Department of Humanities and Sciences

AI&ML(A&B) Course File

APPLIED PHYSICS

(Course Code: AP202BS)

I B.Tech II Semester

2023-24

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Assistant Professor

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APPLIED PHYSICS

Check List

Department of Humanities and Sciences

Int. Marks: 40 Ext. Marks:60 Total Marks:100 **L-T-P-C**
3-1-0-4

Applied Physics

(AI&ML)

Course Code: AP202BS

UNIT-I: WAVE OPTICS

Huygen's principle, superposition of waves, interference, interference in thin films by Reflection, Newton's rings (theory & experiment), diffraction, types of diffraction, Farunhofer diffraction at single slit, plane diffraction gratings, resolving power of grating, polarization, polarization by reflection, polarization by double refraction, Nicol's prism.

UNIT-II: QUANTUMPHYSICS AND SOLIDS

Quantum Physics: blackbody radiation and Planck's law (Qualitative), De Broglie hypothesis, DavissonandGermerexperiment,Heisenberguncertaintyprinciple(Qualitative),Borninterpretationofthewavefunction, time independent Schrodinger wave equation, particle in one dimensional potential box.

Solids: free electron theory (Drude&Lorentz,Sommerfeld) (Qualitative), Bloch's theorem, Kronig-Penney model(Qualitative),E-K diagram, effective mass of electron, origin of energy bands, classification of solids.

UNIT-III:SEMICONDUCTORS AND DEVICES

Intrinsic and extrinsic semiconductors, energy band diagrams, Hall effect, direct and indirect band gap semiconductors, Formation of P-N junction diode, energy level diagram of P-N junction, V-I characteristics of P-N Junction, Zener diode and bipolar junction transistor(BJT),Construction, working and characteristics of LED, photo diode and solarcell.

UNIT-IV:NANOTECHNOLOGY

Nanoscale, quantum confinement, surface to volume ratio, bottom-up fabrication:sol-gel,combustion methods, top-down fabrication: ball milling. physical vapour deposition (PVD) , Chemical vapour deposition(CVD),Characterization techniques-XRD,SEM&TEM, applications of nano materials.

UNIT-V:LASER AND FIBEROPTICS

Lasers: Interaction of radiation with matter: Absorption, Spontaneous emission and stimulated emission, Einstein coefficients and their relations, Laser beam characteristics, important components of laser-active medium, pumping source, optical resonator, Construction and working principle- Nd:YAG laser, He-Ne laser, semiconductor laser, applications of laser.

Fiber Optics: Introduction to optical fiber, advantages of optical fibers, total internal reflection, construction of optical fiber, acceptance angle, numerical aperture, classification of optical fibers- step index and graded index optical fiber, losses in optical fiber, optical fiber for communication system,applications of optical fiber.

TEXTBOOKS:

M.N.Avadhanulu,P.G.Kshirsagar&TVSArunMurthy"

ATextbookofEngineeringPhysics"- S.ChandPublications,11/e2019.

ShatendraSharmaandJyotsnaSharma, EngineeringPhysics, PearsonPublication,2019

P.K. Palanisamy A Text Book of Engineering Physics, Scietech Publications.

REFERENCEBOOKS:

Halliday,ResnickandWalker,FundamentalsofPhysics,JohnWiley&Sons,11thEdition,2018.

B.K.PandeyandS.Chaturvedi, EngineeringPhysics,CengageLearning, 2ndEdition,2022.

EssentialsofNanoscience&NanotechnologybyNarasimhaReddyKatta,TypicalCreativesNANODIGEST ,1stEdition,2021

A.K. Katiyar, C.K.Pandey Engineering Physics 2/e, Wiley India pvt Ltd.2017.

Department of Humanities and Sciences
Time table

I B.Tech. II Semester : AI&ML(A-sec)

Day/Hour	9.30-10.20	10.20-11.10	11.20-12.10	12.10-12.50	12.50-1.35	1.35-2.20	2.30-3.15	3.15-4.00
Monday		AP						
Tuesday						AP		
Wednesday						AP		
Thursday						AP		
Friday		AP						
Saturday		AP						

I B.Tech. II Semester : AI&ML(B-sec)

Day/Hour	9.30-10.20	10.20-11.10	11.20-12.10	12.10-12.50	12.50-1.35	1.35-2.20	2.30-3.15	3.15-4.00
Monday					AP			
Tuesday							AP	
Wednesday			AP					
Thursday							AP	
Friday							AP	
Saturday					AP			

Vision of the Institute

To be a premier Institute in the country and region for the study of Engineering, Technology and Management by maintaining high academic standards which promotes the analytical thinking and independent judgment among the prime stakeholders, enabling them to function responsibly in the globalized society.

Mission of the Institute

To be a world-class Institute, achieving excellence in teaching, research and consultancy in cutting-edge Technologies and be in the service of society in promoting continued education in Engineering,Technology and Management.

Quality Policy

To ensure high standards in imparting professional education by providing world-class infrastructure, top-quality-faculty and decent work culture to sculpt the students into Socially Responsible Professionals through creative team-work, innovation and research.

Vision of the Department

To foster the students with excellence in education and moral values, thereby transform them to be eminent professional engineers and responsible citizens of tomorrow.

Mission of the Department

To metamorphosis the students community to get conversant with Scientific, Mathematical concepts and communication skills by providing perpetual thought provoking teaching, tremendous training and relentless research.

Program Educational Objectives (B.Tech. –AI&ML)
Graduates will be able to

PEO 1: Excel in professional career and/or higher education by acquiring knowledge in mathematical, computing and engineering principles.

PEO 2: Be able to analyze the requirements of the software, understand the technical specifications, design and provide novel engineering solutions and efficient product designs.

PEO 3: Adopt professionalism, ethical attitude, communication skills, team work, lifelong learning in their profession.

Program Outcomes (B.Tech. –AI&ML)
At the end of the Program, a graduate will have the ability to

PO 1: **Understanding** the basics of general mathematics and science skills and use them in the higher levels of engineering program. The basic concepts are very useful, since they are required for understanding various engineering subjects in the future years of graduation.

PO 2: Developing Communicate skills of students in English, which make them to understand the engineering concepts effectively in the advanced levels of graduation.

PO 3: An ability to conduct Investigations by using design of experiments, analysis and interpretation of data to provide valid conclusions**.**

PO 4: Develop the competence to identify, analyze, formulate and solve engineering problems.

PO 5: Acquire an ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO 6: Capable to deliver professional ideas clearly and precisely in making written and oral presentations.

PO 7: Recognize the need to engage in independent and life-long learning.

