{E}$ —— (20).

$|\vec{B}| = 1/v \, |\hat{n} \times \vec{E}|$.

$\vec{B} = 1/v \, \vec{E}$ — (21).

we know,

$\vec{B} = \mu \vec{H}$.

$\mu \vec{H} = 1/v \, \vec{E}$.

$\frac{\vec{E}}{v} = \mu \vec{H}$

$\frac{\vec{E}}{\vec{H}} = v\mu$ —— (22).

we know,

$$v = \frac{1}{\sqrt{\mu\epsilon}}$$

sub in (22).

$$\frac{\vec{E}}{\vec{H}} = \frac{\mu}{\sqrt{\varepsilon \mu}}.$$

$$\frac{\vec{E}}{\vec{H}} = \frac{\sqrt{\mu}\sqrt{\mu}}{\sqrt{\varepsilon}\sqrt{\mu}}$$

$$\frac{\vec{E}}{\vec{H}} = \sqrt{\frac{\mu_r}{\varepsilon_r}}$$

multiply μ_0 & ε_0

$$\frac{\vec{E}}{\vec{H}} = \sqrt{\frac{\mu_0 \mu_r}{\varepsilon_0 \varepsilon_r}}$$

$$\eta = \sqrt{\frac{\mu_0}{\varepsilon_0}} \sqrt{\frac{\mu_r}{\varepsilon_r}} \quad \text{——— (23)}.$$

where, $\eta = \frac{E}{H}$ is the impedance of an EMW in dielectric medium.

For intrinsic impedence $\eta_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}}$

$$\eta = \eta_0 \sqrt{\frac{\mu_r}{\varepsilon_r}} \quad \text{——— (24)}.$$

$$\eta = \frac{\vec{E}}{\vec{H}}$$

$$\vec{E} = \eta \vec{H}.$$

The field vector of EMW is inphase with each other. The amplitude of electric field vector is η time the magnetic field vector.

PHYSICS

ASSIGNMENT : 1

BY.
S. Thanga pooja
1st Mech

Cell Phone Reception

Cell phones work by communicating with the nearest phone mast, and then the base station

A cell phone contains a radio transmitter and receiver combination called transceiver. Transmission and reception take place on different frequencies, so one can talk and listen at same time. This capability is known as full duplex.

In an ideal cellular network, all the transceivers are always within range of at least one base station known as repeater. The base stations pick up the transmissions from a cell phone and retransmit the signals to the telephone network and to other cell phones. The region of coverage for any base station is called a cell.

When a cell phone is in motion, say in a vehicle, the call goes from cell to cell in the network. ~~The situation~~ the curved line is the path of the vehicle. Base stations (dots) transfer access to the cell phone. This is called handoff. Solid lines show the limits of the transmission / reception range for each base station.

All the base stations are connected to the regional telephone system. This makes it possible

for the user of the portable unit to place calls to, or receive calls from anyone else in the system.

Older cellular systems occasionally suffer from call loss or breakup when signals are handed off from one repeater to another.

This problem has been largely overcome by a technology called code-division multiple access.

In CDMA, the repeater coverage zones overlap significantly, but signals do not interfere with each other because every phone set is assigned a unique signal code.

Rather than abruptly switching from one base-station zone to the next, the signal goes through a region in which it is actually sent through more than one base station at a time.

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ASSIGNMENT-3

Class:Mechanical Engineering

Semester :I

Code:PH3151

Subject : Engineering Physics

Topic:Carbon di oxide laser (Fast Learners)

Simple Harmonic Oscillation (Slow learners)

PHYSICS ASSIGNMENT: 5

BV.

S. Thangapooja
1st Mech

10/12 Mon

Analogy between electrical and Mechanical oscillating System.

Electrical and mechanical System are set to be analogous to each other.

In spring mass system their exists their mechanical oscillation.

In LCR ac circuit there exist electrical oscillations.

Spring mass system their exists two forms of energy such as potential energy and kinetic energy.

Similarly there are two forms of energy in LCR circuit such as magnetic energy and electrical energy.

Analogus:

The following Analogies between spring mass System and LCR circuit are as follows.

The kinetic energy in spring mass System is analogous to magnetic energy of the inductor carrying current in LCR circuit.

The potential energy restored in spring mass System is analogous to electrical energy restored by the capacitor in LCR circuit.

The damping force which is responsible to slow down the oscillation in spring mass system is analogus to resistance in restrict the flow of current in LCR circuit.

proof.

Mechanical oscillation in spring mass system.

Consider a spring mass system in which a mass is loaded to a spring.

restoring forces $F_1 \propto -y \Rightarrow F_1 = -ky \rightarrow (1)$

damping forces. $F_2 \propto -v \Rightarrow F_2 = -bv \rightarrow (2)$

k is the force constant
y is the displacement
b is the damping constant
v is the velocity.

$F = ma \rightarrow (3)$

According to, accelerating force = Restoring force + damping force

$$ma = -ky - bv$$

$$ma + ky + bv = 0 \rightarrow (4)$$

we know,

$$\text{Velocity}, v = dy/dt$$

acceleration. $a = \frac{d^2y}{dt^2}$

④ $\Rightarrow \frac{md^2y}{dt^2} + b\frac{dy}{dt} + ky = 0 \rightarrow ⑤$

Eqn ⑤ represent second order differential equation for mechanical oscillations.

(ii) Electromagnetic oscillation in LCR circuit

Consider an LCR circuit and the current flows in anticlockwise direction

Let 'q' represents charge stored in the capacitor

Let 'I' be the current flowing to the circuit

According to loop's law.

$q/C + IR + L\, dI/dt = 0 \rightarrow ⑥$

we known,

Current $I = dq/dt \rightarrow ⑦$

Rate of flow of current.

$\frac{dI}{dt} = \frac{dv^2q}{dt^2} \rightarrow ⑧$

∴ put (7) & (8) in (6)

$$q/C + dq/dt\, R + L\frac{d^2q}{dt^2} = 0$$

$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + q/C = 0 \rightarrow (9)$$

Equation (9) represents 2nd order differential for electro magnetic oscillation in LCR circuit

Comparing equation (6) & (9)

$m = L$ i.e, mass = inductance

$b = R$ i.e, damping constant = resistance

$K = 1/C$ i.e, force constant = Reciprocal of capacitor

Physics Assignment - 6

Thasthir . K. K

5a

MECH .

9/10

CARBON DI-OXIDE (CO_2) LASER

Carbon dioxide laser is a four-level laser.

Vibrational modes of CO_2 molecule.

i) Symmetric Streching mode

ii) Bending mode

iii) Asymmetric Stretching mode.

- Symmebric Stretching mode:-

In this mode, the Carbon atom is at rest and the two Oxygen atom Vibrate along the axis of the molecule.

- Bending mode:-

In this mode, both the Carbon atom and Oxygen atoms Vibrate Perpendicular to the molecular axis.

- Asymmetric Stretching mode:-

In this mode, Oxygen atom and Carbon atoms vibrate asymmetrically.

Characteristics:-

Type:-	Molecular gas laser (4 level laser)
Active medium	Mixture of CO_2, N_2 and He
Active Center	CO_2 molecules
Pumping method	Electrical discharge
optical resonator	A Pair of Concave mirrors Placed at the ends of the tube
Nature of output	Pulsed or Continuous
wavelength of output	9.6 μm to 10.6 μm
Out put Power	10 KW

Principle:-

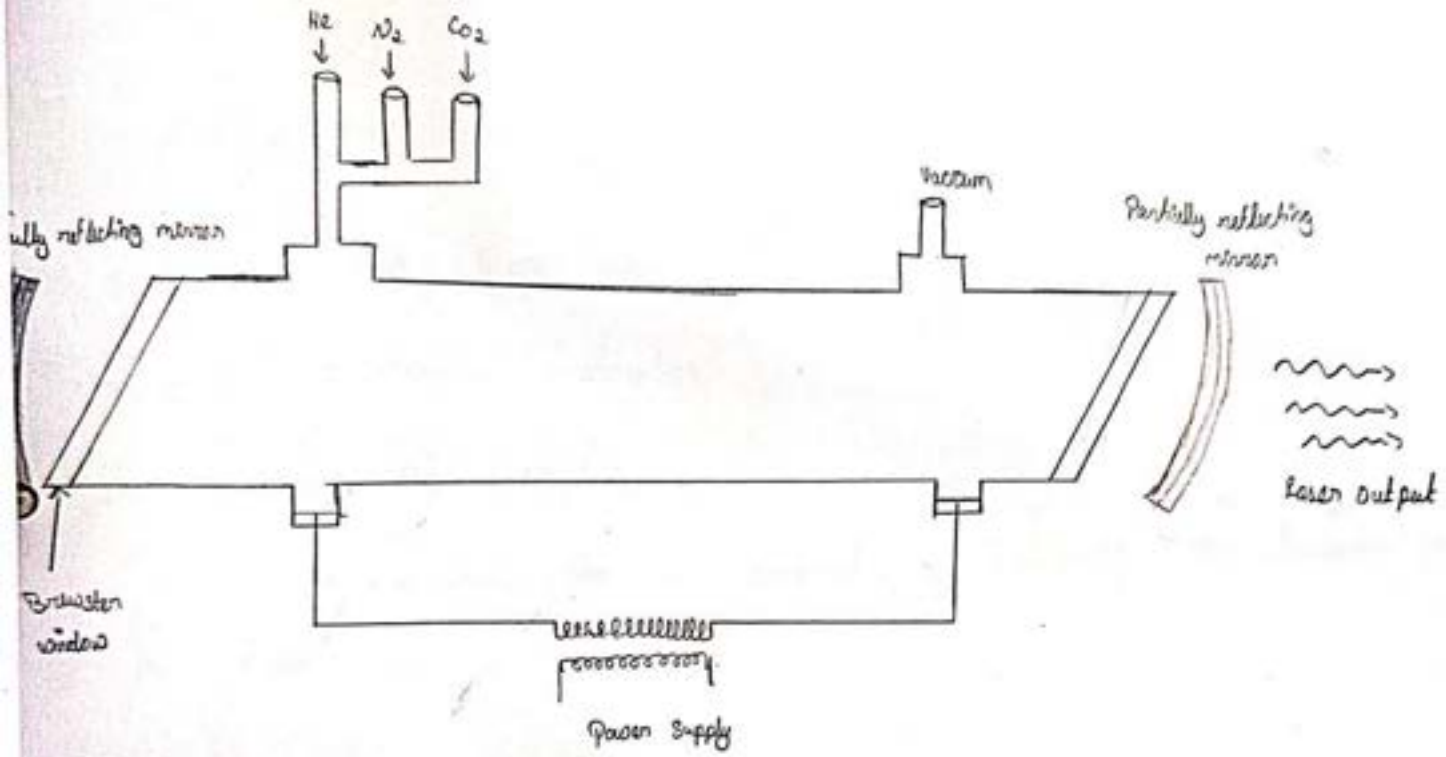
Transitions between Various Vibrational energy levels of Carbon di-oxide molecule leads to laser output.

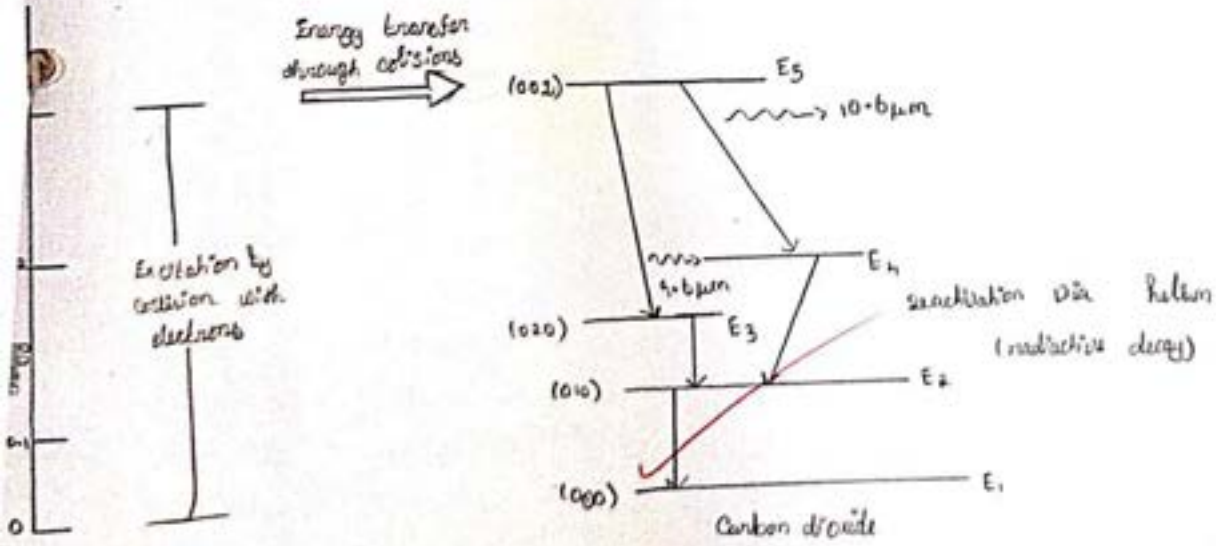
Construction:-

- The setup Consists of a quartz discharge tube with 5 cm long and 2.5 cm in diameter which contains a mixture of nitrogen and CO_2.
- A Power Supply is used to Create a Potential difference across the tube.

Working:-

- The electric discharge Passed through the quart tube accelerate electrons down the tube.
- These accelerated electrons collide with N_2 molecules and excite them to excited energy levels. $N_2 + e^* \longrightarrow N_2^* + e$.
- The excited N_2^* molecules undergo resonant energy exchange with the CO_2 molecules.





$$N_2^* + CO_2 \rightarrow CO_2^* (001) + N_2$$

- Thus Population inversion is achieved between energy levels E_5 and E_4 between E_5 and E_3. Where E_5 is the upper laser, E_3 and E_4 are lower laser.

Laser transitions:

- Transition

- High Power output
- Simple Construction
- High efficiency
- Temperature can be reduced by decreasing the diameter of the tube.

Contamination of gases may occur which decreases laser efficiency.

out Put

Physics

Assignment - VI

9/10

S. Nagesh Kumar
Roll no: 32
mechanical - I

SIMPLE HARMONIC MOTION:-

The oscillatory motion in which the acceleration of a body is directly proportional to its displacement from its equilibrium position and is always directed towards the equilibrium position is as simple harmonic motion.

Examples:-

i) Oscillation of a simple pendulum.

ii) loaded spring.

iii) Vibration of a tunning fork

$$x = A \sin(\omega t + \phi)$$

Characteristics of SHM:-

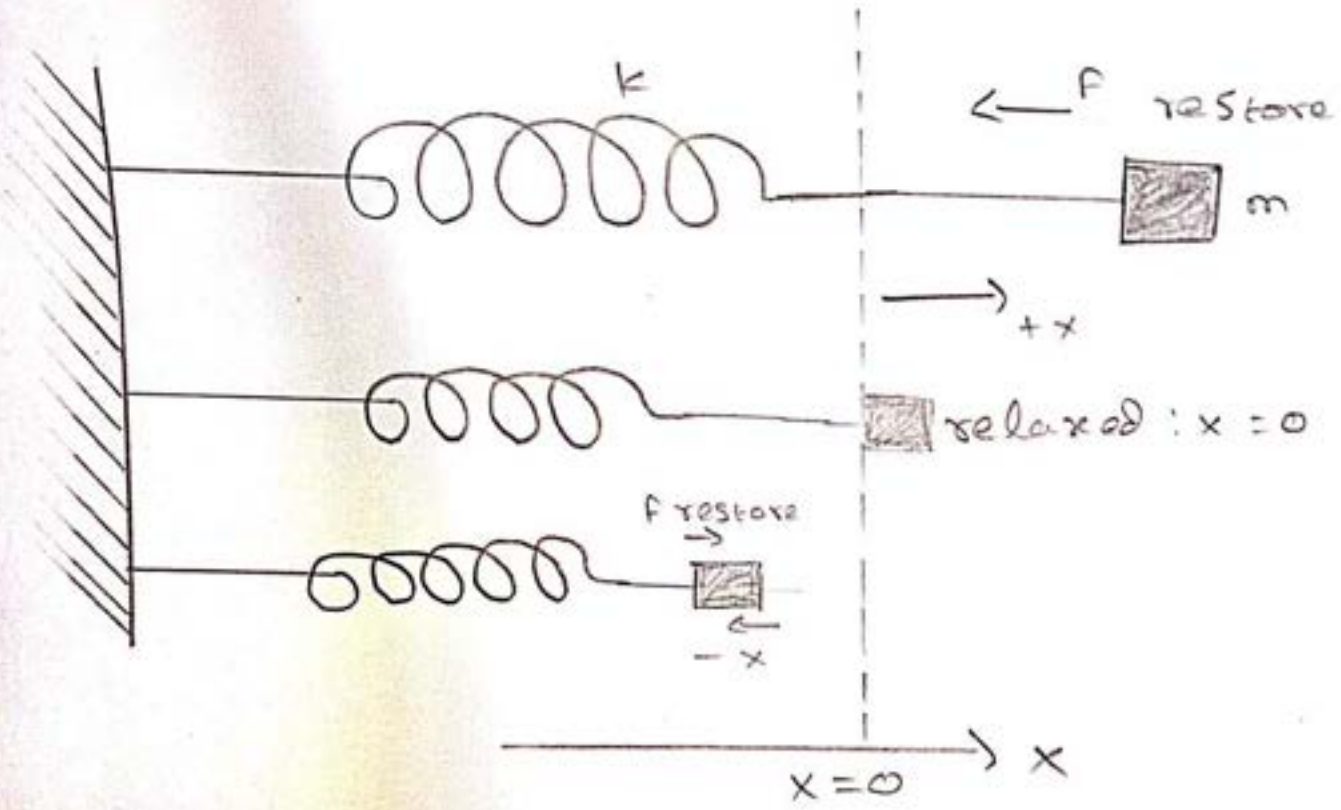
* The motion must be periodic
* The body must have inertia
* The acceleration of the body is always directly proportional to its displacement.
* The body must be elastic.
* The frictional force are small enough. too be ignored.

Differential Equation for SHM:-

* A Particle executing S.H.M is called an harmonic oscillator.

$F \propto x$

$F = -kx$



According to Newton's second law, the inetial force.

$$F = ma \quad \text{—} ③$$

comparing ① and eq. ③ we have

$$ma = -kx$$

Substituting ② in ④, we get

$$m\left(\frac{d^2x}{dt}\right) = -kx$$

$$\left(\frac{d^2x}{dt^2}\right) = -\left(\frac{k}{m}\right)x$$

$$\frac{d^2x}{dt^2} + \left(\frac{k}{m}\right)x = 0$$

$$\frac{d^2x}{dt^2} + \omega^2 x = 0$$

where $\omega = \sqrt{\frac{k}{m}}$, $x = A\sin(\omega t + \phi)$

PHYSICS

ASSIGNMENT - 6

Submitted
By
R. Siva keerthika
1st Year MECH
Roll. No: 46

CARBON DI-OXIDE LASER

Carbon Di-oxide is a four-level laser and was developed by an Indian Scientist C.K.N Patel in the Year 1964

Theory.

The CO_2 laser is based on the transitions between various vibrational and rotational energy levels of the CO_2 molecule.

Vibrational mode of CO_2 molecule.

The Carbon dioxide molecule is a linear, symmetric molecule (O-C-O)

with two oxygen atoms bonded covalently with the central carbon atom.

(i) Symmetric stretching mode

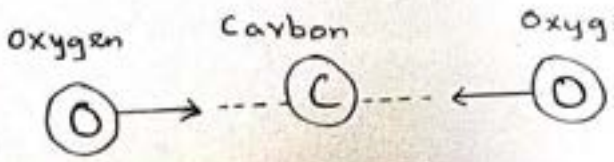
(ii) Bending mode

(iii) Asymmetric Stretching mode

(i) Symmetric Stretching mode

In this mode the carbon atom is at rest and the two oxygen atoms vibrate along the axis of the molecule moving either towards or away from the fixed carbon atom. against each other.

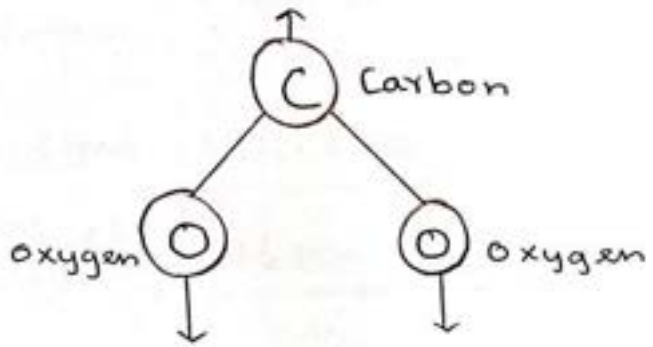
Hence, change in bond length occurs.



ii) Bending mode:

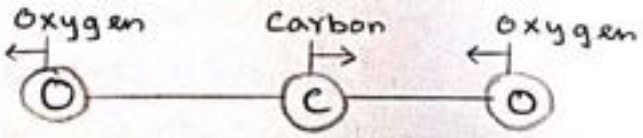
In this mode, both the Carbon atom and Oxygen atoms vibrate Perpendicular to the molecular axis

Hence, the molecule bends and change in bond angle occur.