Department of Humanities and Sciences

COURSE OBJECTIVES

On completion of this Subject/Course the student shall be able to:

S.No	Objectives
1	Understand the phenomenon of diffraction, interference and polarization
2	Recognize the basic principles of quantum physics and band theory of solids
3	Understand the underlying mechanism involved in construction and working principles of various semiconductor devices
4	Identify the importance of nano scale, quantum confinement and various fabrications techniques.
5	Study the characteristics of lasers and optical fibers

COURSE OUTCOMES

The expected outcomes of the Course/Subject are:

S.No	Outcomes
1.	Understand various optical phenomena of light
2.	Apply basic the principles of quantum mechanics to classify solids based on band theory.
3.	Identify the role of semiconductor devices in science and engineering Applications.
4.	Understand the features and applications of Nano material's in various fields
5.	Understand various aspects of Lasers and Optical fiber and their applications in diverse fields.

Signature of faculty

Note: Please refer to Bloom's Taxonomy, to know the illustrative verbs that can be used to state the outcomes.

GUIDELINES TO STUDY THE COURSE / SUBJECT

Course Design and Delivery System (CDD):

- The Course syllabus is written into number of learning objectives and outcomes.
- Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.
- The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

- Understand the principles of Learning
- Understand the psychology of students
- Develop instructional objectives for a given topic
- Prepare course, unit and lesson plans
- Understand different methods of teaching and learning
- Use appropriate teaching and learning aids
- Plan and deliver lectures effectively
- Provide feedback to students using various methods of Assessments and tools of Evaluation
- Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone

Signature of HOD

Date:05-02-2024

Signature of faculty

Date: 05-02-2024

COURSE SCHEDULE :(AI&ML-A)

The Schedule for the whole Course / Subject is:

S. No.	Description	Duration (Date)		Total No. of Periods
		From	To	
1.	**Unit-I: WAVE OPTICS** Huygen's principle, superposition of waves, interference, interference in thin films by Reflection, Newton's rings (theory & experiment), diffraction, types of diffraction, Farunhofer diffraction at single slit, plane diffraction gratings, resolving power of grating, polarization, polarization by reflection, polarization by double refraction, Nicol's prism	14.2.2024	27.02.2024	14
2.	**Unit-II: QUANTUM PHYSICS AND SOLIDS** Quantum Physics: blackbody radiation and Planck's law (Qualitative), De Broglie hypothesis, Davisson – Germer experiment, Heisenberg uncertainty principle (Qualitative), Born interpretation of the wave function, time independent Schrodinger wave equation, particle in one dimensional potential box. Solids: free electron theory (Drude & Lorentz, Somerfield) (Qualitative), Bloch's theorem, Kronig-Penney model (Qualitative), E-K diagram, effective mass of electron, origin of energy bands, classification of solids	28.02.2024	15.3.2024	14
3.	**Unit-III: SEMICONDUCTORS AND DEVICES** Intrinsic and extrinsic semiconductors, energy band diagrams, Hall effect, direct and indirect band gap semiconductors, Formation of P-N junction diode, energy level diagram of P-N junction, V-I characteristics of P-N Junction, Zener diode and bipolar junction transistor (BJT), Construction, working and characteristics of LED, photo diode and solar cell	16.3.2024	25.4.2024	10
4.	**Unit-IV: NANOTECHNOLOGY** Nanoscale, quantum confinement, surface to volume ratio, bottom-up fabrication: sol-gel, combustion methods, top-down fabrication: ball milling. physical vapor deposition (PVD), Chemical vapor deposition (CVD), Characterization techniques - XRD, SEM &TEM, applications of nanomaterials	26.4.2024	7.5.2024	10
5.	**Unit-V: LASER AND FIBER OPTICS** Lasers: Interaction of radiation with matter: Absorption, Spontaneous emission and stimulated emission, Einstein coefficients and their relations, Laser beam characteristics, important components of laser-active medium, pumping	8.5.2024	07.6.2024	08

	source, optical resonator, Construction and working principle- Nd:YAG laser, He- Ne laser, semiconductor laser, applications of laser. Fiber Optics: Introduction to optical fiber, advantages of optical fibers, total internal reflection, construction of optical fiber, acceptance angle, numerical aperture, classification of optical fibers- step index and graded index optical fiber, losses in optical fiber, optical fiber for communication system, applications of optical fiber.			

Total No. of Instructional periods available for the course: 56 Hours + 2hr (Mid-I Exam)

SCHEDULE OF INSTRUCTIONS - COURSE PLAN: (AI&ML-A)

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Textbook, Journal)
1.	1	14.2.2024 15.2.2024	2	Course Introduction, Huygen's principle	1 1	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	2	16.2.2024 17.2.2024	2	superposition of waves, Interference	1 1	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	3	19.2.2024 20.2.2024 21.2.2024	3	Interference in thin films by Reflection, Newton's rings (theory & experiment),	1 1	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	4	22.2.2024	1	diffraction, types of diffraction	1 1	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	5	23.2.2024	2	Fraunhofer diffraction at single slit, plane diffraction gratings	1 1	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	6	24.2.2024	1	resolving power of grating,	1	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	7	26.2.2024	1	polarization, polarization by reflection, polarization by double refraction	1	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
	8	27.2.2024	2	Nicol's prism	1 1	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
2.	1	28.2.2024 29.2.2024	2	blackbody radiation and Planck's law (Qualitative), De Broglie hypothesis,	2 2	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
	2	01.3.2024	1	Davisson – Germer experiment	2 2	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	3	02.3.2024	1	Heisenberg uncertainty principle (Qualitative), Born interpretation of the wave	2 2	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017

				function		
	4	04.3.2024	1	time independent Schrodinger wave equation	2 2	A.K. Katiyar, C. K. Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	5	05.3.2024 06.3.2024	2	particle in one dimensional potential box.	2 2	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
	6	07.3.2024 08.3.2024	2	free electron theory (Drude & Lorentz, Sommerfeld)	2 2	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
	7	09.3.2024 11.3.2024	2	Bloch's theorem, Kronig-Penney model (Qualitative),	2 2	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
	8	12.3.2024	1	E-K diagram, effective mass of electron,	2 2	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
	9	14.3.2024 15.3.2024	1	origin of energy bands, classification of solids.	2 2	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
3.	1	16.3.2024 19.3.2024	1	Intrinsic and extrinsic semiconductors, energy band diagrams, direct and indirect band gap semiconductors	3 3	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
	2	27.3.2024	1	Hall effect	3 3	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
	3	30.3.2024	1	Revision	1,2.3 1,2,3	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
		1.4.2024	2	**Mid-I Exam**		
	4	10.4.2023	1	PN junction diode	3 3	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e 2019
	5	22.4.2024	1	Zener diode	3 3	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11/e 2019
	6	22.4.2024	2	bipolar junction transistor (BJT)	3 3	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11/e 2019
	7	22.4.2024	1	Construction, working and characteristics of LED	3 3	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11/e 2019
	8	23.4.2024	1	Construction, working and characteristics of photo diode	3 3	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11/e 2019
	9	25.4.2024	1	Construction, working and characteristics of solar cell	3 3	M. N. Avadhanulu, A Text book of Engineering

						Physics" S. Chand , 11/e 2019
4	1	26.4.2024	2	Nanoscale, quantum confinement, surface to volume ratio,	4 4	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11/e 2019
	2	27.4.2024	2	Bottom-up fabrication: sol gel, combustion methods	4 4	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11/e 2019
	3	28.4.2024	2	Top-down fabrication: ball milling	4 4	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11/e 2019
	4	1.5.25024	2	Physical vapor deposition (PVD)	4 4	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11/e 2019
	5	3.5.2024	1	Chemical vapor deposition (CVD)	4 4	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand , 11th Edition 2019
	6	4.5.2024	1	Characterization techniques - XRD	4 4	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11th 2019
	7	6.5.2024	1	Scanning Electron Microscope (SEM)	4 4	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e, 2019
	8	7.5.2024	1	Transmission Electron Microscope (TEM), Applications of nanomaterials	4 4	M. N. Avadhanulu, A Text book of Engineering Physics" S. Chand, 11/e, 2019
5	1	8.5.2024	1	Interaction of radiation with matter: Absorption, Spontaneous emission and stimulated emission,	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
	2	9.5.2024	1	Einstein coefficients and their relations Laser beam characteristics	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
	3	10.5.2024	1	Important components of laser-active medium, pumping source, optical resonator	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
	4	3.6.2024	1	Construction and working principle- Nd: YAG laser, He-Ne laser	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
	5	4.6.2024	1	semiconductor laser applications of laser, Introduction to optical fiber advantages of optical fibers	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019

	6	5.6.2024	1	total internal reflection construction of optical fiber	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
	7	06.6.2024	1	acceptance angle, numerical aperture, classification of optical fibers- step index and graded index optical fiber	5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019
	8	7.06.2024	1	losses in optical fiber, optical fiber for communication system, applications of optical fiber.	1, 2 1, 2	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson, 2019

LESSON PLAN (U-I)

Lesson No: 01, 02 Duration of Lessons: 3hr 20 min

Lesson Title: Interference

Instructional / Lesson Objectives:

- To make students understand course structure and phenomenon of wave optics
- To familiarize students on wave fronts and generation of interference
- To understand students the concept of interference.
- To provide information on conditions for interference.

Teaching AIDS : PPTs, Black board

Time Management of Class : 200 minutes

15 mins for taking attendance 15 mins for previous lecture 150 min for the lecture delivery 20 min for doubts session

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Humanities and Sciences
LESSON PLAN (U-I)

Lesson No: 03, 04 Duration of Lesson: 3 hr20 min

Lesson Title: Interference and diffraction

Instructional / Lesson Objectives:

- To make students understand formation of newton rings and interference in thin films
- To familiarize students on formation of interference pattern
- To understand students the concept of diffraction.
- To provide information on types of diffraction and daily life examples.

Teaching AIDS : PPTs, Black board
Time Management of Class : 200 minutes

15 mins for taking attendance
15 mins for previous lecture
150 min for the lecture delivery
20 min for doubts session

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-I)

Lesson No: 05, 06 Duration of Lesson: 2 hr30 min

Lesson Title: Diffraction & Polarization

Instructional / Lesson Objectives:

- To make students understand the concept of resolving power and polarization.
- To familiarize students on single slit and diffraction gratings.
- To understand students the diffraction at single slit &resolving power of grating.
- To provide information on methods of generation of polarized light

Teaching AIDS : PPTs, Black board

Time Management of Class : 150 min.

10 mins for taking attendance
20 for revision of previous class
100 min for lecture delivery
20 min for doubts session

Refer assignment – I & tutorial-I sheets

Signature of faculty

LESSON PLAN (U-I)

Lesson No: 07,08 Duration of Lesson: 2hr 30 min

Lesson Title: Nicol's prism

Instructional / Lesson Objectives:

- To make students understand working and applications of Nicol's prism.
- To familiarize students on polarization methods
- To understand students the concept of double refraction and total internal reflection
- To provide information on applications of polarizers.

Teaching AIDS : PPTs, Black board
Time Management of Class : 150 min

5 mins for taking attendance 10 min for revision of previous class. 120 min for the lecture delivery 15 min for doubts session

Refer assignment – I & tutorial-I sheets

Signature of faculty

LESSON PLAN (U-II)

Lesson No: 01,02 Duration of Lesson: 1hr30 MIN
Lesson Title: blackbody radiation & Davisson – Germer experiment,

Instructional / Lesson Objectives:

- To make students understand the concept of black body radiation & dual nature of matter.
- To familiarize students on planck's law, de Broglie hypothesis
- To understand students' limitations of classical physics and dual nature of matter
- To provide information on Davission - Germer experiment

Teaching AIDS : PPTs, Black board
Time Management of Class : 150 min.

5 mins for taking attendance 10 min for revision of previous class. 120 min for the lecture delivery 15 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

LESSON PLAN (U-II)

Lesson No: 03,04 Duration of Lesson: 1hr 40 min.

Lesson Title: Heisenberg uncertainty principle (Qualitative), Born interpretation of the wave function, time independent Schrodinger wave equation.

Instructional / Lesson Objectives:

- To make students understand Heisenberg uncertainty principle and TISWE.
- To familiarize students on HUP and TISEW.
- To understand students the concept of uncertainty and probability density of wave functions.
- To provide information on wave functions and TISWE.

Teaching AIDS : PPTs, Black board
Time Management of Class : 100 min.

10 mins for taking attendance
10 min for revision of previous class
70 min for the lecture delivery
10 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

LESSON PLAN (U-II)

Lesson No: 05 Duration of Lesson: 1hr 40 min.

Lesson Title: particle in one dimensional potential box.

Instructional / Lesson Objectives:

- To make students understand potential in quantum mechanics
- To familiarize students on one dimensional box and its significance.
- To understand students the concept of wave functions, quantization of energy.
- To provide information on energy levels and probability of finding electron in particular region.

Teaching AIDS : PPTs, Black board
Time Management of Class : 100 min.

10 mins for taking attendance 10 min for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

LESSON PLAN (U-II)

Lesson No: 06, 07,08 Duration of Lesson: 3 hr20 min

Lesson Title: free electron theory (Drude & Lorentz, Sommerfeld), Bloch's theorem, Kronig-Penney model (Qualitative),E-K diagram, effective mass of electron,

Instructional / Lesson Objectives:

- To make students understand the concept of free electron, periodic potential, effective mass
- To familiarize students on free electron theories and K-P model.
- To understand students the conduction of electrons in different materials.
- To provide information on solution for kronig-penny model and E-K diagram.