(iii) Asymmetric stretching mode

In this mode, Oxygen and Carbon atom vibrate assymmetrically.



CHARACTERISTICS:

Type	Molecular gas laser
Active medium	Mixture of CO_2, N_2 and He
Active center	CO_2 molecules
Pumping method	Electric discharge
Optical Resonant	A pair of concave mirros placed at the ends of the tube
Nature of output	Pulsed or continuous
wavelength of output	9.6 μm to 10.6 μm
Output power	10 kW

PRINCIPLE:

Transition between various vibrational energy levels of carbon di-oxide molecule lead to laser output

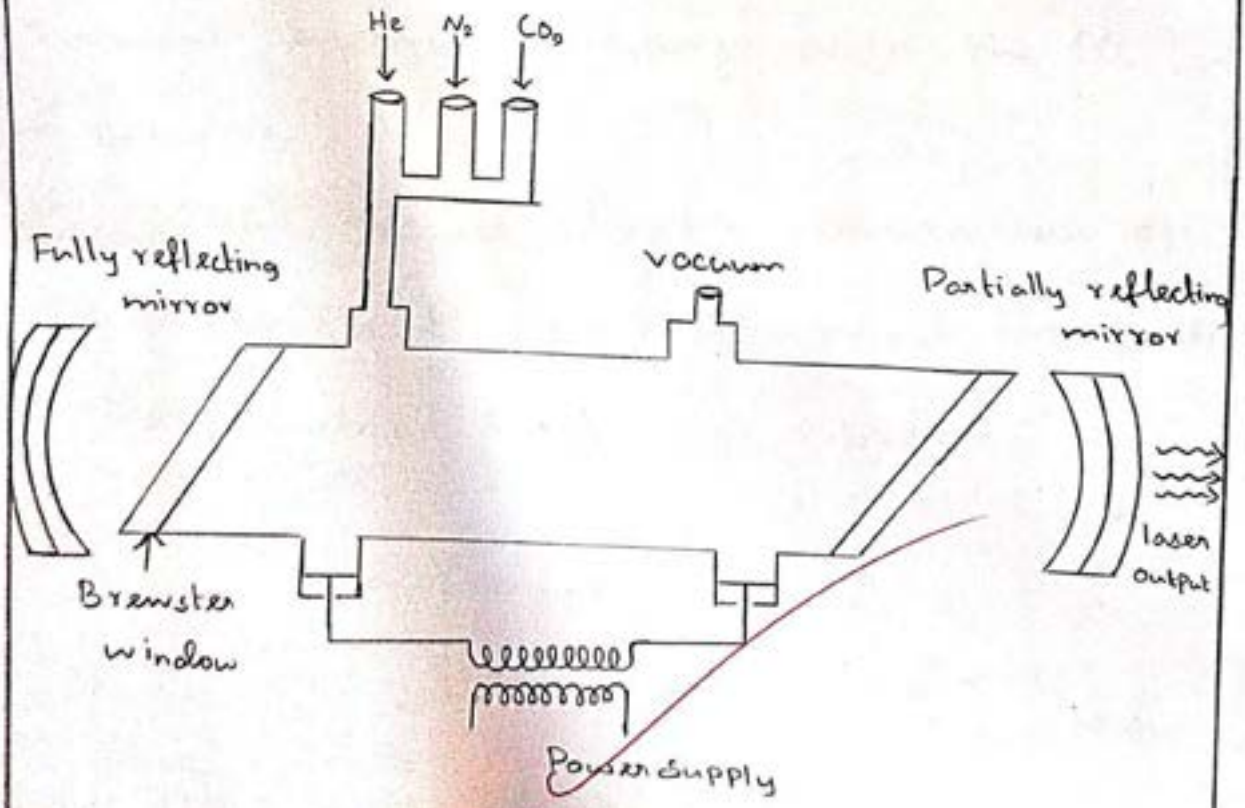
CONSTRUCTION:

* The setup consists of a quartz discharge tube with 5cm long and 2.5

diametre which contains a mixture of nitrogen and CO_2. Other additives such as helium, water vapour are also added

* A Power Supply is used to create a potential difference across the tube

DIAGRAM



WORKING

* The electric discharge Passed through the quartz tube accelerated

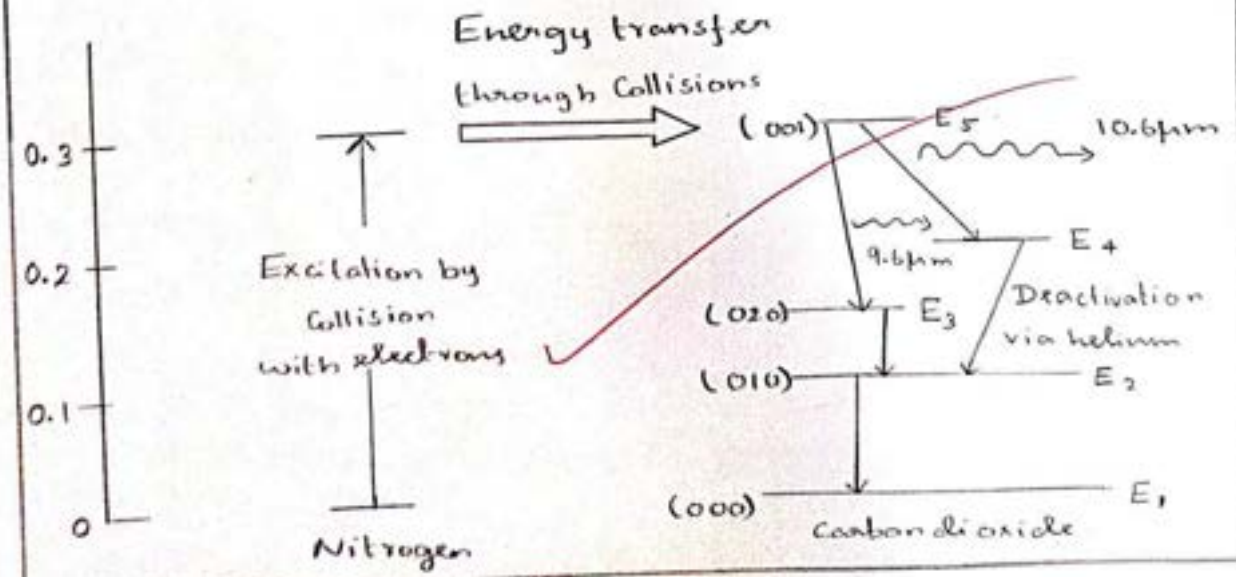
electrons down the tube

* These accelerated electrons collide with the N_2 molecules and excite them to excited energy levels.

$$N_2 + e^* \longrightarrow N_2^* + e$$

* The excited N_2^* molecules undergo resonant energy exchange with the CO_2 molecules.

* This result in the excitation of CO_2 molecules to level E_5 which corresponds to asymmetric stretching vibration (001)



$$N_2^* + CO_2 \longrightarrow CO_2^* (001) + N_2$$

* Thus, Population inversion is achieved between energy levels E_5 (001) and E_4(100) or between E_5(001) and E_3 (020). Here, E_5 is the upper laser level, E_3 and E_4 are lower laser levels

LASER TRANSITION:

* Transition from E_5(001) to E_4(100) leads to laser output with a wavelength of 10.6μm

* Transition from E_5(001) to E_3(020) leads to laser output with a wavelength of 9.6μm.

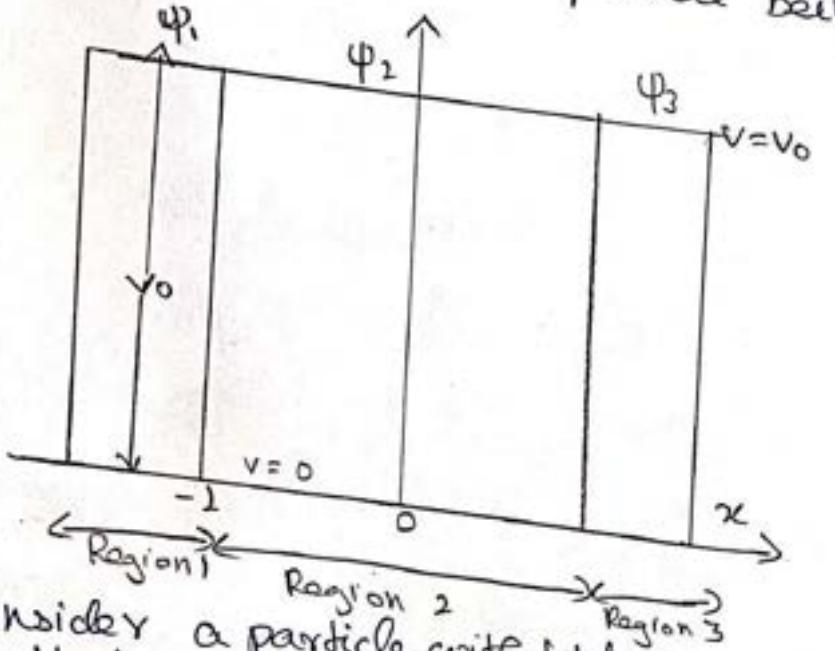
PHYSICS ASSIGNMENT - 9

18/3

By,
S. Babinesh
16
Mechanical.

Finite potential well

A box with finite potential walls in which a particle is confined to known as a finite potential well. unlike like infinite potential well, there is a probability associate with particle being found outside the box.



Let us Consider a particle with total energy $E < V_0$ Confined with a wall bouncing back and forth between the turning points $x = -L$ and $x = L$. The potential well is divided into three regions (1, 2, 3) with associated wave function as follows.

$$\psi = \begin{cases} \psi_1, & \text{if } x < -L \quad \text{(the region outside the box)} \\ \psi_2, & \text{if } -L < x < L \quad \text{(the region inside the Box)} \\ \psi_3, & \text{if } x > L \quad \text{(the region outside the box)} \end{cases}$$

The time independent schrodinger eqn can be coriden as.

$$\frac{-\hbar^2}{2m}\frac{d^2\psi}{dx^2} + V\psi = E\psi \quad \text{—(1)}$$

wave function ad Region - II

$$\frac{-\hbar^2}{2m}\frac{d^2\psi_2}{dx^2} = E\psi_2 \quad \text{—(2)}$$

$$k = \frac{\sqrt{2mE}}{\hbar}$$

eqn(2) beLomes $\Rightarrow$

$$\frac{d^2\psi_2}{dx^2} = -k^2\psi_2$$

$$\psi_2 = A\sin(kx) + B\cos(kx).$$

$$\boxed{E = \frac{k^2\hbar^2}{2m}}$$

wave function at Region I and III

In the regions, $x < -L$ and $x > L$, we have $V = V_0$.

we work this $-\frac{\hbar^2}{2m} \cdot \frac{d^2\psi}{dx^2} + V_0\psi = E\psi$

$$\frac{d^2\psi}{dx^2} - \left[\frac{2m(V_0 - E)}{\hbar}\right]\psi = 0 \quad -(4)$$

Let assume E is less than V_0, so particle is trapped in well.

$$\alpha^2 = \frac{2m(V_0 - E)}{\hbar^2} \quad -(5)$$

$$\frac{d^2\psi}{dx^2} - \alpha^2\psi = 0 \quad -(6)$$

$$\psi_{1,3} = Ce^{\alpha x} + De^{-\alpha x} \quad -(7)$$

$$\psi_1 = Ce^{\alpha x} \quad -(8)$$

$$\psi_3 = De^{-\alpha x} \quad -(9)$$

Conclusion:

i) However in both these regions, the wave function decrease exponentially, with distance from the well.

ii) If the particle manages to acquire energy, $E < V_0$, then will escape from the well.

Characteristics of finite potential well:

- The number of bound state energy is finite.
- The number of bound states increase width and depth of the well.
- Tunelling into the Barrier (wall) is possible.
- Higher energy states are less tightly bound than lower ones.

STELLA MARY'S COLLEGE OFENGINEERING

Aruthenganvilai,KallukattiJunction,AzhikalPost,Kanyakumari District–629202

ASSIGNMENT-4

Class:Mechanical Engineering

Semester :I

Code:PH3151

Subject : Engineering Physics

Topic:Schrodinger Equation (fast learners) & Finite potential well (slow learners)

ASSIGNMENT-PHYSICS

Topic : Schrodinger wave equations.

Submitted by,
S. Gokul
19
Mechanical
I st year.

Schrodinger Wave equations

Schrodinger time independent wave equation:

Consider a system of stationary waves associated with a moving particle of mass 'm' and velocity 'v'

Let x, y, z be the co-ordinates of the particle and 'ψ' be the wave displacement for de-broglie wave at any instant of time 't'.

$$\frac{1}{v^2}\frac{\partial^2\psi}{\partial t^2} = \frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2} \quad ----> (1)$$

$$\frac{\partial^2\psi}{\partial t^2} = v^2\left[\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}\right] ----> (2)$$

$$\frac{\partial^2\psi}{\partial t^2} = v^2\nabla^2\psi \quad ----> (3)$$

on solving (2) and (3) we get,

$$\psi(x,y,z,t) = \psi_0(x,y,z)e^{-i\omega t} \quad ----> (4)$$

Simply can be written as,

$$\psi = \psi_0 e^{-i\omega t} \quad ----> (5)$$

differentiating with t^2 gives,

$$\frac{\partial^2\psi}{\partial t^2} = -\psi_0 e^{-i\omega t}\omega^2 \quad ----> (6)$$

$$\frac{\partial^2\psi}{\partial t^2} = -\omega^2\psi \quad ----> (7)$$

Substitute (7) in (2)

$$v^2\left[\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}\right] = -\omega^2\psi$$

$$\nabla^2\psi + \frac{\omega^2}{v^2}\psi$$

$\because \omega = 2\pi\nu$

$$\nu = \frac{v}{\lambda}$$

$$\frac{\omega}{v} = \frac{2\pi}{\lambda}, \text{ Squaring on both sides,}$$

$$\frac{\omega^2}{v^2} = \frac{4\pi^2}{\lambda^2} \quad ----> (8)$$

Substitute ⑧ in ⑨

$$\nabla^2\psi + \frac{4\pi^2}{\lambda^2}\psi = 0 \text{ ----> } ⑨$$

By de-broglie wavelength,

$$\lambda = \frac{h}{mv}$$

Hence, ⑨ becomes,

$$\nabla^2\psi + \frac{4\pi^2}{h^2} m^2v^2\psi = 0$$

Total energy of particles,

$$E = K.E + P.E$$

$$E = \frac{1}{2}mv^2 + V$$

$$E - V = \frac{1}{2}mv^2$$

$$2(E-V) = mv^2$$

multiply by 'm' on both sides,

$$2m(E-V) = m^2v^2 \text{ ----> } ⑩$$

So,

$$\nabla^2\psi + \frac{4\pi^2}{h^2} 2m(E-V)\psi = 0$$

$$\nabla^2\psi + \frac{8\pi^2 m(E-V)}{h^2}\psi = 0$$

$$\hbar = \frac{h}{2\pi}, \quad h = \hbar 2\pi, \text{ Squaring on}$$

$$h^2 = \hbar^2 4\pi^2$$

$$\nabla^2\psi + \frac{2 8\pi^2 m(E-V)}{\hbar^2 4\pi^2}\psi = 0$$

$$\nabla^2\psi + \frac{2m(E-V)}{\hbar^2}\psi = 0$$

When $V = 0$

$$\nabla^2\psi + \frac{2mE}{\hbar^2}\psi = 0$$

Schrodinger time dependent wave equation :-

$$\psi = \psi_0 e^{-i\omega t}$$

Differentiate with respect to t,

$$\frac{\partial \psi}{\partial t} = -i \psi_0 e^{-i\omega t} \omega$$

$$\omega = 2\pi\nu$$

$$\frac{\partial \psi}{\partial t} = -i \psi_0 e^{-i\omega t} (2\pi\nu)$$

$$\frac{\partial \psi}{\partial t} = -i 2\pi\nu \psi$$

Substitute $E = h\nu$

$$h = \frac{E}{\nu}, \quad \boxed{\nu = \frac{E}{h}}$$

$$\frac{\partial \psi}{\partial t} = -i 2\pi \frac{E}{h} \psi$$

$$\hbar = 2\pi h$$

$$h = 2\pi\hbar$$

$$\frac{\partial \psi}{\partial t} = -i 2\pi \frac{E}{2\pi\hbar} \psi$$

$$\frac{\partial \psi}{\partial t} = -i \hbar E \psi$$

$$E\psi = -i\hbar \frac{\partial \psi}{\partial t}.$$

The schrodinger time independent wave equation is

$$\frac{1}{v^2} \frac{\partial^2 \psi}{\partial t} = \frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} \quad \text{ie,}$$

$$\nabla^2 \psi + \frac{2m}{\hbar^2} (E - V) \psi = 0$$

$$\nabla^2 \psi + \frac{2m}{\hbar^2} (E\psi - V\psi) = 0$$

$$\nabla^2 \psi = -\frac{2m}{\hbar^2}\left[i\hbar \frac{\partial \psi}{\partial t} - V\psi\right]$$

$$-\frac{\hbar^2}{2m}\nabla^2\psi = i\hbar \frac{\partial \psi}{\partial t} - V\psi$$

$$-\frac{\hbar^2}{2m}\nabla^2\psi + V\psi = i\hbar \frac{\partial \psi}{\partial t}$$

$$\left[-\left(\frac{\hbar^2}{2m}\right)\nabla^2 + V\right]\psi = i\hbar \frac{\partial \psi}{\partial t}$$

This equation is called as Schrodinger Time dependent wave equation.

PHYSICS

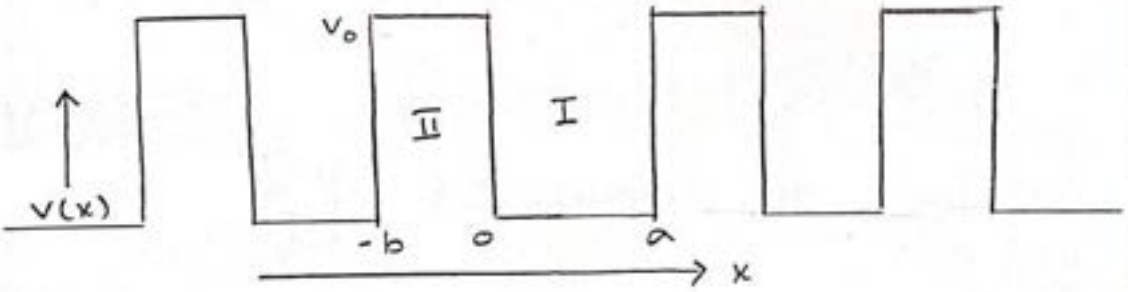
ASSIGNMENT - 9

10

Submitted
By
R. Siva keerthika
1st year MECH
Roll. No: 46

ELECTRON IN PERIODIC POTENTIAL

The study of essential behaviour of electrons by approximating the potential inside a crystal to the shape of rectangular steps is called kroning - Penney model of Potentials.