Teaching AIDS : PPTs, Black board
Time Management of Class: 200 min

15 mins for taking attendance 15 mins for previous lecture 150 min for the lecture delivery 20 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

LESSON PLAN (U-II)

Lesson No: 09 Duration of Lesson: 50 min

Lesson Title: origin of energy bands, classification of solids.

Instructional / Lesson Objectives:

- To make students understand origin of energy bands and classification of solids.
- To familiarize students on conduction and valence bands, conductors, semiconductors and insulators.
- To understand students the concept fermi level, acceptor and donor levels
- To provide information on band structures of materials.

Teaching AIDS : PPTs, Black board

Time Management of Class : 50 min

5 mins for taking attendance 5 mins for previous lecture 30 min for the lecture delivery 10 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

LESSON PLAN (U-IIII)

Lesson No: 01,02 Duration of Lesson: 2hr30 min

Lesson Title: Intrinsic and extrinsic semiconductors, energy band diagrams, Hall effect

Instructional / Lesson Objectives:

- To make students understand Hall effect
- To familiarize students on direct and indirect bandgap semiconductors

- To understand students the concept of doping to form intrinsic and extrinsic semiconductors.
- To provide information on structure and applications of semiconductors

Teaching AIDS : PPTs, Black board
Time Management of Class: 100 min

10 mins for taking attendance 20 for revision of previous class 60 min for lecture delivery 10 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-III)

Lesson No: 04 Duration of Lesson: 50 min

Lesson Title: PN junction diode

Instructional / Lesson Objectives:

- To make students understand the concept of diodes and biasing.
- To familiarize students on formation and working of pn junctions
- To understand students the difference between forward and reverse bias.
- To provide information on I- V Characteristics and applications of pn junction diode

Teaching AIDS : PPTs, Black board
Time Management of Class : 50 min

5 mins for taking attendance 5 mins for previous lecture 30 min for the lecture delivery 10 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

LESSON PLAN (U-III)

Lesson No: 05,06 Duration of Lesson: 2hr 30 min

Lesson Title: Zener diode, Bipolar junction transistor (BJT)

Instructional / Lesson Objectives:

- To make students understand difference between pn and zenar diode.
- To familiarize students on functioning of n-p-n and p-n-p transistor.
- To understand students the concept of different working regions in BJT.
- To provide information on applications of diode and transistor.

Teaching AIDS : PPTs, Black board

Time Management of Class : 150 min

5 mins for taking attendance 10 min for revision of previous class. 120 min for the lecture delivery 15 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

LESSON PLAN (U-III)

Lesson No: 07,08 Duration of Lesson: 1hr 40 min

Lesson Title: LED and Photo diode

Instructional / Lesson Objectives:

- To make students understand construction and working of LED and photodiode.
- To familiarize students on I-V characteristics of LED and photodiode.
- To understand students the concept of electroluminescence and photovoltaic effect.
- To provide information on applications of LED and Photodiode.

Teaching AIDS : PPTs, Black board
Time Management of Class : 100 min

10 mins for taking attendance
15 for revision of previous class
60 min for lecture delivery
15 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-III)

Lesson No: 09 Duration of Lesson: 50 min

Lesson Title: Solar Cell

Instructional / Lesson Objectives:

- To make students understand the concept of photovoltaic effect and efficiency of solar cell'
- To familiarize students on construction and working of solar cell.
- To understand students the difference between solar cell and photodiode.
- To provide information on applications of solar cell.

Teaching AIDS: PPTs, Black board

Time Management of Class : 50 min.

5 mins for taking attendance 5 mins for previous lecture 30 min for the lecture delivery 10 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

LESSON PLAN (U-IV)

Lesson No: 01, 02 Duration of Lesson: 2 hr 30 min

Lesson Title: Nano science and Bottom-up fabrication: sol-gel, combustion methods

Instructional / Lesson Objectives:

- To make students understand the synthesis methods of nanomaterials
- To familiarize students on nanoscale and significance of nanomaterials.
- To understand students the concept of quantum confinement, surface to volume ratio
- To provide information on sol-gel process and combustion methods.

Teaching AIDS : PPTs, Black board
Time Management of Class : 150 min

5 mins for taking attendance 10 min for revision of previous class. 120 min for the lecture delivery 15 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

LESSON PLAN (U-IV)

Lesson No: 03, 04 Duration of Lesson: 3 hr20 min

Lesson Title: Top-down fabrication: ball milling, Physical vapor deposition (PVD)

Instructional / Lesson Objectives:

- To make students understand top down and bottom-up methods.
- To familiarize students on ball milling and PVD
- To understand students the concept of milling and vapor deposition.
- To provide information on advantages, limitation and applications of the method.

Teaching AID : PPTs, Black board

Time Management of Class : 200 min

15 mins for taking attendance 15 mins for previous lecture 150 min for the lecture delivery 20 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

ANURAG Anurag ENGINEERING COLLEGE (An Autonomous Institution)

LESSON PLAN (U-IV)

Lesson No: 05 Duration of Lesson: 1hr30 MIN

Lesson Title: Chemical vapor deposition (CVD)

Instructional / Lesson Objectives:

- To make students understand the concept of CVD
- To familiarize students on procedure to synthesize nanomaterials.
- To provide information on applications of CVD.

Teaching AIDS : PPTs, Black board
Time Management of Class : 50 min

5 mins for taking attendance
5 mins for previous lecture
30 min for the lecture delivery
10 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

LESSON PLAN (U-IV)

Lesson No: 06, 07 Duration of Lesson: 1 hr 40 min

Lesson Title: Characterization techniques – XRD, SEM

Instructional / Lesson Objectives:

- To make students understand significance of characterization of nanomaterials.
- To familiarize students on characterization of nanomaterials using XRD and SEM
- To understand students the analysis of XRD and SEM diagrams of nanomaterials.
- To provide information on crystal structure analysis and morphological studies of nanomaterials.

Teaching AIDS : PPTs, Black board
Time Management of Class : 100 min

10 mins for taking attendance
15 for revision of previous class
60 min for lecture delivery
15 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

LESSON PLAN (U-IV)

Lesson No: 08 Duration of Lesson: 50 min

Lesson Title: Transmission Electron Microscope (TEM), Applications of nanomaterials

Instructional / Lesson Objectives:

- To make students understand the construction and working of TEM
- To familiarize students on TEM image analysis
- To understand students the concept of single crystal, polycrystalline and amorphous
- To provide information on nanoparticle size distribution and defects in materials.