Periodic Potential - kroning Penney model

The model consist of an infinite row of rectangular potential wells separated barriers of width 'b'. Each well has a width 'a' and a depth V_o

Hence, We have

$$V(x) = V_0 \text{ for } -b < x < 0$$

and

$$V(x) = 0 \text{ for } 0 < x < a$$

The Period of the Potential is, $(a+b)$

The possible states that the electron can occupy are determined by Schrodinger equation

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar}(E-V)\psi = 0$$

The Schrodinger equation for the two regions can be written as

Region - I

$$\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E)\psi = 0 \quad \text{for } 0 < x < a$$

[Since $V = 0$] (1)

Region - II

$$\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E-V_0)\psi = 0 \quad \text{for } -b < 0$$

[since $V = V_0$] (2)

We rewrite the above equation as

$$\frac{d^2\psi}{dx^2} + \alpha^2\psi = 0 \quad \text{for } 0 < x < a \qquad \text{—— (3)}$$

$$\frac{d^2\psi}{dx^2} - \beta^2\psi = 0 \quad \text{for } -b < x < 0 \qquad \text{—— (4)}$$

where,

$$\alpha^2 = \frac{2mE}{\hbar^2}$$

$$\beta^2 = \frac{2m}{\hbar^2}(V_0 - E)$$

Bloch has given the solution for Schrodinger equation as

$$\psi(x) = U(x)\cos kx \qquad \text{—— (5)}$$

where, $U(x) = U(x+a)$ —— (6)

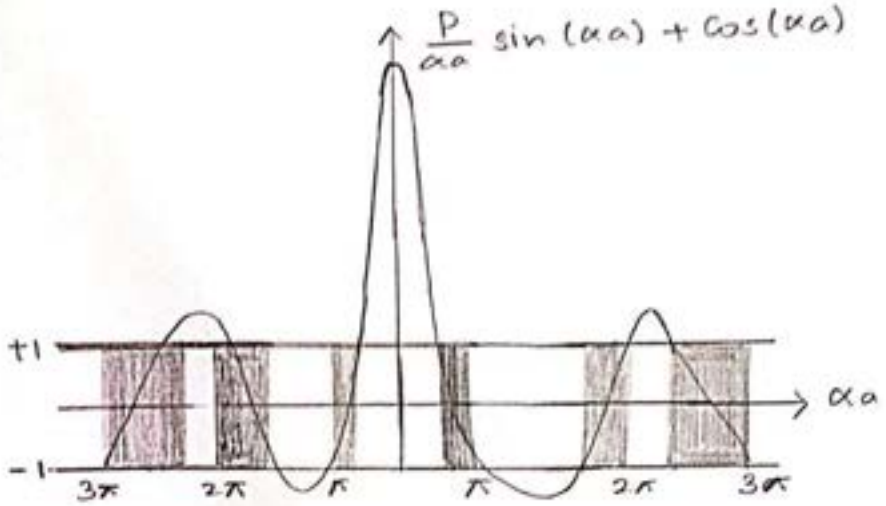
Solving the above equation (3) and (4) by applying boundary conditions, we get

$$\frac{8\pi^2 mV_0}{2\hbar^2 a} b \cdot \sin(\alpha a) + \cos(\alpha a) = \cos(ka) \qquad \text{— (7)}$$

$$\frac{P}{\alpha a}\sin(\alpha a) + \cos(\alpha . a) = \cos(ka) \qquad \text{— (8)}$$

Where,

$$P = \frac{8\pi^2 m V_0 a b}{2h^2} = \text{Potential barrier strength}$$



By varying α, a, a wave mechanical nature could be plotted

The shaded portion of the wave shows the bands of allowed energy with the forbidden region as unshaded portion.

Thus, the energies of a electrons moving under a Periodic lattice potential lie only in certain allowed zones; other energies are forbidden.

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ASSIGNMENT-5

Class:Mechanical Engineering

Semester :l

Code:PH3151

Subject : Engineering Physics

Topic:Electron in Periodic potential(Fast Learners)&

Classification of solids (slow lear ers)

Physics

Assignment - II

V. Anish
Rollno: 10
mech.

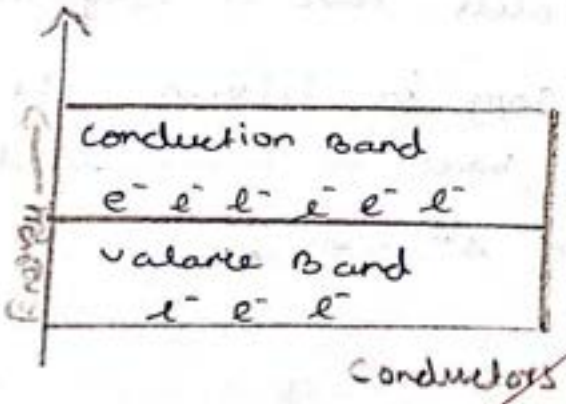
Classification of Solids.

Depending upon the magnitude of the energy gap which separates the conduction band and valance band. The Solids are classified as follows:

1. Conductors
2. semiconductors
3. Insulators

1. Conductors:

The materials in which the valance band and conduction band over lap are called conductors.



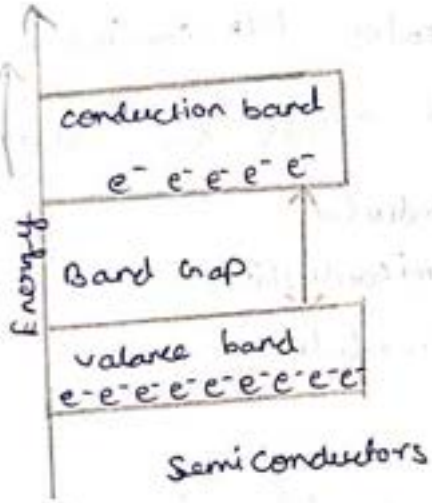
Conductors

2. Semi Conductors.

The solid in which the exist a small energy gap are called semiconductor For typical Semiconductors $E_g \leq 1eV$

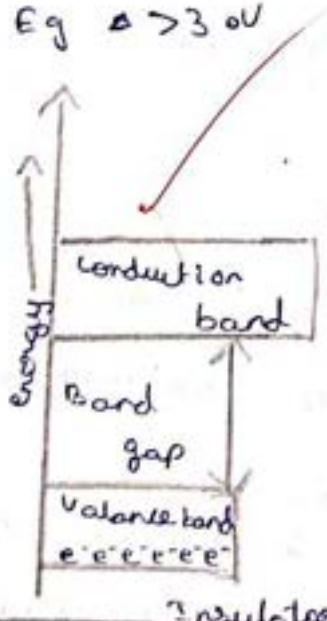
since the energy gap is small less energy is enough to rise an electron from valance band to conduction

band Hence in semiconductor the current flow will be higher than insulators and lower when compared to conductors.



3. Insulators.

the solids have a very large energy gap (forbidden gap) in between the valance band and conduction band as known insulators



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2023 - 2024

UNIVERSITY EXAM

QUESTION PAPER

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Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

UNIVERSITY EXAM

QUESTION PAPER

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Question Paper Code : 60047

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

First Semester

Civil Engineering

PH 3151 — ENGINEERING PHYSICS

(Common to All Branches)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State parallel axis theorem.
2. How center of mass is determined for rigid body and regular shape?
3. Write down the wave equation.
4. Define the term radiation pressure.
5. Distinguish between progressive waves and stationary waves.
6. Calculate the wavelength of light emission from GaAs whose band gap is 3 eV.
7. Define Compton effect and Compton shift.
8. State Eigen value and Eigen function.
9. What is meant by tunneling effect?
10. What is finite potential well in quantum mechanics?

PART B — (5 × 16 = 80 marks)

11. (a) Derive the relation between rotational kinetic energy and moment of inertia and give a short note on moment of inertia of a diatomic molecule.

Or

(b) Describe the principle, construction and working of gyroscope and mention its application in various field.

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12. (a) Discuss the source of electromagnetic waves and also mention the properties of electromagnetic waves.

Or

(b) Derive Maxwell's equations in differential and integral form.

13. (a) Explain simple harmonic motion and discuss its characteristics. Hence derive the wave equation for standing waves.

Or

(b) Outline the principle, construction and working of an Nd-YAG laser. List any three characteristics, advantages and applications of Nd-YAG laser.

14. (a) Give the theory of Compton effect and explain briefly about its experimental verification?

Or

(b) Using Schrodinger's time independent wave equation normalize the wave function of electron trapped in a one-dimensional potential well.

15. (a) Explain the microscopic technique which use quantum tunneling principles to scan the samples with focused electron beam.

Or

(b) Describe the Bloch's theorem for particles in a periodic potential and give a note on Kronig Penney model and the origin of energy bands.

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Question Paper Code : 41521

B.E./B.Tech. DEGREE EXAMINATIONS, JANUARY 2022.

First Semester

Civil Engineering

PH 3151 – ENGINEERING PHYSICS

(Common to all Branches)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the terms : rotational kinetic energy and moment of inertia.
2. The classroom door is of width 50 cm. If the handle of the door is 20 cm from the edge and the force of 5 N is applied on the handle, compute the torque.
3. Write any five properties of electromagnetic waves.
4. Define the term radiation pressure. How do electromagnetic waves have momentum?
5. Define the term Simple harmonic motion.
6. What is spontaneous emission and stimulated emission?
7. What is Compton effect? Compton effect is not observable in the visible region of electromagnetic spectrum, Justify it.
8. What is the meaning of normalization in quantum mechanics?
9. What is quantum tunneling?
10. Give a note on the origin of energy bands.

PART B — (5 × 16 = 80 marks)

11. (a) Explain how the moment of inertia of rigid bodies affects their rotational kinetic energy. (16)

Or

(b) Discuss in detail the concept of conservation of angular momentum. (16)

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12. (a) Deduce the Maxwell equations in integral form. Briefly discuss the plane electromagnetic waves in vacuum and condition on the wave field. (16)

Or

(b) Discuss the reflection and transmission of electromagnetic waves from a non conducting medium. (16)

13. (a) (i) State the different analogies between electrical and mechanical oscillating systems and write a brief note on standing and travelling waves. (12)

(ii) Two sound waves from a point source on the ground travel through the ground to a detector. The speed of one wave is 7.5 kms^{-1}, the speed of the other wave is 5.0 kms^{-1}. The waves arrive at the detector 15 s apart. What is the distance from the point source to the detector? (4)

Or

(b) Explain the principle, construction and working of a semiconductor diode laser with necessary diagrams. Mention its characteristics, advantages and applications. (16)

14. (a) Derive Schröndinger equation for a particle in three dimensional box. Determine the eigen values and eigen functions for the same. (16)

Or

(b) Discuss the normalization and probability interpretation of a wave function. (16)

15. (a) Explain the concepts of Barrier penetration and quantum tunneling in detail with necessary sketch. (16)

Or

(b) Write a brief note on Bloch's theorem for particles in a periodic potential and Kronig Penney model. (16)

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2023 - 2024

ICT CONTENT

-

GOOGLE CLASSROOM DETAILS

Stella Mary's College of Engineering
Aruthenganvilai, KallukattiJunction, Azhikkal (PO)
Kanyakumari District-629202

DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR : 2023-24(ODD)

YEAR/SEMESTER/BRANCH : I/I/MECH

COURSE CODE : PH3151

Google class room Mechanical Engineering

COURSE COORDINATOR

HOD

STELLA MARY'S COLLEGE OF ENGINEERING

Aruthenganvilai, Kallukatti Junction, Azhikal Post, Kanyakumari District – 629202

2023 - 2024

E-LEARNING CONTENT

-

FLIPPED CLASSROOM

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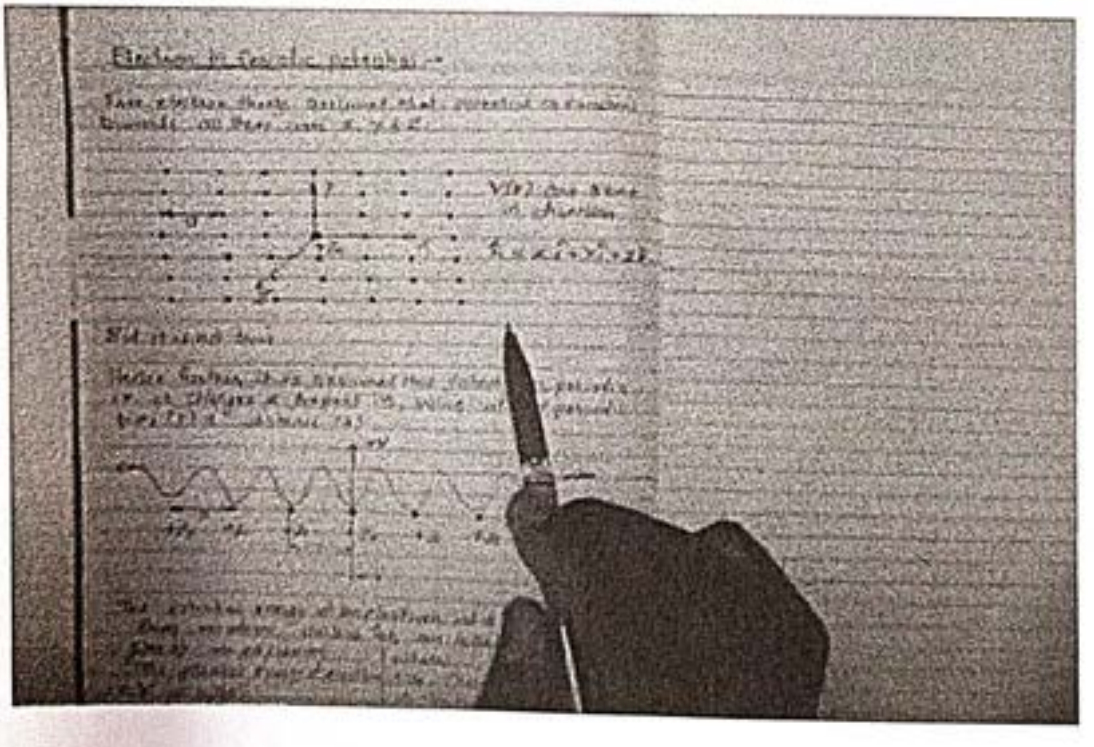
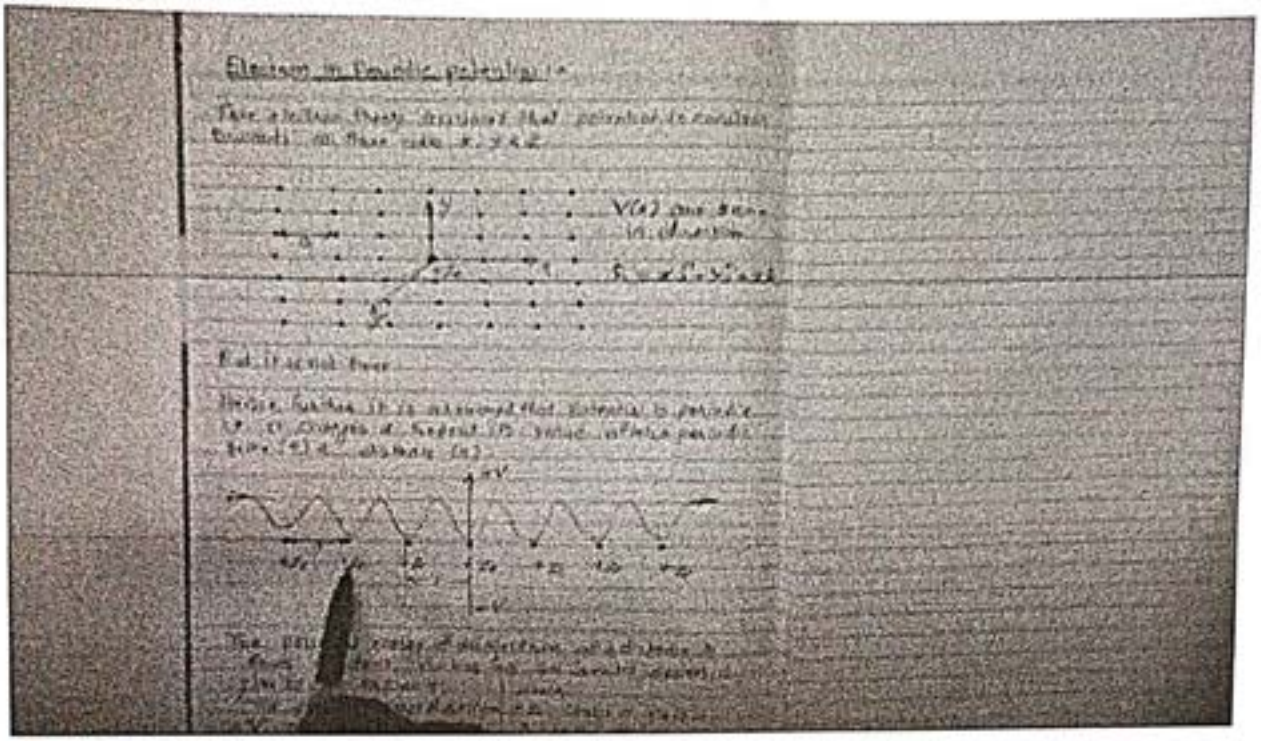
Aruthenganvilai, KallukattiJunction,Azhikkal (PO)
Kanyakumari District-629202

2023-24/ODD S1

DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: FLIPPED CLASSROOM
YEAR/SEMESTER/BRANCH	: I/I/MECH, ECE
COURSE CODE	: PH3151
SUBJECT	: Engineering Physics
UNIT	: I / MECHANICS
TOPIC	: Rotational Kinematics





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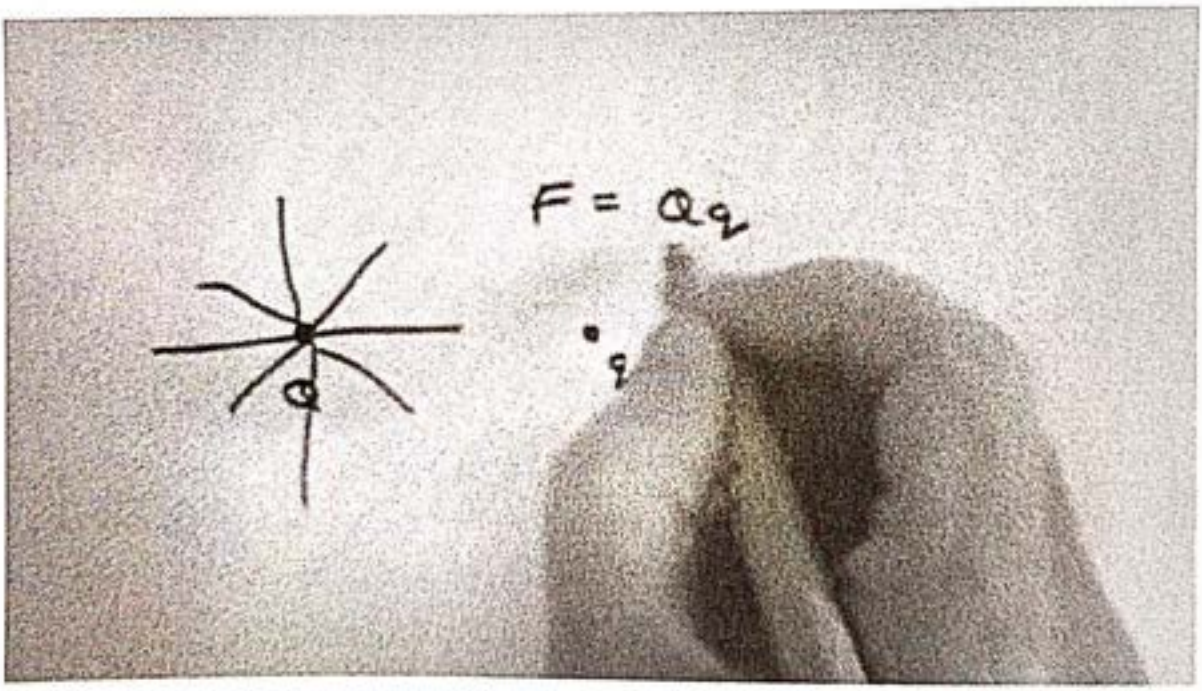
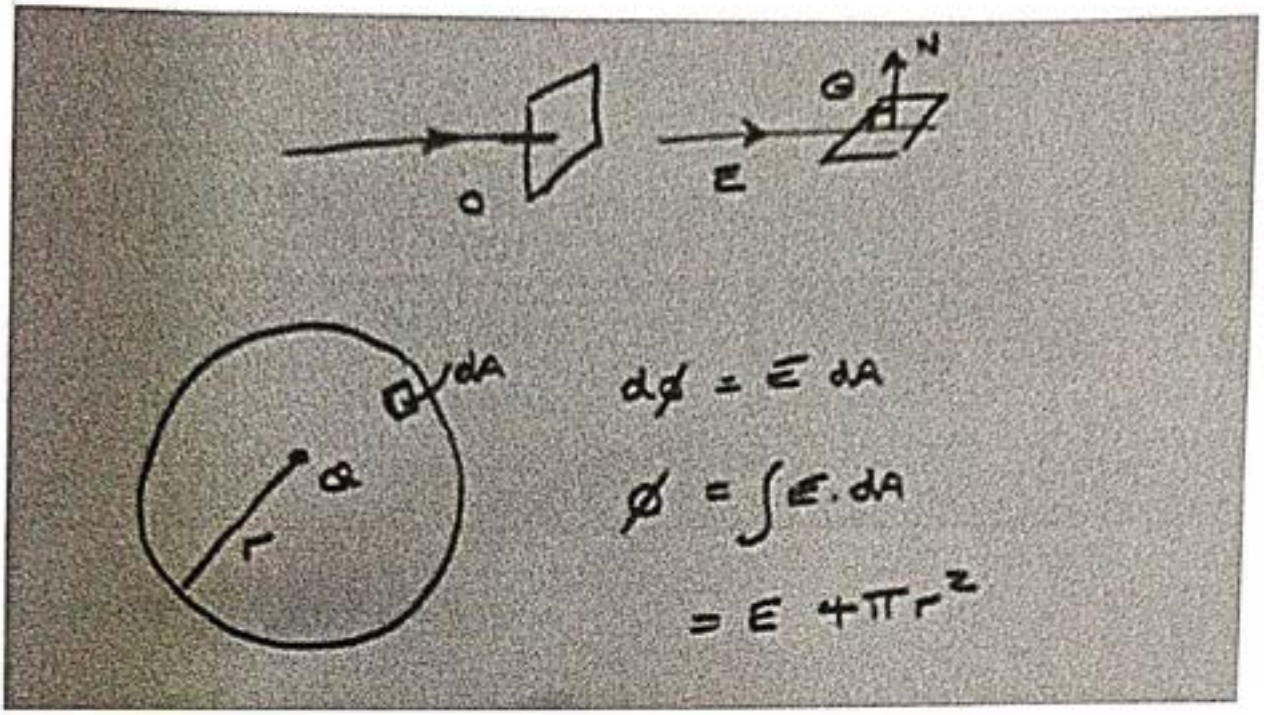
Kanyakumari District-629202