Teaching AIDS : PPTs, Black board
Time Management of Class : 50 min

5 mins for taking attendance 5 mins for previous lecture 30 min for the lecture delivery 10 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

LESSON PLAN (U-V)

Lesson No: 01,02 Duration of Lessons: 3hr 20 min

Lesson Title: Interaction of radiation with matter & Einstein coefficients and their relations

Instructional / Lesson Objectives:

- To make students understand the concept of absorption and stimulated emission
- To familiarize students on interaction of matter with radiation.
- To provide information on Einstein coefficients and relations.

Teaching AIDS : PPTs, Black board
Time Management of Class : 200 min

15 mins for taking attendance 15 mins for previous lecture 150 min for the lecture delivery 20 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

LESSON PLAN (U-V)

Lesson No: 03,04 Duration of Lesson: 1hr 40 min

Lesson Title: Laser beam characteristics, Important components of laser-active medium, pumping source, optical
Resonator, Construction and working principle- Nd: YAG laser, He-Ne laser

Instructional / Lesson Objectives:

- To make students understand working of laser

- To familiarize students on components of laser and its functioning
- To understand students the concept of population inversion and lasing action
- To provide information on Construction and working of Lasers.

Teaching AIDS : PPTs, Black board
Time Management of Class : 100 min

10 mins for taking attendance 15 for revision of previous class 60 min for lecture delivery 15 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

LESSON PLAN (U-V)

Lesson No: 05 Duration of Lesson: 1hr40 min

Lesson Title: semiconductor laser and applications of laser,

Instructional / Lesson Objectives:

- To make students understand working of semiconductor laser.
- To familiarize students on laser characteristics and applications
- To provide information on applications of lasers in different fields.

Teaching AIDS : PPTs, Black board
Time Management of Class : 100 min

10 mins for taking attendance 15 for revision of previous class 60 min for lecture delivery 15 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-V)

Lesson No: 06, 07 Duration of Lesson: 2hr30 min

Lesson Title: Introduction to optical fibers and classification

Instructional / Lesson Objectives:

- To make students understand the concept of total internal reflection, acceptance angle and numerical aperture.
- To familiarize students on construction and types of optical fibers.
- To understand students, step and graded index fibers.
- To provide information on advantages of optical fibers

Teaching AIDS : PPTs, Black board
Time Management of Class : 150 min

5 mins for taking attendance
10 min for revision of previous class.
120 min for the lecture delivery
15 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

LESSON PLAN (U-V)

Lesson No: 08 Duration of Lesson: 50 min

Lesson Title: losses in optical fiber, optical fiber for communication system, applications of optical fiber.

Instructional / Lesson Objectives:

- To make students understand losses in optical fibers.
- To familiarize students on communication systems in optical fibers.
- To understand student applications of optical fibers

Teaching AIDS : PPTs, Black board
Time Management of Class :50 min

2 mins for taking attendance
5 for revision of previous class
35 min for lecture delivery
08 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

COURSE SCHEDULE:(AI&ML-B)

The Schedule for the whole Course / Subject is:

S. No.	Description	Duration (Date)		Total No. of Periods
		From	To	
1.	**Unit-I: WAVE OPTICS** Huygen's principle, superposition of waves, interference, interference in thin films byReflection, Newton's rings (theory & experiment), diffraction, types of diffraction, Farunhofer diffractionat single slit, plane diffraction gratings, resolving power of grating, polarization, polarization byreflection, polarization by double refraction, Nicol's prism	5.2.2024	22.2.2024	14
2.	**Unit-II: QUANTUM PHYSICS AND SOLIDS** Quantum Physics: blackbody radiation and Planck's law (Qualitative), De Broglie hypothesis, Davisson– Germer experiment, Heisenberg uncertainty principle (Qualitative), Born interpretation of the wavefunction, time independent Schrodinger wave equation, particle in one dimensional potential box.Solids: free electron theory (Drude & Lorentz, Somerfield) (Qualitative), Bloch's theorem, Kronig-Penney model (Qualitative), E-K diagram, effective mass of electron, origin of energy bands, classification of solids	23.2.2024	12.3.2024	14
3.	**Unit-III: SEMICONDUCTORS AND DEVICES** Intrinsic and extrinsic semiconductors, energy band diagrams, Hall effect, direct and indirect band gap semiconductors, Formation of P-N junction diode, energy level diagram of P-N junction, V-I characteristics of P-N Junction, Zener diode and bipolar junction transistor (BJT), Construction, working and characteristics of LED, photo diode and solar cell	16.3.2024	25.4.2024	10
4.	**Unit-IV: NANOTECHNOLOGY** Nano scale, quantum confinement, surface to volume ratio, bottom-up fabrication: sol-gel,combustion methods, top-down fabrication: ball milling. physical vapor deposition (PVD),Chemical vapor deposition (CVD), Characterization techniques - XRD, SEM &TEM, applications of nanomaterials	26.4.2024	4.5.2024	12
5.	**Unit-V: LASER AND FIBER OPTICS** Lasers: Interaction of radiation with matter: Absorption, Spontaneous emission and stimulated emissio,Einstein coefficients and their relations, Laser beam characteristics, important components of laser-active medium, pumping	6.5.2024	11.6.2024	14

	source, optical resonator, Construction and working principle- Nd:YAG laser, He-Ne laser, semiconductor laser, applications of laser. Fiber Optics: Introduction to optical fiber, advantages of optical fibers, total internal reflection,construction of optical fiber, acceptance angle, numerical aperture, classification of optical fibers- stepindex and graded index optical fiber, losses in optical fiber, optical fiber for communication system,applications of optical fiber.			

Total No. of Instructional periods available for the course: 64 Hours + 2hr (Mid-I Exam)

SCHEDULE OF INSTRUCTIONS - COURSE PLAN:(AI&ML-B)

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Textbook, Journal)
1.	1	8.2.2024 9.2.2024	2	Course Introduction, Huygen's principle	1 1	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	2	12.2.2024 13.2.2024	2	superposition of waves, Interference	1 1	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	3	14.2.2024 15.2.2024 16.3.2024	3	Interference in thin films by Reflection,Newton's rings (theory & experiment),	1 1	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	4	17.2.2024	1	diffraction, types of diffraction	1 1	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	5	19.2.2024	2	Fraunhofer diffraction at single slit, plane diffraction gratings	1 1	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	6	20.2.2024	1	resolving power of grating,	1	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	7	21.2.2024	1	polarization, polarization by reflection,polarization by double refraction	1	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
	8	22.2.2024	2	Nicol's prism	1 1	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
2.	1	23.2.2024 24.2.2024	2	blackbody radiation and Planck's law (Qualitative), De Broglie hypothesis,	2 2	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
	2	26.2.2024	1	Davisson – Germer experiment	2 2	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	3	27.2.2024	1	Heisenberg uncertainty principle (Qualitative), Born interpretation of the wave function	2 2	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017

	4	28.2.2024	1	time independent Schrodinger wave equation	2 2	A.K. Katiyar,C.K.Pandey Engineering Physics 2/e Wiley India Pvt Ltd., 2017
	5	29.2.2024 1.3.2024	2	particle in one dimensional potential box.	2 2	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
	6	2.3.2024 5.3.2024	2	free electron theory (Drude & Lorentz, Sommerfeld)	2 2	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
	7	6.3.2024 11.3.2024	2	Bloch's theorem, Kronig-Penney model (Qualitative),	2 2	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
	8	12.3.2024	1	E-K diagram, effective mass of electron,	2 2	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
	9	14.3.2024 15.3.2024	1	origin of energy bands, classification of solids.	2 2	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
3.	1	16.3.2024 19.3.2024	1	Intrinsic and extrinsic semiconductors, energy band diagrams, direct and indirect band gap semiconductors	3 3	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
	2	27.3.2024	1	Hall effect	3 3	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
	3	30.3.2024	1	Revision	1,2.3 1,2,3	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
		1.4.2024	2	**Mid-I Exam**		
	4	10.4.2023	1	PN junction diode	3 3	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e2019
	5	23.4.2024	1	Zener diode	3 3	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand,11/e2019
	6	24.4.2024	2	bipolar junction transistor (BJT)	3 3	M. N. Avadhanulu, A Text book ofEngineeringPhysics" S. Chand,11/e2019
	7	25.4.2024	1	Construction, working and characteristics of LED	3 3	M. N. Avadhanulu, A Text book ofEngineeringPhysics" S. Chand,11/e2019
	8	26.4.2024	1	Construction, working and	3	M. N. Avadhanulu, A Text

				characteristics of photo diode	3	book ofEngineeringPhysics" S. Chand,11/e2019
	9	26.4.2024	1	Construction, working and characteristics of solar cell	3 3	M. N. Avadhanulu, A Text book ofEngineeringPhysics" S. Chand,11/e2019
4	1	27.4.2024	2	Nanoscale, quantum confinement, surface to volume ratio,	4 4	M. N. Avadhanulu, A Text book ofEngineeringPhysics" S. Chand,11/e2019
	2	29.4.2024	2	Bottom-up fabrication: sol gel,combustion methods	4 4	M. N. Avadhanulu, A Text book ofEngineeringPhysics" S. Chand,11/e2019
	3	30.4.2024	2	Top-down fabrication: ball milling	4 4	M. N. Avadhanulu, A Text book ofEngineeringPhysics" S. Chand, 11/e 2019
	4	1.5.25024	2	Physical vapor deposition (PVD)	4 4	M. N. Avadhanulu, A Text book ofEngineeringPhysics" S. Chand, 11/e 2019
	5	3.5.2024	1	Chemical vapor deposition (CVD)	4 4	M. N. Avadhanulu, A Text book ofEngineeringPhysics" S. Chand, 11th Edition 2019
	6	3.5.2024	1	Characterization techniques - XRD	4 4	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11th 2019
	7	4.5.2024	1	Scanning Electron Microscope (SEM)	4 4	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e, 2019
	8	4.5.2024	1	Transmission Electron Microscope (TEM), Applications of nanomaterials	4 4	M. N. Avadhanulu, A Text book ofEngineeringPhysics"S. Chand, 11/e, 2019
5	1	6.5.2024	2	Interaction of radiation with matter: Absorption, Spontaneous emission and stimulated emission,	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
	2	7.5.2024	2	Einstein coefficients and their relations Laser beamcharacteristics	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
	3	8.5.2024	1	Important components of laser-active medium, pumping source, optical resonator	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
	4	9.5.2024	1	Construction and working principle- Nd:YAG laser,He-Ne laser	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
	5	9.5.2024	2	semiconductor laserapplications of laser, Introduction to optical fiber advantages of optical fibers	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
	6	10.5.2024	1	total internal reflection construction of optical fiber	5 5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019

	7	4.6.2024 5.6.2024	2	acceptance angle, numerical aperture, classification of optical fibers- step index and graded index optical fiber	5	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019
	8	6.06.2024 11.6.2024	3	losses in optical fiber, optical fiber for communication system, applications of optical fiber.	1, 2 1, 2	Shatendra Sharma and Jyotsna Sharma, Engineering Physics, Pearson,2019

Signature of HOD

Signature of faculty

Date: 05-02-2024

Date: 05-02-2024

Note:

1. Ensure that all topics specified in the course are mentioned.
2. Additional topics covered, if any, may also be specified in bold.
3. Mention the corresponding course objective and outcome numbers against each topic.

LESSON PLAN (U-I)

Lesson No: 01, 02 Duration of Lessons: 3hr20 min

Lesson Title: Interference

Instructional / Lesson Objectives:

- To make students understand course structure and phenomenon of wave optics
- To familiarize students on wave fronts and generation of interference
- To understand students the concept of interference.
- To provide information on conditions for interference.

Teaching AIDS :PPTs, Black board

Time Management of Class :200 minutes

15 mins for taking attendance
15 mins for previous lecture
150 min for the lecture delivery
20 min for doubts session

Refer assignment – I & tutorial-I sheets

Signature of faculty

LESSON PLAN (U-I)

Lesson No: 03, 04 Duration of Lesson: 3 hr20 min

Lesson Title: Interference anddiffraction

Instructional / Lesson Objectives:

- To make students understand formation of Newton rings and interference in thin films
- To familiarize students on formation of interference pattern
- To understand students the concept of diffraction.
- To provide information on types of diffraction and daily life examples.

Teaching AIDS :PPTs, Black board
Time Management of Clas:200 minutes

15 mins for taking attendance 15 mins for previous lecture 150 min for the lecture delivery 20 min for doubts session

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-I)

Lesson No: 05, 06 Duration of Lesson: 2 hr30 min

Lesson Title: Diffraction &Polarization

<u>Instructional / Lesson Objectives:</u>

- To make students understand the concept of resolving power and polarization.
- To familiarize students on single slit and diffraction gratings.
- To understand students the diffraction at single slit &resolving power of grating.
- To provide information on methods of generation of polarized light

Teaching AIDS :PPTs, Black board

Time Management of Class : 150 min.

10 mins for taking attendance 20 for revision of previous class 100 min for lecture delivery 20 min for doubts session

Refer assignment – I & tutorial-I sheets

Signature of faculty

LESSON PLAN (U-I)

Lesson No: 07,08 Duration of Lesson: 2hr30 min

Lesson Title: Nicol's prism

Instructional / Lesson Objectives:

- To make students understand working and applications of Nicol's prism.
- To familiarize students on polarization methods
- To understand students the concept of double refraction and total internal reflection
- To provide information on applications of polarizers.