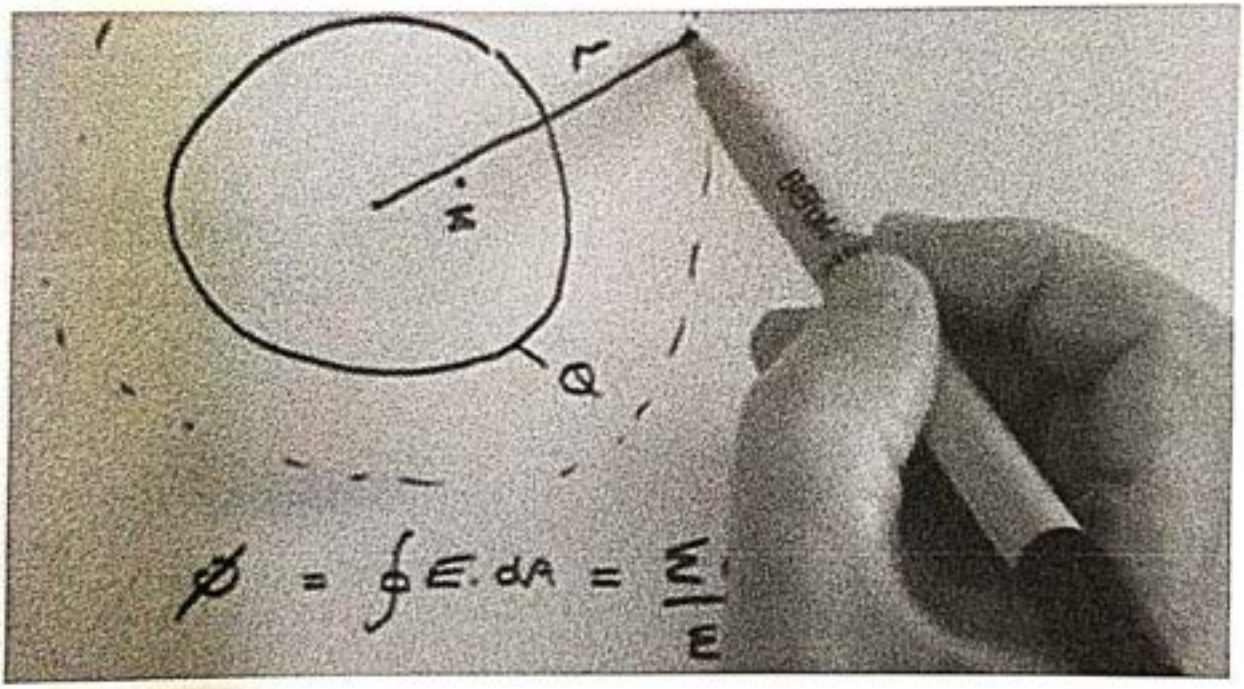
2023-24/ODD SI

DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: FLIPPED CLASSROOM
YEAR/SEMESTER/BRANCH	: I/I/MECH, ECE
COURSE CODE	: PH3151
SUBJECT	: Engineering Physics
UNIT	: II / Electromagnetic waves
TOPIC	:The Maxwell's Equation







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DEPARTMENT OF SCIENCE AND HUMANITIES

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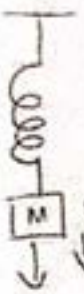
LEARNING METHODOLOGY	: FLIPPED CLASSROOM
YEAR/SEMESTER/BRANCH	: I/II/MECH &ECE
COURSE CODE	: PH3151
SUBJECT	: Engineering Physics
UNIT	: III / Engineering Physics
TOPIC	: Oscillation, Optics & Lasers

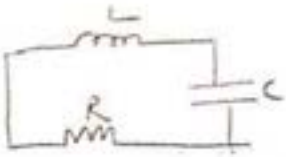
Analogy between electrical and mechanical Oscillating Systems



Restoring force $\propto y$

$= ky$

Damping force



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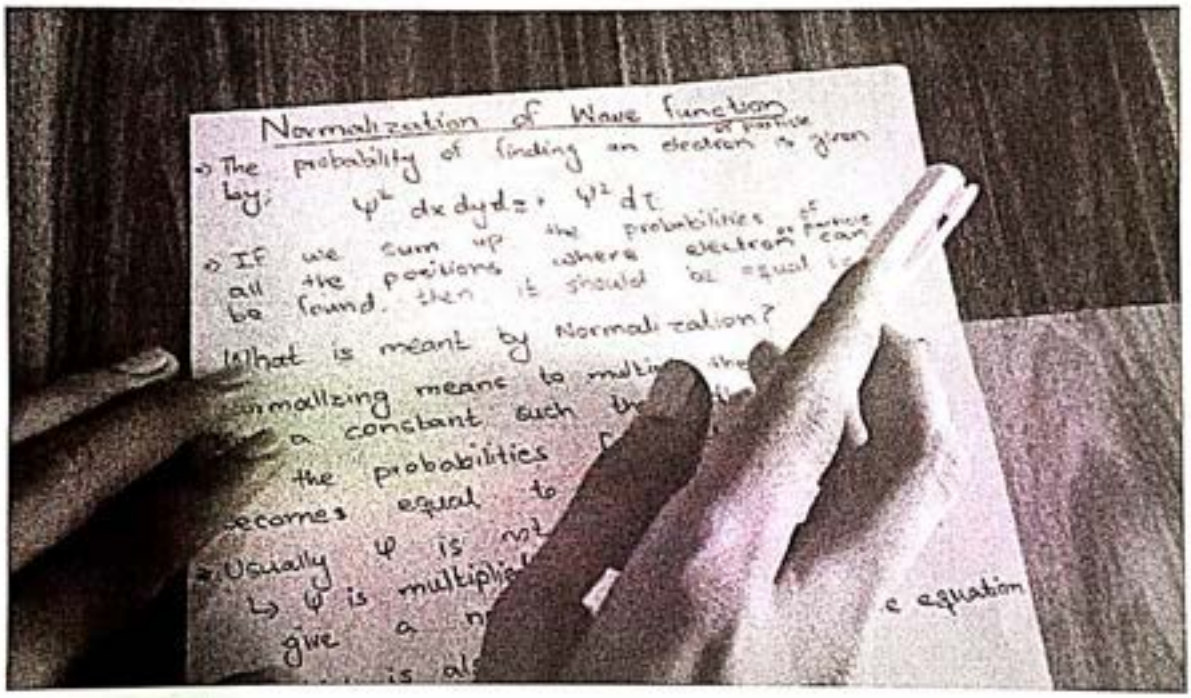
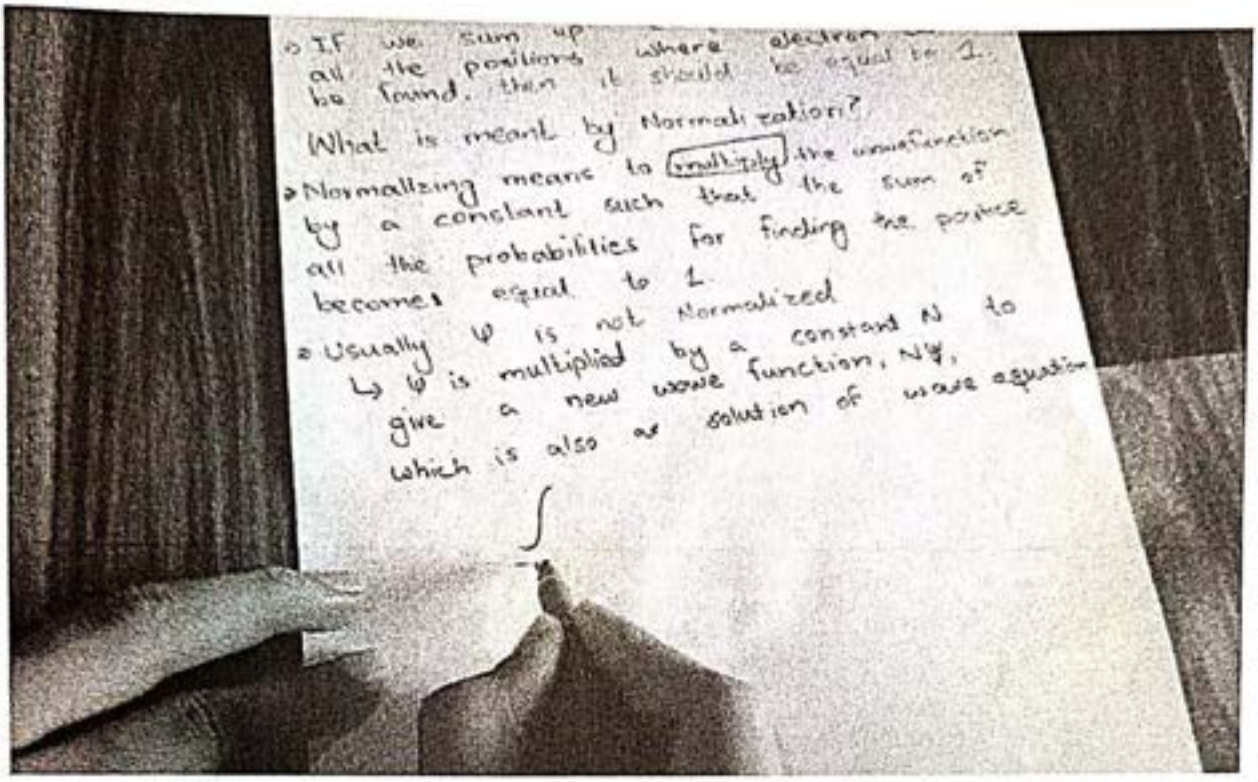
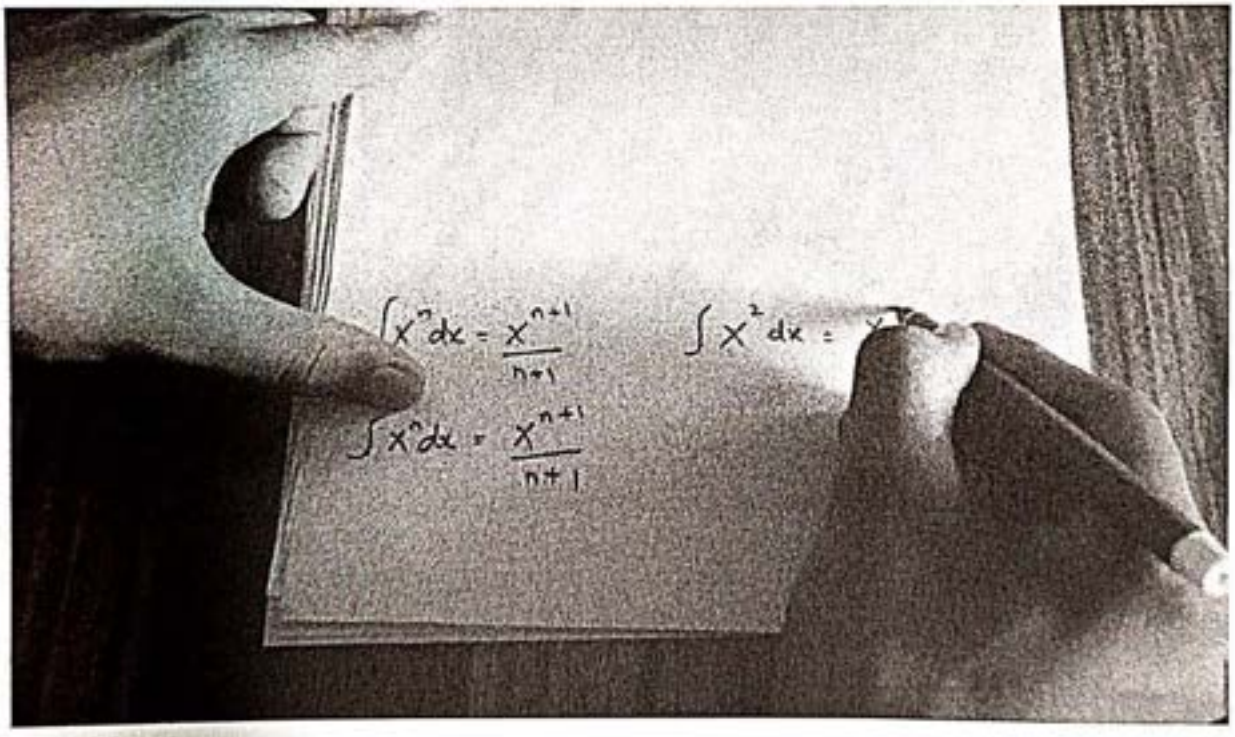
DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: FLIPPED CLASSROOM
YEAR/SEMESTER/BRANCH	: I/I/MECH, ECE
COURSE CODE	: PH3151
SUBJECT	: Engineering Physics
UNIT	: IV / Basic Quantum Mechanics
TOPIC	: Normalization of Wave function







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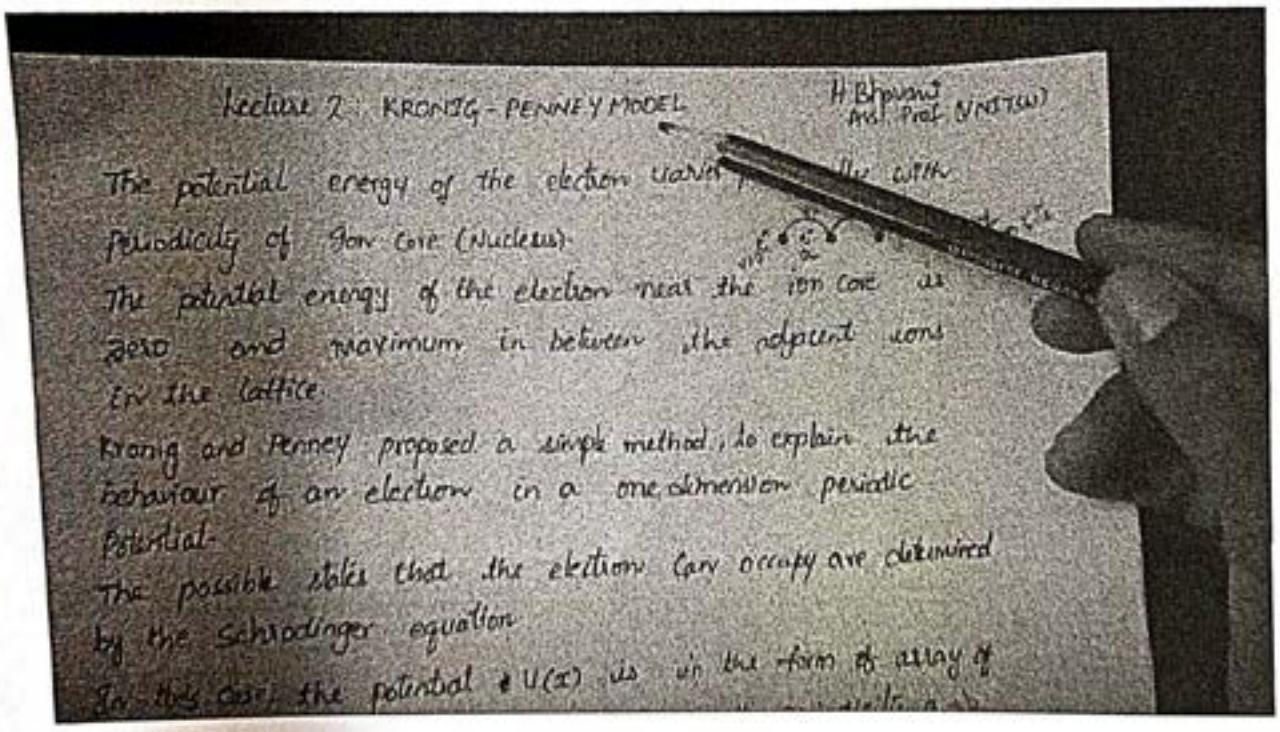
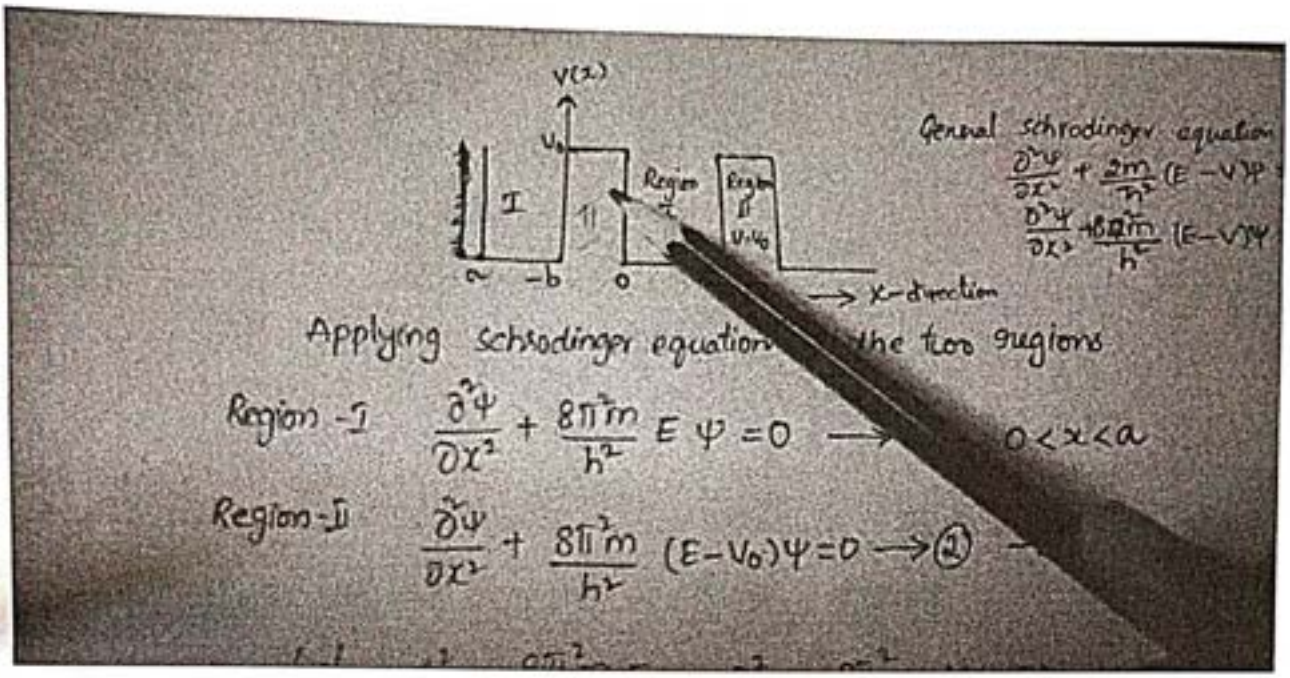
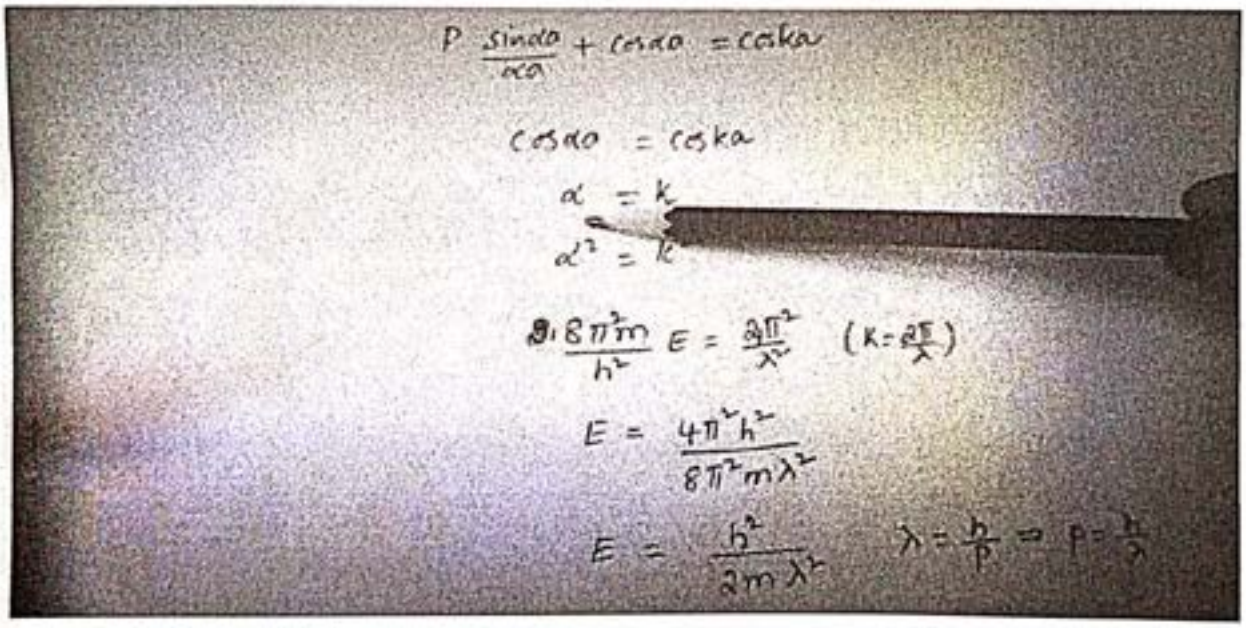
LEARNING METHODOLOGY	: FLIPPED CLASSROOM
YEAR/SEMESTER/BRANCH	: I/I/CSE, MECH
COURSE CODE	: PH3151
SUBJECT	: Engineering Physics
UNIT	: V / Applied Quantum mechanics
TOPIC	: Kronig-Penney Model







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2023 - 2024

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2023 - 2024

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STELLA MARY'S COLLEGE OFENGINEERING

Aruthenganvilai,KallukattiJunction,AzhikalPost,Kanyakumari District–629202

Seminar Presentation-1

Class:Mechanical Emgineering

Semester :I

Code:PH3151

Subject : Engineering Physics

Topic:Torsional Pendulum

PHYSICS

SEMINOR - 1

10/10 M

Submitted By

R. Siva keerthika

1st Year MECH

Roll. NO : 46.

TORSIONAL PENDULUM

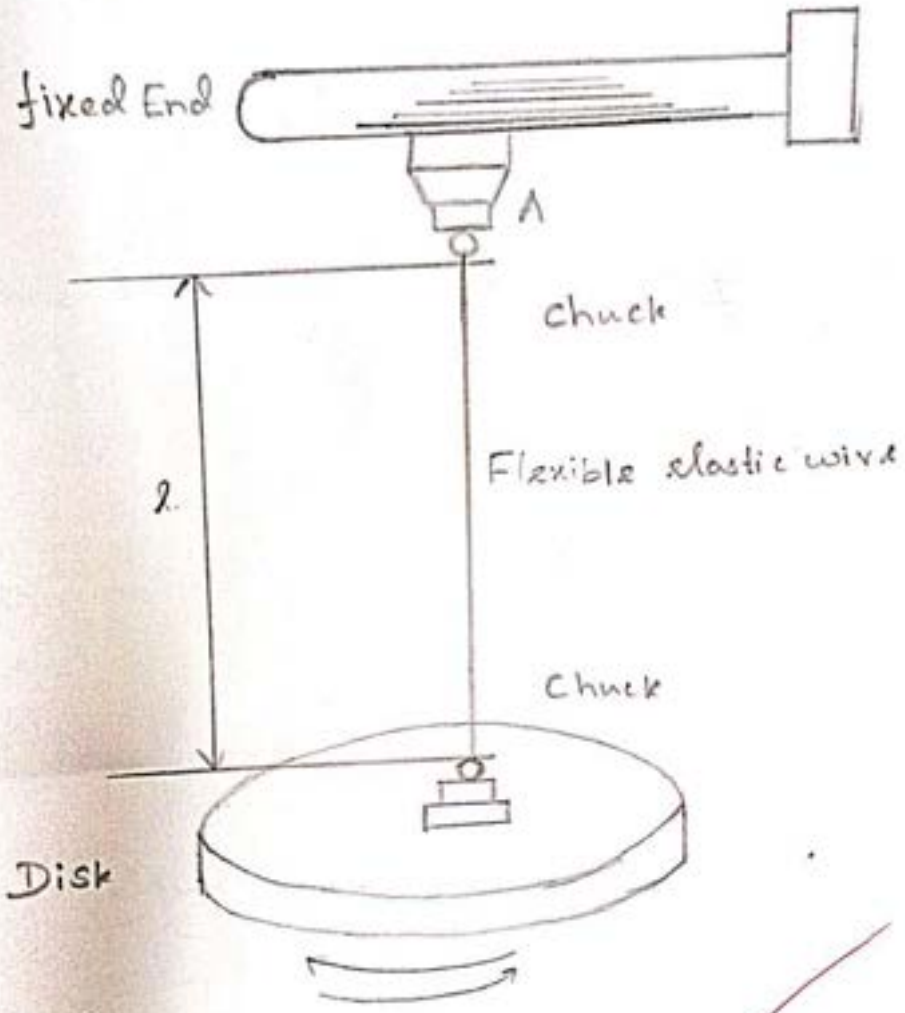
Definition:

A circular metallic disc suspended by a thin wire which produced torsional oscillation due to twisting at the other end is called torsional Pendulum

Construction:

A torsional Pendulum consists of Metal wire connected to a rigid support at one end and a heavy Circular disc at the other end.

When the disc is twisted and released, the disc oscillate back and forth and produces simple harmonic motion.



Torsional Pendulum

Restoring Couple setup in wire $= -C\theta$

Applied Couple $= I \frac{d^2\theta}{dt^2}$

Equating ① & ②

$$-C\theta = I \frac{d^2\theta}{dt^2}$$

$$\frac{d^2\theta}{dt^2} = -\left(\frac{C}{I}\right)\theta$$

$$T = 2\pi\sqrt{\frac{\text{Angular displacement}}{\text{Angular acceleration}}}$$

Time Period, $T = 2\pi\sqrt{\frac{\theta}{\frac{C\theta}{I}}}$

$$T = 2\pi\sqrt{\frac{I}{C}}$$

Determination of Rigidity modulus of the wire.

Time period, $T = 2\pi\sqrt{I/C}$

Squaring on both side

$$T^2 = \frac{4\pi^2 I}{C}$$

$\therefore$ For cylindrical wire

Couple / twist

$$C = \frac{\pi \eta r^4}{2l}$$

(5) $\Rightarrow$ $T^2 = \frac{4\pi^2 I}{\frac{\pi\eta r^4}{2l}}$

$$T^2 = \frac{8\pi I l}{\eta r^4}$$

$$I = \frac{\eta T^2 r^4}{8\pi l}$$

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Seminar Presentation-2

Class:Mechanical Emgineering

Semester :I

Code:PH3151

Subject : Engineering Physics

Topic:Plane Electromagnetic waves

Seminar - II

10/10

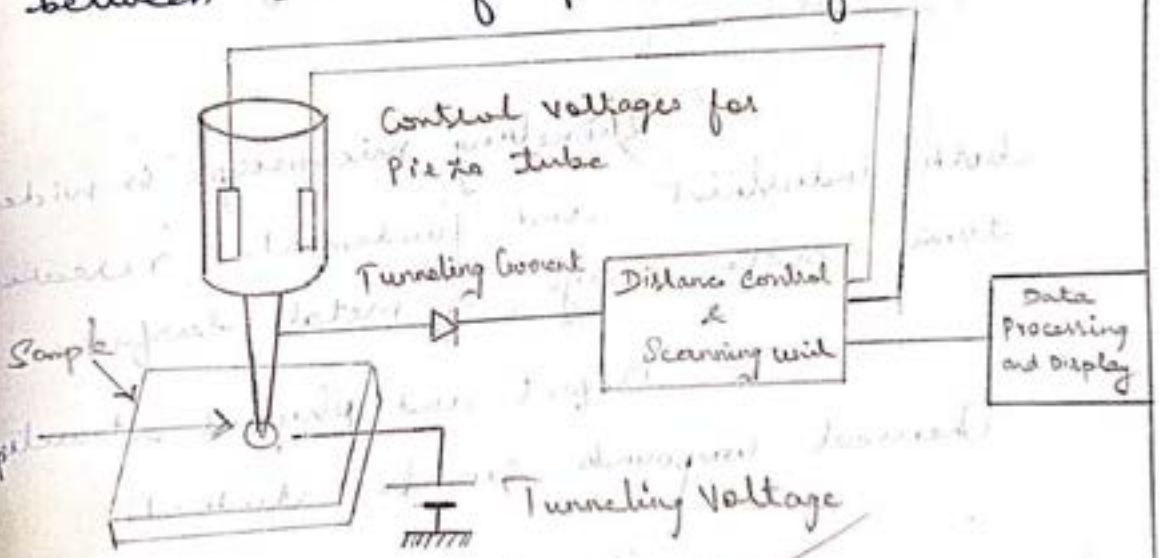
Ps. Arun Kumar
III
Mechanical

Tunnelling Microscope:

An electron microscope that works by quantum tunnelling phenomenon and creates atomic scale imaging of surface is known as Tunnelling microscope.

Principle:

Voltage is applied between a conducting tip and surface close to electron can Tunnel through Vaccum between atom of Tip and surface.



Merits:

* High resolution of STM enable researches to examine surface at atomic level.
* Gives three dimensional profile of surface.
* Versatile and can used ultrahigh Vaccum, air, water and other liquid and gases.

Demerits:

* Require very stable, clean surface and conducting surface.

* Difficult to use effectively.

* Electronics required are extremely sophisticated as well as very expensive.

Applications:

* Tunnelling microscope is widely used in both industrial and fundamental research to obtain atomic-scale image of metal surface.

* Defect and physical structure of synthetic chemical compounds can be studied.

* To study charge transport mechanisms in molecules.

* Used in research surrounding semiconductor and microelectronics.

Seminar

2

8/10 14

By

el. elkash

04

Mech.

Unit - 2.

Plane electromagnetic Waves in Vaccuo.

Maxwells equation

$$\nabla \cdot \vec{E}' = 0 \longrightarrow (1)$$

$$\nabla \cdot \vec{B}' = 0 \longrightarrow (2)$$

$$\nabla \times \vec{B}' = \varepsilon_0 \mu_0 \frac{\partial \vec{E}'}{\partial t} \longrightarrow (3)$$

$$\nabla \times \vec{E}' = \frac{\partial \vec{B}'}{\partial t} \longrightarrow (4)$$

wave eqn in terms of electric field in free space

Taking Curl on both side

$$\nabla \times \nabla \times \vec{E}' = \frac{-\partial}{\partial t} (\nabla \times \vec{B}') \longrightarrow (5)$$

Sub $(\nabla \times \vec{B}')$ from (3) & (5)

$$\nabla \times \nabla \times \vec{E}' = -\varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}'}{\partial t^2} \longrightarrow (6)$$

$$\nabla \times \nabla \times E = \nabla(\nabla E) - \nabla^2 E \longrightarrow (7)$$

Compare (6) & (7)

$$-\varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}'}{\partial t^2} = \nabla(\nabla \cdot E) - \nabla^2 E$$

Maxwell's first equation

$$\nabla \cdot \vec{E}' = 0$$

Eqn (6) becomes

$$-\varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}'}{\partial t^2} = \nabla(0) - \nabla^2 E$$

$$\nabla^2 \vec{E}' - \varepsilon_0 \mu_0 \frac{\partial^2 \vec{E}'}{\partial t^2} = 0 \longrightarrow (8)$$

Wave equation in terms of magnetic field in free space (or) Vacuum:-

$$\nabla \times (\nabla \times B) = \varepsilon_0 \mu_0 \nabla \times \left(\frac{\partial E}{\partial t}\right) \quad -(10)$$

$$\nabla \times \nabla \times B = \nabla (\nabla \cdot B) - \nabla^2 B \quad -(11)$$

Comparing eqn (10) & (11)

$$\varepsilon_0 \mu_0 \nabla \times \left(\frac{\partial t}{\partial t}\right) = \nabla (\nabla \cdot B) - \nabla^2 B$$

$$\nabla \times \vec{E} = \frac{\partial \vec{B}}{\partial t} \quad -(9)$$

Eqn (10) becomes

$$-\varepsilon_0 \mu_0 \frac{\partial}{\partial t} \left(\frac{\partial \vec{B}}{\partial t}\right) = \nabla (\nabla \cdot B) - \nabla^2 B$$

Since, we have

$$\nabla \cdot B = 0 \quad \text{eqn (8)}$$

$$-\varepsilon_0 \mu_0 \frac{\partial^2 \vec{B}}{\partial t^2} = \nabla (0) - \nabla^2 B$$

Hence

$$\nabla^2 \vec{B} - \varepsilon_0 \mu_0 \frac{\partial^2 \vec{B}}{\partial t^2} = 0.$$

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Seminar Presentation-3

Class:Mechanical Emgineering

Semester :I

Code:PH3151

Subject : Engineering Physics

Topic:Semiconductor laser & Airwedge

Seminar

3

By

Abdbasit

04

Mech

Unit - 3.

Semi Conductor laser.

Definition

A PN junction device which emit whenever light when it is forward biased is known as semi conductor laser.

Types of semiconductor laser

(i) Homojunction semiconductor laser

(ii) Hetrojunction semiconductor laser

Homojunction semiconductor laser

Principle:

Stimulated recombination - Electrons in the conduction band recombines with holes in the valance band and releases energy in the form of light photons.

Characteristics.

Active : PN junction

Active center : electron - hole recombination

Pumping method : Direct conversion.

Optical resonator : polished end faces of pn junction

power output : 1 mw

Nature output : pulsed

Wave length of output : 8400 Å - 8600 Å

Band gap : 1.44 eV

Construction:

The N region and P region are obtained by doping one side with zinc and the other side with Tellurium.

The sides of P and N through which the emitted light is coming out are well published and polled to one another and they consitable the optical resonator system.

The battery provides the necessary bis to the diode

Working:

The energy band diagram of the semiconductor laser. The PN junction is forward biased with large applied voltage.

The electron from n-side and hole from P side are injected in the junction region. The recombination of electrons and holes at the junction produce light emission.

Merits:

- High power output
- High power Coherence.
- High Stability.

merits:

* High cost
* Fabrication is difficult.
* Large divergence

Applications:

In optical communication

Laser printing

Data storage.

Hetrojunction Semiconductor diode lasers.

Principle:

Stimulated recombination electrons in the conduction band recombines with holes in the valance band and releases energy in the form of light photon.

Characteristics:

Active medium	PN junction.
Active center	Electron. hole recombination
Pumping method	Direct conversion
Optical resonator	polished end faces of PN junction.

Power Output 10mW

Natural of Output continuous wave

Wave length of Output 8000 Å

Band gap 1.55 eV.

Construction:

It consists of five layers. A layer of GaAs p-type having narrow band gap acts as an active region.

This 3rd is sandwith between the 2nd layer and 4th layer.

Working:

The working principle is similar to that of homo function diode laser.

These charge carries are injected continuosly to the 3rd layer from 2nd and 4th layer to achive population inversion condition

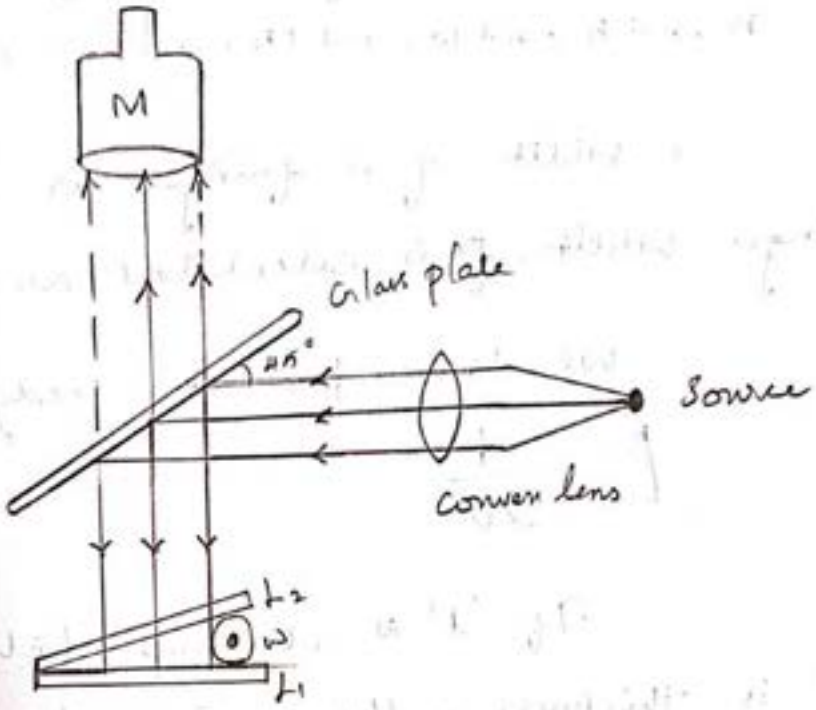
Advantages:

* Highly directional with almost zero divergence
* Threshold current density is drastically reduced
* The stripe gemotry provides a good stability and laser life time

Seminar - II

G. Arun Kumar
IV
Mechanical

Air Wedge:



* Two optically plane glass plates are placed one over other and tied together by means of rubber band at one end. Thin wire is inserted between plates at other end.

* Wedge shaped air film is formed between the two glass plates.

* Light from sodium vapour lamp is rendered parallel with condensing lens and made incident on plane glass sheet held over the wedge at angle of 45° with vertical.

* Light falls normally on air wedge arrangement due to interference between wave from top and bottom surface of film, large number of interference fringes are formed.

* Horizontal position of dark fringes in order. $n, n+5, n+10, n+15, \ldots$ are measured.

* Width of n fringe is calculated ($x = 5\beta$) The fringe width, β is calculated as mean of given fringes.

We know from air wedge theory,

$$\beta = \frac{\lambda}{2\theta}.$$

If 'l' is distance between pnt of contact 't' is thickness, then $\theta = \frac{t}{l}$ (for small, θ) — ②

Using ② in ①

$$\beta = \frac{\lambda l}{2t}$$

Where,

l - length of air wedge

t - thickness of material

λ - Wavelength of light

Also, Thickness of Material is given by,

$$t = \frac{\lambda l}{2\beta}.$$

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Seminar Presentation-4

Class:Mechanical Engineering

Semester :I

Code:PH3151

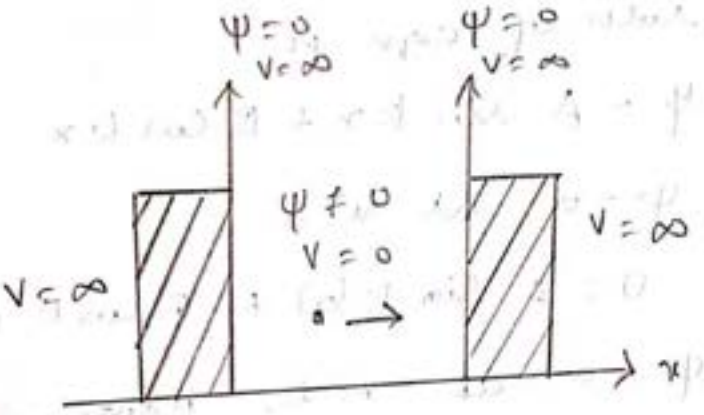
Subject : Engineering Physics

Topic:Particle in One Dimension & Compton Effect

Seminar - EV

Jr. Arun Kumar
ME
Mechanical

Particle in One Dimension:



Consider a particle like electron of mass 'm' moves in one dimensional box of length 'L'. This particle moves between the walls of infinite well. The Potential energy (V) of particle inside box is Zero. Potential energy (V) outside the box is infinite.

$$\left.\begin{aligned} V = 0 \quad &\text{at} \quad x \geq 0 \\ V = 0 \quad &\text{at} \quad x \leq L \\ V = \infty \quad &\text{at} \quad 0 \geq x \geq L \end{aligned}\right\} \quad — (1)$$

$$\left.\begin{aligned} \psi = 0 \quad &\text{at} \quad x = 0 \\ \psi = 0 \quad &\text{at} \quad x = L \end{aligned}\right\} \quad — (2)$$

eqn (1) & (2) know as boundary Condition for free electron.