Teaching AIDS :PPTs, Black board
Time Management of Class : 150 min

5 mins for taking attendance
10 min for revision of previous class.
120 min for the lecture delivery
15 min for doubts session

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-II)

Lesson No: 01,02 Duration of Lesson: 1hr30 MIN
Lesson Title: blackbody radiation&Davisson – Germer experiment,

Instructional / Lesson Objectives:

- To make students understand the concept of black body radiation& dual nature of matter.
- To familiarize students on plank's law, de Broglie hypothesis
- To understand students'limitations of classical physics and dual nature of matter
- To provide information on Davission - Germer experiment

Teaching AIDS :PPTs, Black board
Time Management of Class : 150 min.

5 mins for taking attendance
10 min for revision of previous class.
120 min for the lecture delivery
15 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

LESSON PLAN (U-II)

Lesson No: 03,04 Duration of Lesson: 1hr40 min.

Lesson Title: Heisenberg uncertainty principle(Qualitative), Born interpretation of the wave function,time independent Schrodinger wave equation.

Instructional / Lesson Objectives:

- To make students understand Heisenberg uncertainty principle and TISWE.
- To familiarize students on HUP and TISEW.
- To understand students the concept of uncertainty and probability density of wave functions.
- To provide information on wave functions and TISWE.

Teaching AIDS :PPTs, Black board
Time Management of Class : 100 min.

10 mins for taking attendance 10 min for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-II)

Lesson No: 05 Duration of Lesson: 1hr 40 min.

Lesson Title: particle in one dimensional potential box.

Instructional / Lesson Objectives:

- To make students understand potential in quantum mechanics
- To familiarize students on one dimensional box and its significance.
- To understand students the concept of wave functions, quantization of energy.
- To provide information on energy levels and probability of finding electron in particular region.

Teaching AIDS :PPTs, Black board
Time Management of Class : 100 min.

10 mins for taking attendance 10 min for revision of previous class 70 min for the lecture delivery 10 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-II)

Lesson No: 06, 07,08 Duration of Lesson: 3 hr20 min

Lesson Title: free electron theory (Drude & Lorentz, Sommerfeld), Bloch's theorem, Kronig-Penney model (Qualitative),E-K diagram, effective mass of electron,

Instructional / Lesson Objectives:

- To make students understand the concept of free electron, periodic potential, effective mass
- To familiarize students on free electron theories and K-P model.
- To understand students the conduction of electrons in different materials.
- To provide information on solution for kronig-penny model and E-K diagram.

Teaching AIDS :PPTs, Black board
Time Management of Class : 200 min

15 mins for taking attendance
15 mins for previous lecture
150 min for the lecture delivery
20 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

LESSON PLAN (U-II)

Lesson No: 09 Duration of Lesson: 50 min
Lesson Title: origin of energy bands, classification of solids.

Instructional / Lesson Objectives:

- To make students understand origin of energy bands and classification of solids.
- To familiarize students on conduction and valence bands, conductors, semiconductors and insulators.
- To understand students the concept fermi level, acceptor and donor levels
- To provide information on band structures of materials.

Teaching AIDS :PPTs, Black board
Time Management of Class : 50 min

5 mins for taking attendance 5 mins for previous lecture 30 min for the lecture delivery 10 min for doubts session

Refer assignment-II & tutorial-II sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-IIII)

Lesson No: 01,02 Duration of Lesson: 2hr30 min

Lesson Title: Intrinsic and extrinsic semiconductors, energy band diagrams,Hall effect

Instructional / Lesson Objectives:

- To make students understand Hall effect
- To familiarize students on direct and indirect bandgap semiconductors
- To understand students the concept of doping to form intrinsic and extrinsic semiconductors.
- To provide information on structure and applications of semiconductors

Teaching AIDS :PPTs, Black board
Time Management of Class : 100 min

10 mins for taking attendance
20 for revision of previous class
60 min for lecture delivery
10 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

LESSON PLAN (U-III)

Lesson No:04 Duration of Lesson: 50 min

Lesson Title: pn junction diode

Instructional / Lesson Objectives:

- To make students understand the concept of diodes and biasing.
- To familiarize students on formation and working ofpn junctions
- To understand students the difference between forward and reverse bias.
- To provide information on I- V Characteristics and applications of pn junction diode

Teaching AIDS :PPTs, Black board
Time Management of Class : 50 min

5 mins for taking attendance
5 mins for previous lecture
30 min for the lecture delivery
10 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

LESSON PLAN (U-III)

Lesson No: 05,06 Duration of Lesson: 2hr30 min

Lesson Title: Zener diode, Bipolar junction transistor (BJT)

Instructional / Lesson Objectives:

- To make students understand difference between pn and zenar diode.
- To familiarize students on functioning of n-p-n and p-n-p transistor.
- To understand students the concept of different working regions in BJT.
- To provide information on applications of diode and transistor.

Teaching AIDS :PPTs, Black board

Time Management of Class : 150 min

5 mins for taking attendance
10 min for revision of previous class.
120 min for the lecture delivery
15 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

LESSON PLAN (U-III)

Lesson No: 07,08 Duration of Lesson: 1hr 40 min

Lesson Title: LED and Photo diode

Instructional / Lesson Objectives:

- To make students understand construction and working of LED and photodiode.
- To familiarize students on I-V characteristics of LED and photodiode.
- To understand students the concept of electroluminescence and photovoltaic effect.
- To provide information on applications of LED and Photodiode.

Teaching AIDS :PPTs, Black board
Time Management of Class : 100 min

10 mins for taking attendance 15 for revision of previous class 60 min for lecture delivery 15 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-III)

Lesson No: 09 Duration of Lesson: 50 min

Lesson Title: Solar Cell

Instructional / Lesson Objectives:

- To make students understand the concept of photovoltaic effect and efficiency of solar cell'
- To familiarize students on construction and working of solarcell.
- To understand students the difference between solar cell and photodiode.
- To provide information on applications of solar cell.

Teaching AIDS :PPTs, Black board
Time Management of Class : 50 min.

5 mins for taking attendance 5 mins for previous lecture 30 min for the lecture delivery 10 min for doubts session

Refer assignment-III & tutorial-III sheets.

Signature of faculty

LESSON PLAN (U-IV)

Lesson No: 01, 02 Duration of Lesson: 2 hr30 min

Lesson Title: Nano science and Bottom-up fabrication: sol-gel, combustion methods

Instructional / Lesson Objectives:

- To make students understand the synthesis methods of nanomaterials
- To familiarize students on nanoscale and significance of nanomaterials.
- To understand students the concept ofquantum confinement, surface to volume ratio
- To provide information on sol-gel process and combustion methods.