Schrodinger eqn for free particle,

$$\nabla^2 \psi + \frac{8\pi^2 m}{h^2} E\psi = 0 \quad — (3)$$

$$\frac{8\pi^2 mE}{h^2} = k^2$$

eqn ③ become, $\nabla^2\psi + k^2\psi = 0$ — ④

General solution of eqn is

$$\psi = A \sin kx + B \cos kx \quad — ⑤$$

$\psi = 0$ at $x = 0$

$$0 = A \sin k(0) + B \cos k(0)$$

$\psi = 0$ at $x = L$, hence,

$$0 = A \sin kL$$

Here, $A \neq 0$ and $\sin kL = 0$

$\sin kL = 0$ when,

$$kL = n\pi$$

where n is an integer,

$$k = \frac{n\pi}{L}$$

Sub the value of k in ⑤

$$\psi_n(x) = A \sin\left(\frac{n\pi x}{L}\right) \quad — ⑥$$

Above eqn is wave fnt of free electron

$$k^2 = \frac{8\pi^2 mE}{h^2}$$

$$E_n = \frac{k^2 h^2}{8\pi^2 m}$$

$$k = \frac{n\pi}{L}$$

$$E_n = \frac{n^2\pi^2 h^2}{L^2 8\pi^2 m}$$

the energy of free electron is

$$E_n = \frac{n^2 h^2}{8mL^2}$$

Seminar

4

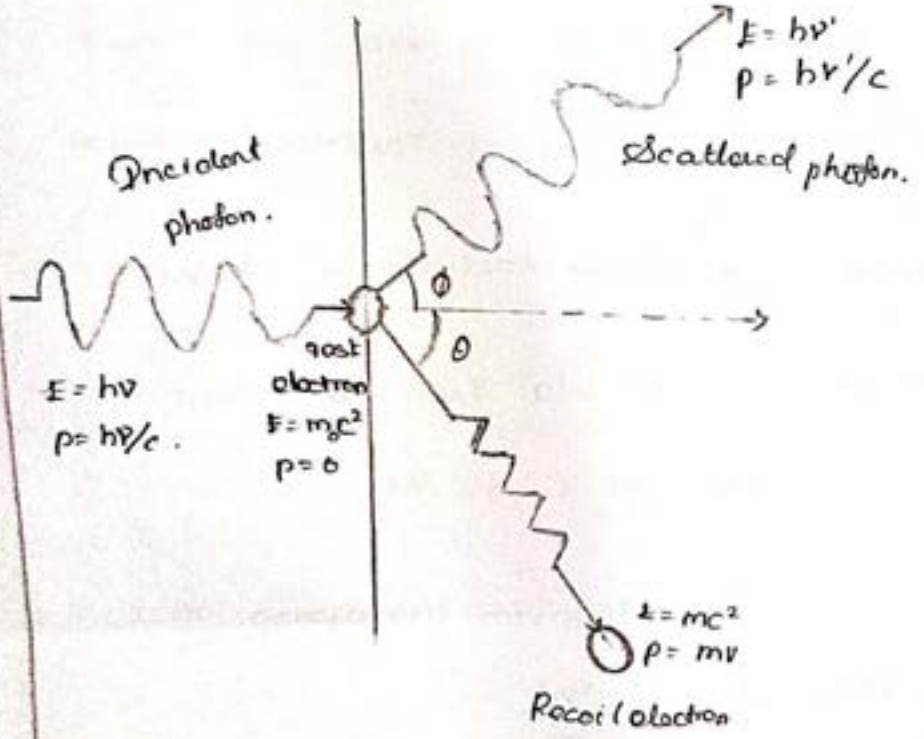
By
A. Akash
04
Mech.

Unit - 4.

Crompton Effect :

The phenomenon of change in wavelength of an x ray photon after scattering by a target material is known as compton effect.

Theory of Compton Effect.



Before collision Effect :

Energy of Incident photon $E = h\nu$

moment of Incident photon $p = \frac{h\nu}{c}$

Energy of rest electron $E = m_0c^2$

Moment of rest electron $p = 0$.

After Collision Effect :

Energy of photon $E = h\nu'$

Moment of photon $p = \frac{h\nu'}{c}$

Energy of recoil electron $E = mc^2$

moment of recoil electron $p = mv$

For law of conservation of energy total energy before collision is equal total energy after collision.

Energy of the incident photon + Energy of rest electron = Energy of scattered photon + Energy of recoil electron.

$$h\nu + m_0c^2 = h\nu' + mc^2 \quad \text{—— (1)}$$

from the law of conservation of momentum.

Total momentum before collision = Total momentum of after collision

Moment of Incident photon + Moment of rest electron = momentum of scattered photon + moment of recoil electron

$$\frac{h\nu}{c} + 0 = \frac{h\nu'}{c} + mv$$

x component momentum:

$$\frac{h\nu'}{c} + 0 = \frac{h\nu'}{c}\cos\phi + mv\cos\theta \quad \text{—— (2)}$$

Y component momentum

momentum before collision = momentum after collision

$$0 + 0 = \frac{h\nu'}{c}\sin\phi - mv\sin\theta \quad \text{—— (3)}$$

x'y eqn (2) by c.

$$h\nu = h\nu'\cos\phi + mvc\cos\theta \quad \text{— (4)}.$$

x'y eqn (3) by c.

$$0 = h\nu'\sin\phi - mvc.\sin\theta \quad \text{— (5)}$$

(4) $\Rightarrow$ $mvc\cos\theta = h\nu - h\nu'\cos\phi$

$$mvc\cos\theta = h(\nu - \nu'\cos\phi) \quad \text{— (6)}$$

⑤ $\Rightarrow mcv\sin\theta = hv'\sin\phi$ — ⑦

Squaring and adding the above two equation

$$\left[\begin{matrix} m^2v^2c^2\cos^2\theta \\ + \\ m^2v^2c^2\sin^2\theta \end{matrix}\right] = \left[\begin{matrix} h^2(v - v'\cos\phi)^2 \\ + \\ h^2v'^2\sin^2\phi \end{matrix}\right]$$

$$mv^2c^2(\cos^2\theta + \sin^2\theta) = h^2[v^2 + v'^2\cos\phi - 2vv'\cos\phi] + h^2v'^2\sin^2\phi$$

$$m^2v^2c^2 = h^2[v^2v'^2\cos^2\phi - 2vv'\cos\phi + v'^2\sin^2\phi]$$

$$m^2v^2c^2 = h^2[v^2 + v'^2\cos\phi + v'^2[\cos^2\phi + \sin^2\phi]$$

$$m^2v^2c^2 = h^2[v^2 - 2vv'\cos\phi + v'^2] \quad — ⑧$$

rewrite eqn ①.

$$hv + m_0c^2 = hv' + mc^2$$

$$mc^2 = hv - hv' + m_0c^2$$

$$mc^2 = h(v - v') + m_0c^2.$$

$$m^2c^4 = [h(v - v') + m_0c^2]^2$$

$$m^2c^4 = h^2(v - v')^2 + 2h(v - v')m_0c^2 + m_0^2c^4$$

$$m^2c^2c^2 = h^2(v^2 - 2vv' + v'^2) + 2h(v - v')m_0c^2 + m_0^2c^4$$

Subtracting eqn ⑧ from ⑨

$$m^2[c^2 - v^2 = -2h^2vv'[1 - \cos\phi] + 2hm_0c^2(v - v') + m_0^2c^4$$

By using theorem of relativity we know

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Squaring the above equation

$$m^2 = \frac{m_0^2}{\frac{1 - v^2}{c^2}}$$

$$m^2\left[\frac{1 - v^2}{c^2}\right] = m_0^2c^2$$

$$m^2\left(\frac{c^2-v^2}{c^2}\right) = m_0^2$$

$$m^2(c^2-v^2) = m_0^2c^2$$

multiply both sides by c^2 we get

$$m^2c^2(c^2-v^2) = m_0^2c^4$$

(ii) $\Rightarrow m_0^2c^4 = -2h^2\nu\nu'[1-\cos\phi] + 2hm_0c^2(\nu-\nu') + m_0^2$

$$\frac{\nu-\nu'}{\nu\nu'} = \frac{h}{m_0c^2}(1-\cos\phi)$$

$$\frac{\nu}{\nu\nu'} - \frac{\nu'}{\nu\nu'} = \frac{h}{m_0c^2}(1-\cos\phi)$$

$$\frac{1}{\nu'} - \frac{1}{\nu} = \frac{h}{m_0c^2}(1-\cos\phi)$$

$$\lambda' - \lambda = \frac{h}{m_0c^2}(1-\cos\phi)$$

$$\Delta\lambda = \frac{h}{m_0c^2}(1-\cos\phi)$$

STELLA MARY'S COLLEGE OFENGINEERING

Aruthenganvilai,KallukattiJunction,AzhikalPost,Kanyakumari District–629202

Seminar Presentation-5

Class:Mechanical Emgineering

Semester :I

Code:PH3151

Subject : Engineering Physics

Topic:Kronig Penney Model

PHYSICS

SEMINAR-5

TOPIC : THE KRONIG PENNEY MODEL

Submitted by.

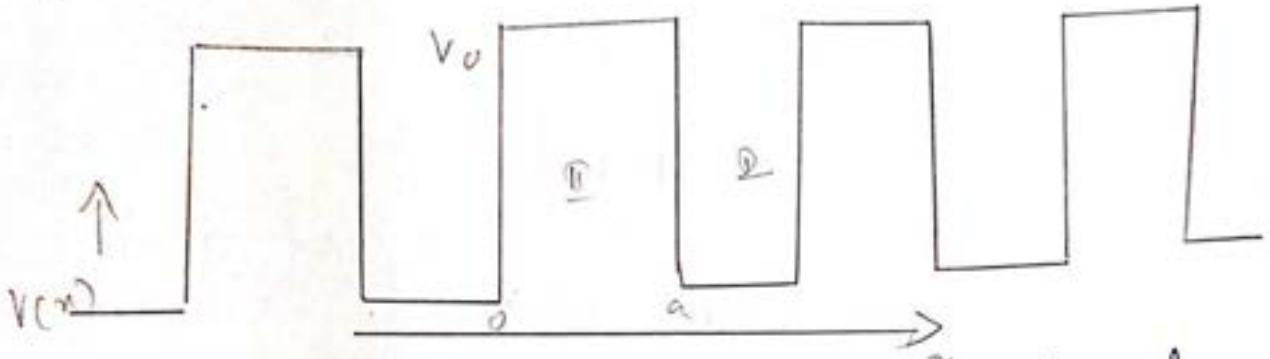
S. S. Sinju

23RVEC058

ECE department

THE KRONIG PENNEY MODEL.

The Study of essential behaviour of electrons by approximating the potentials inside a Crystal to the shape of rectangular steps is called kronig penney model.



This model Consist of an infinite row of rectangular potential wells seperated by barriers of width 'b'. Each well has a width 'a' and a depth 'V_0'.

It is assumed that when a electron is near the positive in Site. potential energy is taken as Zero. Whereas the outside the Well that is between postive ions potential energy is assumed to be V_0

$V(x) = V_0$ for $-b < x < 0$

$V(x) = 0$ for $0 < x < a$

The period of the potential is $(a+b)$

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E-V)\psi = 0$$

Regim I $= \frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E)\psi = 0$ for $0 < x < a$ $(\sin\theta\, V = 0)$ — ①

Regim II $\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E-V_0)\psi = 0$ for $-b < x < 0$ — ②

$$\frac{d^2\psi}{dx^2} + \alpha^2\psi = 0 \text{ for } 0 < x < a \quad — ③$$

$$\frac{d^2\psi}{dx^2} - \beta^2\psi = 0 \quad \text{for } -b < x < 0 \quad -(4)$$

$$\alpha^2 = \frac{2mE}{\hbar^2}$$

$$\beta^2 = \frac{2m}{\hbar^2}(V_0 - E)$$

Bloch has given solution for Schrodinger equation

$$\psi(x) = U(x)\cos kx \quad -(5)$$

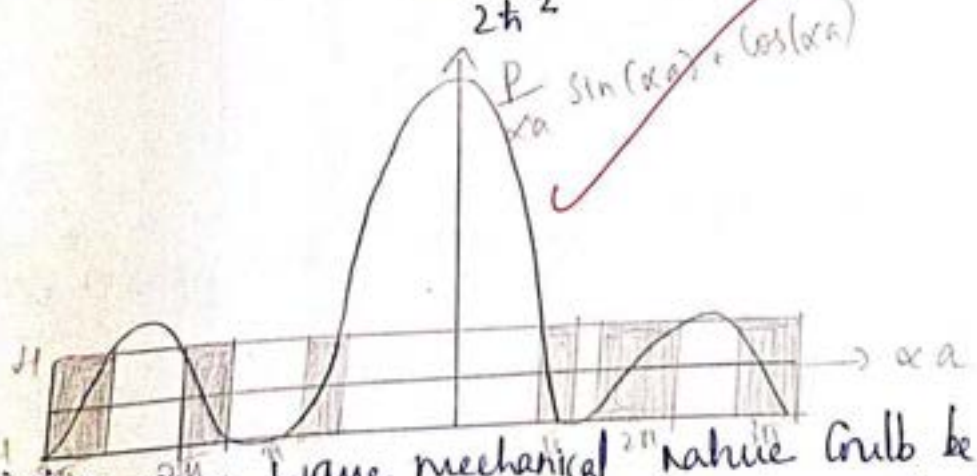
$$U(x) = U(x+a) \quad -(6)$$

Solve (3) & (4)

$$\frac{8\pi^2 m V_0}{2\hbar^2 a} b \cdot \sin(\alpha a) + a(\alpha a) = \cos(ka) \quad -(7)$$

$$\frac{P}{\alpha a}\sin(\alpha a) + \cos(\alpha a) = \cos(ka) \quad -(8)$$

$P = \frac{8\pi^2 m V_0 \alpha b}{2\hbar^2}$. potential barrier strength



By varying αa, a wave mechanical result can be plotted The shaded portion of the wave shows the bands of allowed energy with forbidden energy as unshaded region. Thus the energies of an electron moving under a periodic lattice potential only in certain allowed zones. Other energies are forbidden

Results from kronig - penney model

1. The kronig - penney model demonstrates that a simple one-dimensional periodic potential yields energy bands as well as energy band gaps.

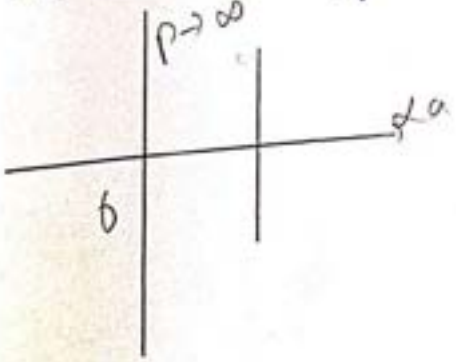
2. If potential barrier between wells is weak energy bands are wide and spaced close together.

3. When 'α' increases, the width of the allowed energy bands also increases and forbidden energy regions become narrow.

4. The energy spectrum of electron consist of an infinite number of allowed energy bands are seperated by intervals in which, there are no allowed energy level. These are known as forbidden energy

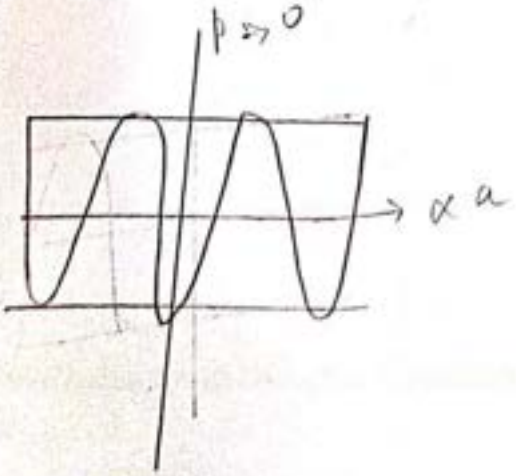
Special Case: 1

When $p \to \infty$ the allowed energy states are compressed to line spectrum



Special Case 2:

When $p \to 0$ the energy band is broadened and it is a quasi continuous



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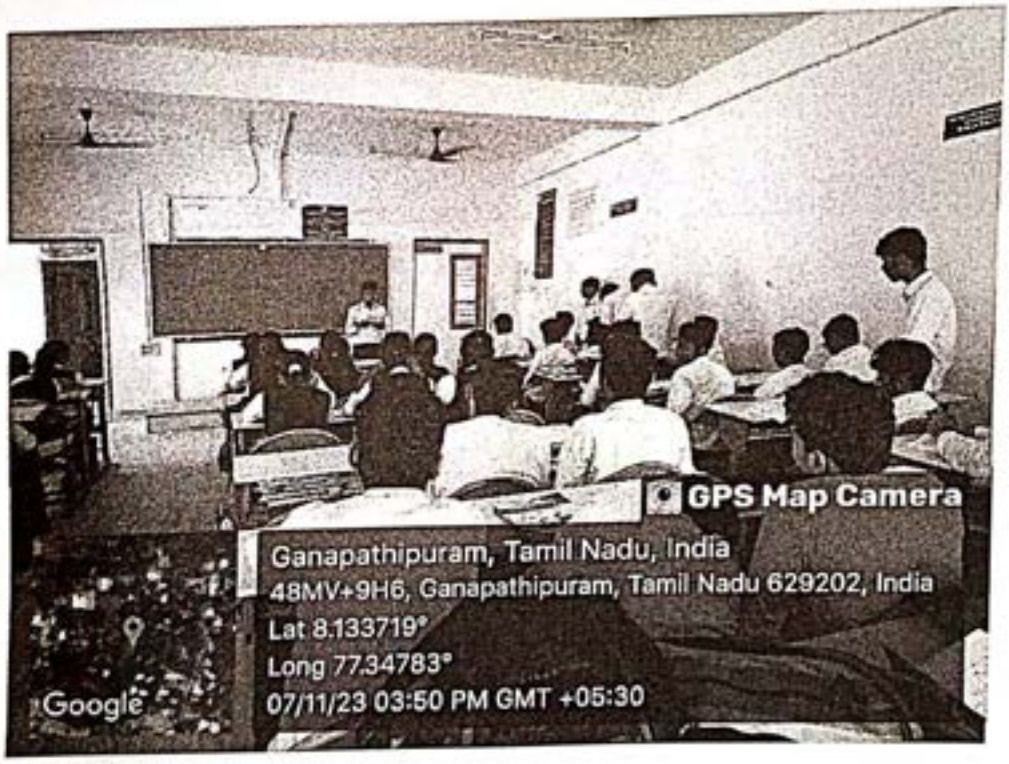
DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: PARTICIPATIVE (SEMINAR)
YEAR/SEMESTER/BRANCH	: I/I/MECH
COURSE CODE	: PH3151
UNIT	:I
TOPIC	: Centre of Mass in real life



COURSE COORDINATOR

HOD

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2023-24/ODD SI

DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: PARTICIPATIVE (SEMINAR)
YEAR/SEMESTER/BRANCH	: I/I/MECH
COURSE CODE	: PH3151
UNIT	: II
TOPIC	: Maxwell's Equations-Producing electromagnetic waves

COURSE COORDINATOR

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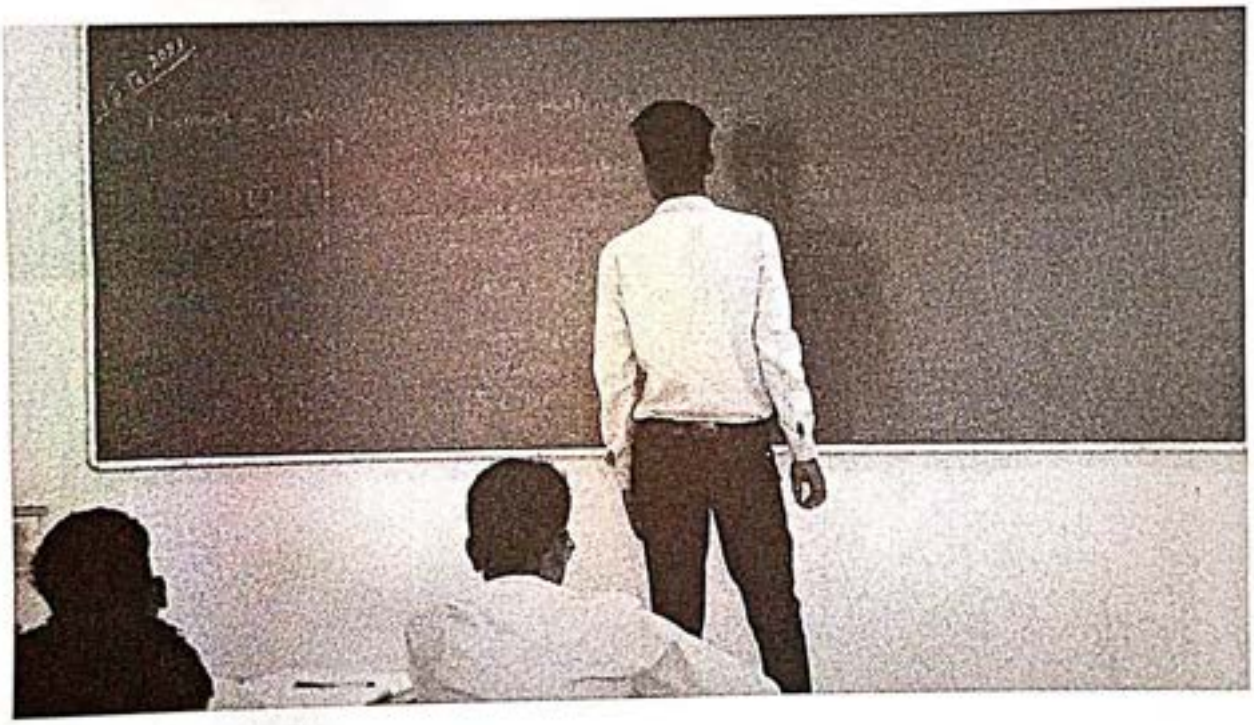
2023-24/ODD SI

DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: PARTICIPATIVE (SEMINAR)
YEAR/SEMESTER/BRANCH	: I/I/MECH
COURSE CODE	: PH3151
UNIT	: III
TOPIC	: Moment of Inertia of Diatomic molecule



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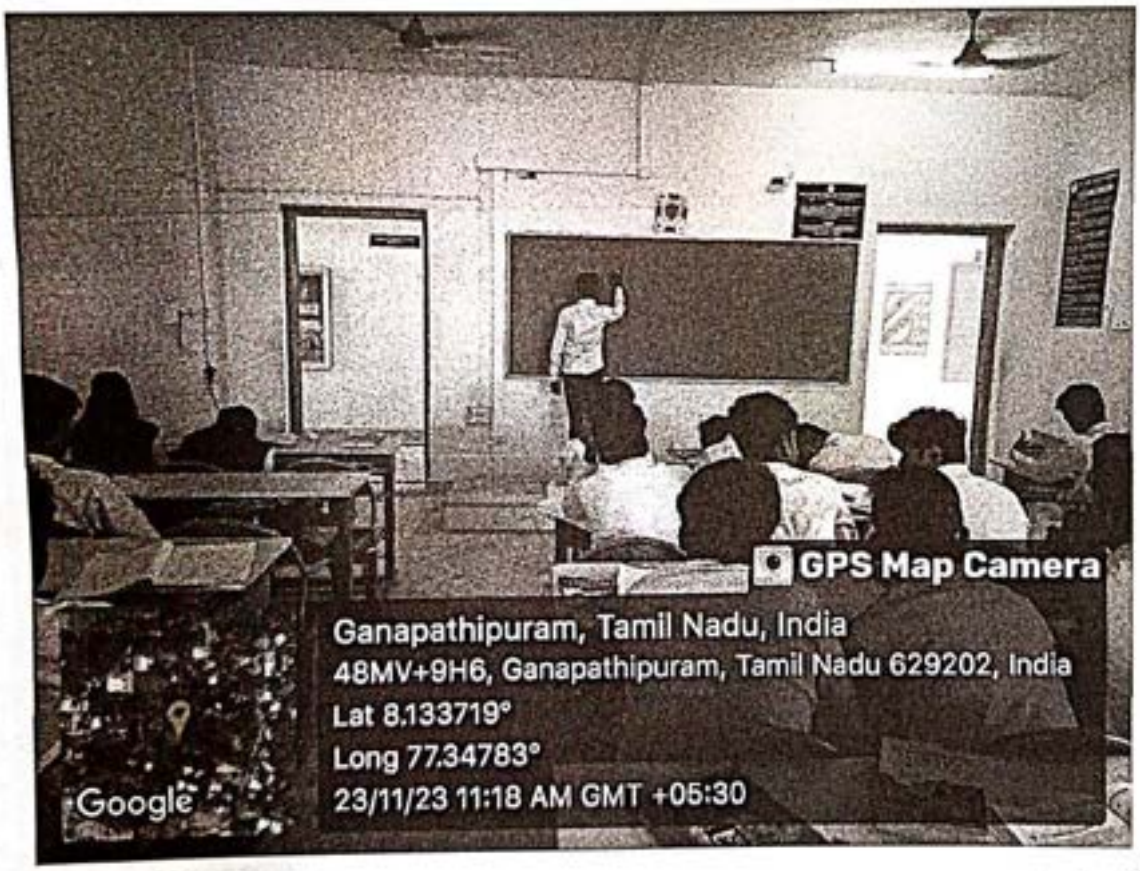
2023-24/ODD SI

DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: PARTICIPATIVE (SEMINAR)
YEAR/SEMESTER/BRANCH	: I/I/MECH
COURSE CODE	: PH3151
UNIT	:IV
TOPIC	: Normalization and particle in an infinite potential well



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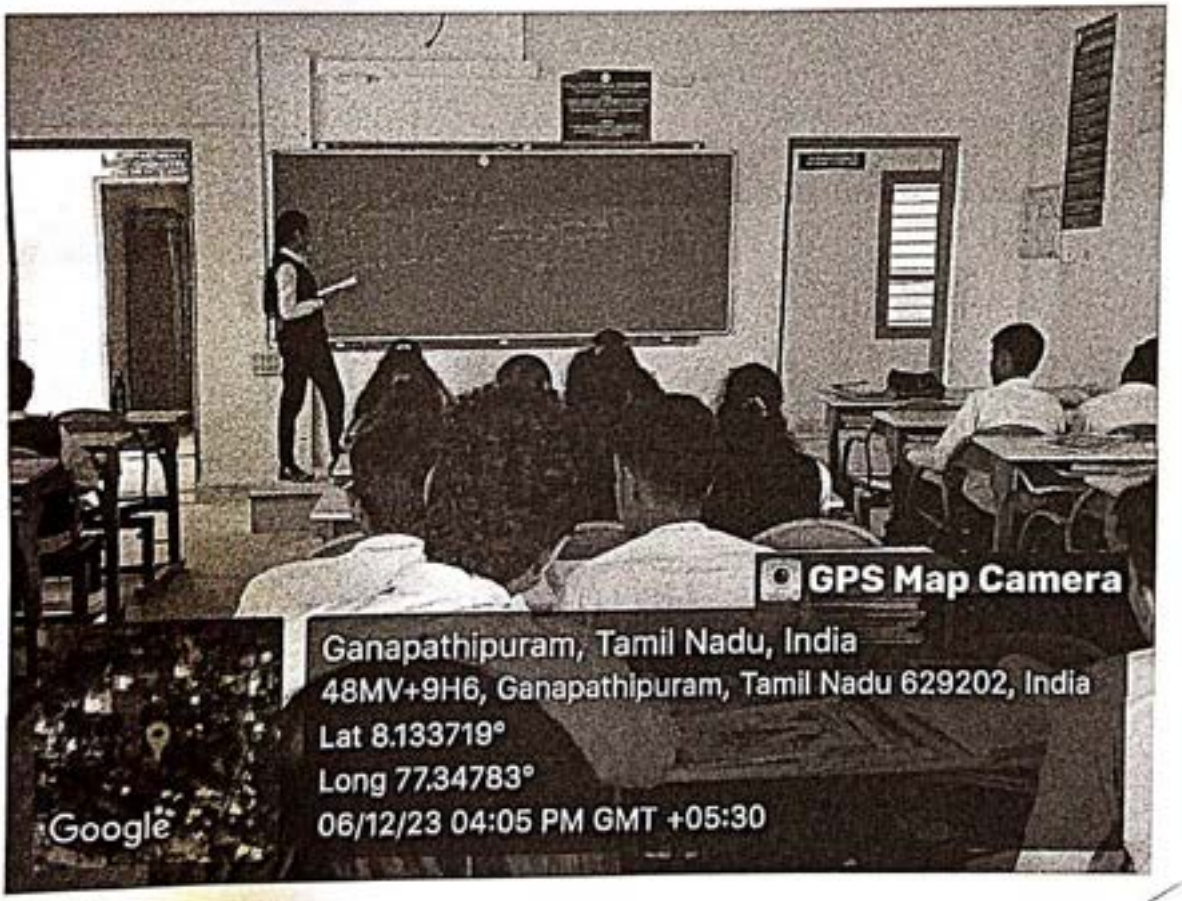
DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: PARTICIPATIVE (SEMINAR)
YEAR/SEMESTER/BRANCH	: I/I/MECH
COURSE CODE	: PH3151
UNIT	: V
TOPIC	: Harmonic Oscillator



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DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: Experiential Learning (Physics Lab)
YEAR/SEMESTER/BRANCH	: I/I/Mech
COURSE CODE	: PH3151
UNIT	: I
TOPIC	: **TORSIONAL PENDULUM**

COURSE COORDINATOR

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2023-24/ODD SI

DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR	: 2023-24(ODD)
LEARNING METHODOLOGY	: Experiential Learning (Physics Lab)
YEAR/SEMESTER/BRANCH	: I/I/Mech
COURSE CODE	: PH3151
UNIT	: IV
TOPIC	: **Airwedge**

COURSE COORDINATOR

HOD

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2023 - 2024

PEER GROUP LEARNING

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Aruthenganvilai, KallukattiJunction,Azhikkal (PO)
Kanyakumari District-629202

2021-22/ODD S1

DEPARTMENT OF SCIENCE AND HUMANITIES

ACEDEMIC YEAR : 2021-22(ODD)

LEARNING METHODOLOGY : PEER GROUP LEARNING

YEAR/SEMESTER/BRANCH : I/I/MECH

COURSE CODE : PH3151

SUBJECT : Engineering Physics

COURSE COORDINATOR

HOD

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2023 - 2024

GATE EXAM MATERIALS

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2023 - 2024

LOG BOOK

SMCE/OEADTM/RR-19/AEAT

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ATTENDANCE
and
ASSESSMENT REGISTER
(THEORY)

20 23 20 24 (Odd/Even)

Year : 2023-24 Semester : 1

Class : I Year Branch : Mech

Name of the Faculty : Dr. J. MARY NOVENA

Department : Mech [PHYSICS]

Code / Subject Title : PH3151 [ENGINEERING PHYSICS]

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ATTENDANCE and ASSESSMENT REGISTER (THEORY)

SMCE/OEADTM/RR-19/AEAT

20 23 20 24 (Odd/Even)

Year : 2023 - 2024 Semester : I

Class : I Year Branch : Mechanical

Name of the Faculty : Dr. L. Mary Novena

Department : Physics

Code / Subject Title : PH3151 / Engineering Physics

Assessment Report	1	2	3	4
Assessment Date	25/9/23 to	16/11/23 to 4/1/2024	—	—
Report Due on	15/11/23 18/11/23	12/1/2024		
Signature of the Faculty in Charge				
Initials of the Head of the Department with Date				

Class : Mech / S1

Sl. No.	Roll No.	Name	Date	26	27	3	4	5	10	11	12	13	17
			Month	9	9	10	10	10	10	10	10	10	10
			Period	6	4	4.5	4	1	4	4.5	4	1	4.5
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2	23RUME002	Agash . G		a	/	/	/	a	/	/	/	/	/
3	23RUME003	Akhlaq . A		/	/	/	/	/	/	/	/	/	/
4	23RUME004	Akash . A (		/	/	/	/	/	/	/	/	/	/
5	23RUME005	Akash . G		/	/	/	/	/	/	/	/	a	/
6	23RUME006	Akash . K		/	/	a	a	/	/	/	/	/	a
7	23RUME007	Akshay . S		/	/	a	/	a	/	/	/	/	/
8	23RUME008	Albin . X		/	/	a	/	/	/	a	/	/	/
9	23RUME009	Anish . V (28/8/2005)		/	/	/	/	/	/	/	/	/	/
10	23RUME010	Anish . V (24/9/2005)		/	/	/	/	/	/	/	/	/	/
11	23RUME011	Anto Sibinson-A		/	/	/	/	/	/	/	/	/	a
12	23RUME012	Ari Krishnan . S.R		/	/	/	/	/	/	/	/	/	/
13	23RUME013	Arsath Basheeba . S		/	/	a	a	/	/	a	/	a	a
14	23RUME014	Arul Renn . P		/	/	/	/	/	/	/	/	/	/
15	23RUME015	Arun kumar . S		/	/	/	/	/	/	/	/	/	/
16	23RUME016	Babinesh . S		/	/	/	/	/	/	/	/	/	/
17	23RUME017	Barsith . S . L		/	/	a	/	a	/	/	/	/	/
18	23RUME018	Bhuvaneshwaran . R		/	/	/	/	a	/	/	/	/	/
19	23RUME019	Gokul . S		/	/	/	/	a	/	/	/	/	/
20	23RUME020	Jaweher . J . S		/	/	/	/	/	/	/	/	/	/
21	23RUME021	Jebin . Y		/	/	a	/	/	/	/	/	/	/
22	23RUME022	Jenil . K . M		/	/	/	/	/	/	/	/	/	/
23	23RUME023	Jobin Benet . C . B		/	/	/	/	/	/	/	/	/	/
24	23RUME024	John Bishop . A		/	/	/	/	/	/	/	/	/	/
25	23RUME025	John Franco . J		/	a	a	a	a	a	a	a	/	a
26	23RUME026	Johnfly Rock . G		/	/	/	/	a	/	/	/	/	/
27	23RUME027	Joselin . S		/	/	/	/	/	a	a	a	a	a
28	23RUME028	Kannan . M		/	/	/	/	/	/	/	/	/	/
29	23RUME029	Marudhappa . M		a	/	a	/	/	/	/	/	a	/
30	23RUME030	Mathis . M		/	/	/	/	/	/	/	/	/	/
31	23RUME031	Mohammed Raihan M		/	/	/	/	/	/	/	/	/	/
32	23RUME032	Mogeshkumar . S		/	/	/	/	/	/	/	/	/	/
33	23RUME033	Muruganeswaran . M		/	/	/	a	/	/	a	/	/	a
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35	23RUME035	Nithin . G		/	/	/	/	a	/	a	/	/	/
36	23RUME036	Nithin . U		/	/	/	/	/	/	/	/	/	/
Signature of the Faculty													
Signature of the HOD													

(24)

Sl. No.	ATTENDANCE 20	21	30	31	3	7	8	9	17	21
	10	10	10	10	4	11	11	11	11	11
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36	/	a	/	a	/	/	/	/	/	/

RT1	RT3-R2017/R2021-RT2				RT4-R2017		Int. Mark
Total (100)	ATT	TM (100/60)	Assignment (0/40)	Total (100)	ATT	ATT	

Class : Mech / S1

Sl. No.	Roll No.	Name
1	23RUMEC001	Abishek . M
2	23RUMEC002	Agash . G
3	23RUMEC003	Akilan . A
4	23RUMEC004	Akash . A C
5	23RUMEC005	Akash . G
6	23RUMEC006	Akash K
7	23RUMEC007	Akshay . S
8	23RUMEC008	Albin . V
9	23RUMEC009	Anish . V
10	23RUMEC010	Anish . V
11	23RUMEC011	Anto Sibinson-A
12	23RUMEC012	Ari Krishnan . S
13	23RUMEC013	Arseth Mathews
14	23RUMEC014	Arul Renso . P
15	23RUMEC015	Arun kumar . S
16	23RUMEC016	Babinesh . S
17	23RUMEC017	Barsitha . S . L
18	23RUMEC018	Bivya Darshan
19	23RUMEC019	Gokul S
20	23RUMEC020	Jaseeber . T . S
21	23RUMEC021	Jebin . Y
22	23RUMEC022	Jenil . K H
23	23RUMEC023	Jobin Bennet .
24	23RUMEC024	John Bisher .
25	23RUMEC025	John Franco .
26	23RUMEC026	Johnsly Koch . G
27	23RUMEC027	Joselin . S
28	23RUMEC028	Kannan . M
29	23RUMEC029	Maruthappa . M
30	23RUMEC030	Mathis . M
31	23RUMEC031	Mohammed Raib
32	23RUMEC032	Nagesh Kumar .
33	23RUMEC033	Murugeswaran
34	23RUMEC034	Nithin . T
35	23RUMEC035	Nithin . C
36	23RUMEC036	Nithin . U
Signature of the Faculty		
Signature of the HOD		

ATTENDANCE

	22	24	27	28	29	30	1	5	6	7
	U	11	11	U	H	U	12	12	12	12
	4	4	6	4	4.5	4	1	4	4.5	4
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22	a	/	a	/	/	/	a	a	/	/
23	/	/	/	/	/	/	/	/	/	/
24	/	/	/	/	/	/	/	a	/	/
25	/	a	/	a	/	/	/	/	/	a
26	a	a	a	/	/	/	/	/	/	/
27	a	a	/	a	a	a	a	a	a	a
28	a	/	/	/	/	/	a	/	/	/
29	/	/	/	/	/	/	a	/	/	/
30	a	a	/	a	a	/	a	/	/	/
31	a	/	/	/	/	/	/	/	/	/
32	/	/	/	/	/	a	/	/	/	/
33	a	a	a	a	a	/	a	a	a	a
34	a	a	a	a	a	a	a	/	/	/
35	a	a	a	a	a	a	a	a	a	a
36	/	/	/	/	/	/	a	/		
	N	N	N	N	N	N	N	N	N	N
	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA

21, 33, 35, 38

(28)

ATTENDANCE

	8	11	12	13	14	18	20	21	22	29
	12	12	12	12	12	12	12	12	12	12
	4.5	1	6	4	4.5	1	6	4	4.5	1
1	/	/	/	/	/	/	/	/	/	/
2	/	/	/	/	/	/	/	/	/	/
3	/	/	/	/	/	/	/	/	/	/
4	/	/	/	/	/	/	/	/	/	/
5	/	/	/	/	/	/	/	/	/	/
6	/	/	/	/	/	a	/	/	/	/
7	/	/	/	/	/	/	/	/	/	/
8	a	/	/	/	/	/	/	/	/	/
9	/	/	/	/	/	/	a	/	/	/
10	/	/	/	/	/	/	a	/	/	/
11	/	/	/	/	/	/	/	/	/	a
12	/	/	/	a	/	/	/	/	/	/
13	a	a	/	a	/	/	/	/	/	/
14	a	/	/	a	/	/	/	/	/	/
15	/	/	/	/	/	/	/	/	/	/
16	/	/	/	/	/	/	/	/	/	/
17	/	/	/	/	/	/	a	/	/	/
18	/	/	/	/	/	/	/	/	/	a
19	/	/	/	/	/	/	/	/	/	/
20	/	/	/	/	/	/	/	/	/	/
21	/	/	/	/	/	/	/	/	/	/
22	a	/	/	a	a	a	a	a	/	a
23	/	/	/	/	/	/	/	/	/	/
24	/	/	/	/	/	/	/	/	/	/
25	/	/	/	/	/	/	/	/	/	/
26	/	/	/	/	/	/	/	/	/	/
27	a	a	a	a	a	a	a	a	/	a
28	/	/	/	/	/	/	/	/	/	/
29	/	/	/	/	/	/	/	/	/	/
30	a	a	/	a	/	/	/	/	/	/
31	/	/	/	/	/	/	/	/	/	/
32	/	/	/	/	/	/	/	/	/	/
33	/	a	a	a	a	a	a	a	a	a
34	/	/	/	/	/	/	/	/	/	/
35	a	a	/	a	/	a	a	a	a	a
36	/	/	/	/	/	/	/	/	/	a
	N	N	N	N	N	N	N	N	N	N
	AA	AA	AA	AA	AA	AA	AA	AA	AA	AA

RT1	RT3-R2017/R2021-RT2				RT4-R2017		Int. Mark
Total (100)	ATT	TM (100/60)	Assignment (0/40)	Total (100)	ATT	ATT	

- 1 mark
- 2 marks
- 3 marks
- 4 marks
- 5 marks

Class : Mech / S1

Sl. No.	Roll No.	Name	Date / Month / Period
1	23RUMEC001	Abishek · M	
2	23RUMEC002	Agash · G	
3	23RUMEC003	Akilan · A	
4	23RUMEC004	Akash · A (	
5	23RUMEC005	Akash · G	
6	23RUMEC006	Akash · K	
7	23RUMEC007	Akshay · S	
8	23RUMEC008	Albin · V	
9	23RUMEC009	Anish · V (23/8/2	
10	23RUMEC010	Anish · V (24/9/2	
11	23RUMEC011	Ante Sibigsen-A	
12	23RUMEC012	Ali Krishnan · S	
13	23RUMEC013	Arsath Basheer	
14	23RUMEC014	Arul Renn · P	
15	23RUMEC015	Arun Kumar · S	
16	23RUMEC016	Babinesh · S	
17	23RUMEC017	Barsith · S · L	
18	23RUMEC018	Binge Darshan ·	
19	23RUMEC019	Gokul · S	
20	23RUMEC020	Jameer · J.S	
21	23RUMEC021	Jebin · Y	
22	23RUMEC022	Jenil · K N	
23	23RUMEC023	Jobin Benet ·	
24	23RUMEC024	John Bishop · A	
25	23RUMEC025	John Franco ·	
26	23RUMEC026	Johodly Rock · G	
27	23RUMEC027	Joseph · S	
28	23RUMEC028	Kannan · M	
29	23RUMEC029	Maruthappa · M	
30	23RUMEC030	Mathi's · N	
31	23RUMEC031	Mohammed Raiba	
32	23RUMEC032	Mogeshkumar ·	
33	23RUMEC033	Mohugeswaran	
34	23RUMEC034	Nibin · J	
35	23RUMEC035	Nithin · E	
36	23RUMEC036	Nithin · U	
	Signature of the Faculty		
	Signature of the HOD		

ATTENDANCE

	28	29	30	31	5	8	9	10		
	12	1	1	1						
	6	4/5	4	1						
1	/	/	/	/						
2	a	/	/	/	/					
3	/	/	/	/	/					
4	/	a	/	/	/					
5	a	/	a	/	/					
6		/	/	/	/					
7	a	/	/	/	/					
8	/	a	/	/	/					
9	/	/	/	/	/					
10	/	/	/	/	/					
11	a	a	a	/	/					
12	/	/	/	/	/					
13	a	a	/	/	/					
14	a	/	/	/	/					
15	/	/	/	/	/					
16		/	/	/	/					
17	/	/	/	/	/					
18	a	a	/	/	/					
19	/	/	/	/	/					
20	/	/	/	/	/					
21	a	a	/	/	/					
22	/	/	/	/	/					
23	/	/	/	/	/					
24	/	a	a	/	/					
25	a	a	/	/	/					
26	a	/	/	/	/					
27	a	a	—	—	—	—	—	—	—	—
28	/	a	/	/	/					
29	a	/	/	/	/					
30	/	a	/	/	/					
31	/	/	/	/	/					
32	/	a	/	/	/					
33	a	—	—	—	—	—	—	—	—	—
34	/	/	/	/	/					
35	a	—	—	—	—	—	—	—	—	—
36	/	a	/	/	/					

ATTENDANCE

RT1	RT3-R2017/R2021-RT2				RT4-R2017		Int. Mark
Total (100)	ATT	TM (100/60)	Assignment (0/40)	Total (100)	ATT	ATT	

- - 1 mark
- - 2 marks
- - 3 marks
- - 4 marks
- - 5 marks

Class : Mech / S1

Sl. No.	Roll No.	Name	Date Month Period
1	23RUME001	Abishek . M	
2	23RUME002	Agash . G	
3	23RUME003	Akilan . A	
4	23RUME004	Akash . A (	
5	23RUME005	Akash . G	
6	23RUME006	Akash . K	
7	23RUME007	Akshay . S	
8	23RUME008	Albin . X	
9	23RUME009	Anish . V	
10	23RUME010	Anish . V	
11	23RUME011	Anto Sibinson-A	
12	23RUME012	Arl Krishnan . S	
13	23RUME013	Arsath Basheer	
14	23RUME014	Arul Renu . P	
15	23RUME015	Arun Kumar . S	
16	23RUME016	Babinesh . S	
17	23RUME017	Barsith . S . L	
18	23RUME018	Bhuvan Darshan .	
19	23RUME019	Gokul S	
20	23RUME020	Jaseber . J . S	
21	23RUME021	Jebin . Y	
22	23RUME022	Jenil . K M	
23	23RUME023	Jobin Bennet . (	
24	23RUME024	John Bishop . A	
25	23RUME025	John Franco . ?	
26	23RUME026	Johodley Rock . G	
27	23RUME027	Joseph . S	
28	23RUME028	Kannan . M	
29	23RUME029	Maruthappa . M	
30	23RUME030	Mathi . M	
31	23RUME031	Mohammed Raiba	
32	23RUME032	Mugeshkumar .	
33	23RUME033	Murugeswaran .	
34	23RUME034	Nibin . J	
35	23RUME035	Nithin . G	
36	23RUME036	Nithin . U	
Signature of the Faculty			
Signature of the HOD			

Internal Assessment Test marks(100)(A)				Best 2 (200)	Marks out of (75) (A)
IAT-III		MODEL EXAM			
Date: mark Scored:	Date: mark Scored:	Date: mark Scored:	Date: mark Scored:		
		50			
		50			
		52			
		53			
		60			
		50			
		50			
		45			
		45			
		50			
		62			

Class :

ATTENDANCE 3 6 1 2 3 1

Sl. No.	Roll No.	Name	Date	26	27	3	4	5	10	11	12	13	19
			Month	09	9	10	10	10	10	10	10	10	10
			Period	6	4	4,5	4	1	4	4,5	4	1	4,5
37	23RUMEC037	Alithish. M		/	/	a	/	a	a	/	/	/	/
38	23RUMEC038	Alithish. K.A		/	/	/	a	/	/	a	/	/	/
39	23RUMEC035	Paul James. P.S		/	/	a	/	/	/	a	/	/	/
40	23RUMEC040	Rexcilia Jino. R		a	a	a	a	/	a	/	/	/	/
41	23RUMEC041	Risni. V.J		/	a	a	a	/	/	/	a	/	/
42	23RUMEC042	Rixshol Sijin. M		/	/	/	a	a	/	/	/	a	a
43	23RUMEC043	Saja. C.V		/	/	/	/	/	/	/	/	/	/
44	23RUMEC044	Santhosh. S		/	/	/	/	a	/	/	/	/	/
45	23RUMEC045	Shahil. R		/	/	/	/	/	/	/	/	/	/
46	23RUMEC046	Siva Keerthik a.R		/	/	/	/	/	/	/	/	/	/
47	23RUMEC047	Siva Nathan. V		/	/	/	/	/	/	/	/	/	/
48	23RUMEC048	Sree Dharshan. K.S		/	/	/	/	/	/	/	/	/	/
49	23RUMEC049	Subilesh. S		/	/	/	/	/	a	a	/	/	/
50	23RUMEC050	Tarun Raj. M		/	/	/	a	/	/	/	/	/	/
51	23RUMEC051	Thanga Pooja. S		/	/	/	/	/	/	/	/	a	a
52	23RUMEC052	Thoshbia. K		/	/	a	a	/	/	/	/	/	/
53													
54													
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Signature of the Faculty													
Signature of the HOD													

2, ATTENDANCE

	20	24	30	31	3	7	8	9	17	21
	10	10	10	10	11	11	4	11	11	11
	4	4	4	4,5	1	6	4	4,5	6	3,4
37	/	a	a	a	a	a	/	a	a	/
38	/	/	/	/	/	/	/	/	/	/
39	/	/	/	/	/	/	/	/	/	/
40	/	/	/	/	/	/	/	/	a	/
41	/	/	/	/	/	/	/	/	a	/
42	/	a	a	a	/	/	a	a	/	a
43	/	a	a	a	a	a	a	a	a	a
44	/	/	/	/	/	/	/	/	/	/
45	/	a	/	/	/	/	/	/	a	/
46	/	/	/	/	/	/	/	/	/	/
47	/	/	/	/	/	/	/	/	/	/
48	/	/	/	/	/	/	/	/	/	/
49	/	a	/	/	/	/	/	/	/	/
50	/	a	a	/	/	/	/	/	/	/
51	/	/	/	/	/	a	/	/	/	/
52	/	/	/	/	/	a	/	/	a	/

1-RT1	RT3-R2017/R2021-RT2				RT4-R2017		Int. Mark
Total (100)	ATT	TM (100/60)	Assignment (0/40)	Total (100)	ATT	ATT	

ance - 1 mark
ance - 2 marks
ance - 3 marks
ance - 4 marks
ance - 5 marks

Class :

Sl. No.	Roll No.	Name
37	23RUME037	Alithish. H
38	23RUME038	Alithish. K.A
39	23RUME039	Paul James.
40	23RUME040	Rexcilin Jino.
41	23RUME041	Risni. V. J
42	23RUME042	Rishal Sijin
43	23RUME043	Sajan. C.V
44	23RUME044	Santhosh. S
45	23RUME045	Shahil. R
46	23RUME046	Siva Keerthik
47	23RUME047	Siva Nathan
48	23RUME048	Sree. Dheersha
49	23RUME049	Subilesh. S
50	23RUME050	Tarun Raj. M
51	23RUME051	Thaage Pooja
52	23RUME052	Thushbin. K.
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Signature of the Faculty

Signature of the HOD

ATTENDANCE

	22	24	27	28	29	30	1	5	6	7
	4	1	11	11	11	4	12	12	12	12
	4	4	6	4	4.5	4	1	4	4.5	4
37	/	a	a	a	/	/	a	a	/	a
38	/	/	/	/	a	/	/	/	/	/
39	/	/	a	/	/	a	/	/	/	/
40	/	/	/	/	/	/	/	/	/	/
41	/	/	/	/	/	/	/	/	/	/
42	a	a	a	a	a	/	a	a	/	a
43	/	a	a	a	a	a	a	a	a	a
44	/	/	/	/	/	/	/	/	/	/
45	/	/	/	/	/	/	/	/	/	/
46	/	/	/	/	/	/	/	/	/	/
47	/	/	/	/	/	/	/	/	/	/
48	/	/	a	a	/	/	/	/	/	/
49	/	/	/	/	/	/	/	/	/	/
50	/	/	/	/	/	/	/	/	/	/
51	/	/	/	/	/	/	/	/	/	/
52	/	/	/	/	/	/	/	/	/	/

ATTENDANCE

	8	11	12	13	14	18	20	21	22	25
	12	12	12	12	12	12	12	12	12	12
	6	4	4	1	4.5	6	1	11	4	1
37	a	a	a	a	a	a	/	/	a	a
38	/	/	/	/	/	/	/	/	/	/
39	/	/	/	/	/	/	/	/	/	/
40	/	/	/	/	/	/	/	/	/	/
41	/	/	/	/	/	/	/	/	/	/
42	a	a	/	a	a	a	a	a	a	/
43	a	a	/	a	a	a	a	a	a	a
44	/	/	/	/	/	/	/	/	/	a
45	/	/	/	/	/	/	/	/	/	a
46	/	/	/	/	/	/	a	/	/	/
47	/	/	/	/	/	/	/	/	/	/
48	/	/	/	/	/	/	/	/	/	/
49	/	/	/	/	/	/	/	/	/	a
50	/	/	/	/	/	/	a	/	/	/
51	/	/	/	a	/	/	/	/	/	/
52	/	/	/	/	/	/	/	/	/	/

1-RT1	RT3-R2017/R2021-RT2				RT4-R2017		Int. Mark
Total (100)	ATT	TM (100/60)	Assignment (0/40)	Total (100)	ATT	ATT	

tance - 1 mark
tance - 2 marks
tance - 3 marks
tance - 4 marks
tance - 5 marks

Class :

Sl. No.	Roll No.	Name	Date / Mont / Perio
37	23RUME037	Nithish. H	
38	23RUME038	Alithish. K.A	
39	23RUME039	Paul James.	
40	23RUME040	Rexilin Jino.	
41	23RUME041	Rismi. V. J	
42	23RUME042	Rishol Sijin	
43	23RUME043	Sajin. C.V	
44	23RUME044	Shathish. S	
45	23RUME045	Shahil. R	
46	23RUME046	Siva Keerthik	
47	23RUME047	Siva Nathan.	
48	23RUME048	Sree Dheersha.	
49	23RUME049	Subiksh. S	
50	23RUME050	Tarun Raj. M	
51	23RUME051	Thasse Pooje	
52	23RUME052	Thushbin. K	
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Signature of the Faculty

Signature of the HOD

ATTENDANCE

	28	2	3	4	5					
	12	1	1	1	1					
	4	3	2	1	3					
37	a	a								
38	1	a	1	1	1					
39	1	1	1	1	1					
40	1	1	1	1	1					
41	1	1	1	1	1					
42	a	a	1	1	1					
43	a									
44	1	1	1	1	1					
45	1	1	1	1	1					
46	a	1	1	1	1					
47	1	1	1	1	1					
48	1	1	1	1	1					
49	a	1	1	1	1					
50	1	a	1	1	1					
51	1	1	1	1	1					
52	1	1	1	1	1					

ATTENDANCE

I-RT1	RT3-R2017/R2021-RT2				RT4-R2017		Int. Mark
Total (100)	ATT	TM (100/60)	Assignment (0/40)	Total (100)	ATT	ATT	

lance - 1 mark
lance - 2 marks
lance - 3 marks
lance - 4 marks
lance - 5 marks

Class :

Sl. No.	Roll No.	Name	Date Month Period
37	23RUMEC032	Akhilesh. H	
38	23RUMEC038	Alidhisha. K.A	
39	23RUMEC035	Paul James.	
40	23RUMEC040	Rexcilia Jino.	
41	23RUMEC041	Rismi. V. J	
42	23RUMEC042	Rishol Sijin.	
43	23RUMEC043	Sajin. C.V	
44	23RUMEC044	Santhosh. S	
45	23RUMEC045	Shahil. R	
46	23RUMEC046	Siva Keerthika	
47	23RUMEC047	Siva Nathan.	
48	23RUMEC048	Sree Dharsha.	
49	23RUMEC049	Subilesh. S	
50	23RUMEC050	Tarun Raj. M	
51	23RUMEC051	Thooya Abija.	
52	23RUMEC052	Thushbin. K.	
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Signature of the Faculty			
Signature of the HOD			

Weekly Test Marks			
XV		XVI	
Date: mark Scored:	Date: Retest Mark	Date: mark Scored:	Date: Retest Mark

Internal Assessment Test marks(100)(A)			
IAT-1		IAT-II	
Date: mark Scored:	Date: Retest Mark	Date: 11/12 mark Scored:	Date: Retest Mark
AB	50	AB	
05	53	05	
13	50	18	
00	49	05	
13	54	60	
00	AB	~~28~~ AB	
AB	AB	AB	
09	47	28	
10	46	01	
60		57	
05	58	07	
52		32	
12	43	17	
17	38	~~23~~ 30	
AB	53	52	
AB	41	53	
~~AB~~			
3			

Class :

Sl. No.	Roll No.	Name	Date Mon Peri
37	23RUME032	Nithish A. H	
38	23RUME038	Alithish K.A	
39	23RUME035	Paul James.	
40	23RUME049	Rexcilia Jino.	
41	23RUME041	Risni. V. J	
42	23RUME042	Rixshol Sijin	
43	23RUME043	Sajin. C.V	
44	23RUME044	Sandhosh. S	
45	23RUME045	Shahil. R	
46	23RUME046	Siva Keerthik	
47	23RUME047	Siva Nathan.	
48	23RUME048	Sree Dharshan	
49	23RUME049	Subiloshi. S	
50	23RUME050	Tarun Raj. M	
51	23RUME051	Thanga Abija.	
52	23RUME052	Thasthin. K.	
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	Internal Assessment Test marks(100)(A)					
	IAT-III		MODEL EXAM		Best 1 (2)(B)	Marks out of (75) (A)
	Date: mark Scored:	Date: mark Scored:	Date: 21/12/24 mark Scored:	Date: mark Scored:		
37			1			
38			70			
35			70			
40			50			
41			70			
42			45			
43			1			
44			50			
45			50			
46			80			
47			40			
48			AB			
49			45			
50			45			
51			56			
52			50			
			AB			

	Assignment					RT1-R2017	RT2-R2017/R2021-RT1				RT3-R2017/R2021-RT2				RT4-R2017		Int. Mark
	Date	Date	Date	Date	Date	ATT	ATT	TM (100/60)	Assignment (0/40)	Total (100)	ATT	TM (100/60)	Assignment (0/40)	Total (100)	ATT	ATT	
37	1	1	1	1	1												
38	9	9	9	9	9												
35	8	8	9	10	9												
40	9	9	9	9	9												
41	10	9	9	9	10												
42	9	9	9	9	9												
43	—	—	—	—	—												
44	9	9	8	8	8												
45	8	8	8	8	8												
46	10	10	10	10	10												
47	9	9	9	9	9												
48	9	9	8	8	8												
49	9	9	9	9	8												
50	10	10	10	9	10												
51	10	10	10	10	10												
52	9	10	9	9	10												
	12	12	12	12	12												

76% to 80% of attendance - 1 mark
81% to 85% of attendance - 2 marks
86% to 90% of attendance - 3 marks
91% to 95% of attendance - 4 marks
96% to 100% of attendance - 5 marks

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SUBJECT COVERAGE STATEMENT

Sl. No.	Date	Period	Topics Covered	Books Followed	Initials	
					Faculty	HOD
			UNIT- I MECHANICS			
1.	3.10.23	4	Multiparticle dynamics	P. Mary Novele		
2.	7.10.23	4	Centre of Mass			
3.	4.10.23	3,5	COM of Continuous bodies.			
4.	5.10.23	4,5 1	Motion of CM	Dr. + Dr.		
5.	6.10.23	4	Kinetic Energy of System of particles			
6.	11.10.23	1	Rotational K.E, Moment of Inertia	Physics - Physics		
	11.10.23	5	Moment of Inertia of diatomic molecules			
	12.10.23	4	Rotational dynamics of rigid bodies			
	12.10.23	4	Rotational energy state of rigid diatomic mol.	Engineering Physics		
	13.10.23	1	Gyroscope			
	13.10.23	1	Torsional Pendulum			
	19.10.23	4	Double Pendulum			
	19.10.23	5	Introduction to Non-linear Oscillations			
	20.10.23	4	Class - Test.			

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SUBJECT COVERAGE STATEMENT

Sl. No.	Date	Period	Topics Covered	Books Followed	Initials	
					Faculty	HOD
	27.10.23	6	UNIT- II ELECTROMAGNETIC WAVES	P. Mary Novele Dr. + Dr. Physics - Engineering Physics		
	27.10.23	6	Maxwell's Equations			
	30.10.23	4	Electromagnetic Wave Equation			
	31.10.23	4	Plane EMW Equation in vacuum			
	31.10.23	5	plane EMW Equation in Medium			
	3.11.23	3	Production of EMW			
	3.11.23	3	Energy & Momentum of EMW			
	7.11.23	6	Intensity of EMW			
	7.11.23	6	Radiation Pressure			
	8.11.23	4	Cell-Phone reception			
	8.11.23	4	Reflection & transmission			
	8.11.23	4	Coefficient of EMW			
	9.11.23	4,5	Class Test			
	17.11.23	6	Seminar Presentation			
	21.11.23	3,4	Seminar Presentation			

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SUBJECT COVERAGE STATEMENT

Sl. No.	Date	Period	Topics Covered	Books Followed	Initials	
					Faculty	HOD
			UNIT- IV.			
	22.11.23	4	OSCILLATIONS, OPTICS AND LASERS	Dr. P. Mani, Dr. J. Mary Novaka Engineering Physics		
	23.11.23	4	SIMPLE HARMONIC Motion			
	24.11.23	4	Analogy between electrical & Mechanical oscillation.			
	25.11.23	4	Energy transfer in Standing Waves			
	27.11.23	6	Energy transfer in travelling Waves.			
	27.11.23	6	Doppler Effect.			
	28.11.23	4	Reflection & Refraction of Light waves.			
	28.11.23	4	Total Internal Reflection			
	29.11.23	4	Michelson Interferometer			
	29.11.23	5	Theory of Aircoedge experiment			
	30.11.23	4	Einstein's A & B Coefficients			
	30.11.23	4	ND-YAG Laser			
	1.12.23	1	CO_2 Laser			

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SUBJECT COVERAGE STATEMENT

Sl. No.	Date	Period	Topics Covered	Books Followed	Initials	
					Faculty	HOD
	1.12.23	1	Semiconductor Lasers	Dr. P. Mani, Dr. J. Mary Novaka Engineering Physics		
	5.12.23	4	Class Test			
			UNIT - V			
	6.12.23	4.15	BASIC QUANTUM PHYSICS			
	6.12.23	4.15	Photons & Light Waves			
	6.12.23	4.15	Electrons & Matter Waves			
	6.12.23	4.15	Compton Effect			
	7.12.23	4	Schrodinger Equation			
	7.12.23	4	1) Time dependent & 2) Time independent			
	8.12.23	4.15	Particle in 1D Box.			
	11.12.23	1	Particle in 2D Box			
	12.12.23	6	Particle in 3D Box			
	13.12.23	4	Normalisation			
	13.12.23	4	Probabilities			

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SUBJECT COVERAGE STATEMENT

Sl. No.	Date	Period	Topics Covered	Books Followed	Initials: Faculty	Initials: HOD
	4	14.12.23	Correspondence Principle			
	1	15.12.23	Class Test.			
				Morgan Mano.		
			UNIT - V			
	6	20.12.23	APPLIED PHYSICS	Dr. P. Mani		
	6	20.12.23	The Harmonic Oscillator			
	6	21.12.23	Barrier Penetration	Dr. P. Mani Engineering Physics		
	6	21.12.23	Quantum tunneling			
	4	22.12.23	Tunneling Microscope			
	5	22.12.23	Resonant Diode			
	1	27.12.23	Finite potential well			
	1	27.12.23	Bloch Theorem for			
	6	28.12.23	Particles in Periodic potential			
	6	28.12.23	Kronig-Penny Model			
	6	29.12.23	Origin of Energy Bands			

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SUBJECT COVERAGE STATEMENT

Sl. No.	Date	Period	Topics Covered	Books Followed	Initials: Faculty	Initials: HOD
	2.1.24		Coaching Class	Dr. P. Mani		
	3.1.24		Coaching Class			
	4.1.24		Class Test			