Teaching AIDS :PPTs, Black board
Time Management of Class : 150 min

5 mins for taking attendance 10 min for revision of previous class. 120 min for the lecture delivery 15 min for doubts session

Refer assignment – IV& tutorial-IV sheets

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-IV)

Lesson No: 03, 04 Duration of Lesson: 3 hr20 min

Lesson Title: Top-down fabrication: ball milling, Physical vapor deposition (PVD)

Instructional / Lesson Objectives:

- To make students understand top down and bottom-up methods.
- To familiarize students on ball milling and PVD
- To understand students the concept of milling and vapor deposition.
- To provide information on advantages, limitation and applications of the method.

Teaching AIDS :PPTs, Black board

Time Management of Class : 200 min

15 mins for taking attendance
15 mins for previous lecture
150 min for the lecture delivery
20 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-IV)

Lesson No: 05 Duration of Lesson: 1hr30 MIN

Lesson Title: Chemical vapor deposition (CVD)

Instructional / Lesson Objectives:

- To make students understand the concept of CVD
- To familiarize students on procedure to synthesize nanomaterials.
- To provide information on applications of CVD.

Teaching AIDS :PPTs, Black board
Time Management of Class : 50 min

5 mins for taking attendance
5 mins for previous lecture
30 min for the lecture delivery
10 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

LESSON PLAN (U-IV)

Lesson No: 06, 07 Duration of Lesson: 1 hr40 min

Lesson Title: Characterization techniques – XRD, SEM

Instructional / Lesson Objectives:

- To make students understand significance of characterization of nanomaterials.
- To familiarize students on characterization of nanomaterials usingXRD and SEM
- To understand students the analysis of XRD and SEM diagrams of nanomaterials.
- To provide information on crystal structure analysis and morphological studies of nanomaterials.

Teaching AIDS :PPTs, Black board
Time Management of Class : 100 min

10 mins for taking attendance
15 for revision of previous class
60 min for lecture delivery
15 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-IV)

Lesson No:08 Duration of Lesson: 50 min

Lesson Title: Transmission Electron Microscope (TEM), Applications of nanomaterials

Instructional / Lesson Objectives:

- To make students understand the construction and working of TEM
- To familiarize students on TEM image analysis
- To understand students the concept of single crystal, polycrystalline and amorphous
- To provide information on nanoparticle size distribution and defects in materials.

Teaching AIDS :PPTs, Black board
Time Management of Class : 50 min

5 mins for taking attendance
5 mins for previous lecture
30 min for the lecture delivery
10 min for doubts session

Refer assignment – IV & tutorial-IV sheets

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-V)

Lesson No: 01,02 Duration of Lessons: 3hr 20 min

Lesson Title: Interaction of radiation with matter& Einstein coefficients and their relations

Instructional / Lesson Objectives:

- To make students understand the concept of absorption and stimulated emission
- To familiarize students on interaction of matter with radiation.
- To provide information on Einstein coefficients and relations.

Teaching AIDS:PPTs, Black board
Time Management of Class : 200 min

15 min for taking attendance
15 min for previous lecture
150 min for the lecture delivery
20 min for doubts session

Refer assignment- V& tutorial-V sheets.

Signature of faculty

LESSON PLAN (U-V)

Lesson No: 03,04 Duration of Lesson: 1hr40 min

Lesson Title: Laser beam characteristics, Important components of laser-active medium, pumping source, optical
Resonator,Construction and working principle- Nd:YAG laser, He-Ne laser

Instructional / Lesson Objectives:

- To make students understand working of laser
- To familiarize students on components of laser and its functioning
- To understand students the concept of population inversion and lasing action
- To provide information on Construction and working of Lasers.

Teaching AIDS:PPTs, Black board
Time Management of Class:100 min

10 min for taking attendance 15 for revision of previous class 60 min for lecture delivery 15 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-V)

Lesson No: 05 Duration of Lesson: 1hr40 min

Lesson Title: semiconductor laser and applications of laser,

Instructional / Lesson Objectives:

- To make students understand working of semiconductor laser.
- To familiarize students on laser characteristics and applications
- To provide information on applications of lasers in different fields.

Teaching AIDS: PPTs, Black board
Time Management of Class : 100 min

10 min for taking attendance
15 for revision of previous class
60 min for lecture delivery
15 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

LESSON PLAN (U-V)

Lesson No: 06, 07 Duration of Lesson: 2hr30 min

Lesson Title: Introduction to optical fibers and classification

Instructional / Lesson Objectives:

- To make students understand the concept of total internal reflection, acceptance angle and numerical aperture.
- To familiarize students on construction and types of optical fibers.
- To understand students,step and graded index fibers.
- To provide information on advantages of optical fibers

Teaching AIDS: PPTs, Black board
Time Management of Class: 150 min

5 min for taking attendance 10 min for revision of previous class. 120 min for the lecture delivery 15 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

Department of Humanities and Sciences

LESSON PLAN (U-V)

Lesson No: 08 Duration of Lesson: 1hr 90 min

Lesson Title: losses in optical fiber, optical fiber for communication system, applications of optical fiber.

Instructional / Lesson Objectives:

- To make students understand losses in optical fibers.
- To familiarize students on communication systems in optical fibers.
- To understand student applications of optical fibers

Teaching AIDS:PPTs, Black board
Time Management of Class:150 min

10 min for taking attendance 25 for revision of previous class 90 min for lecture delivery 25 min for doubts session

Refer assignment- V & tutorial-V sheets.

Signature of faculty

ASSIGNMENT – 1

This Assignment corresponds to Unit No. 1

Question No.	Question	Objective No.	Outcome No.
1	Demonstrate Newton's rings Experiment with neat diagram and derive expression for calculation of radius of curvature of Plano convex lens.	1	1
2	Explain construction and working of Nicol prism and mention its applications.	1	1
3	Apply the concept of path difference to explain the bright and dark conditions of Interference in thin films by reflection.	1	1

Signature of HOD

Date:05-02-2024

Signature of faculty

Date:05-02-2024

Department of Humanities and Sciences

ASSIGNMENT – 2

This Assignment corresponds to Unit No. 2

Question No.	Question	Objective No.	Outcome No.
1	Develop expression for one dimensional Schrödinger time independent wave equation.	2	2
2	Explain Kronig-Penny model with neat diagram	2	2
3	Demonstrate Davisson-Germer experiment with neat diagram mention its significance.	2	2

Signature of HOD

Date:05-02-2024

Signature of faculty

Date: 05-02-2024

ASSIGNMENT – 3

This Assignment corresponds to Unit No. 3

Question No.	Question	Objective No.	Outcome No.
1	what is Hall Effect and develop an expression for Hall coefficient (note illustrate with neat diagram.	3	3
2	Explain the V-I characteristics of P-N junction diode in forward and reverse bias conditions.	3	3

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

Department of Humanities and Sciences

ASSIGNMENT – 4

This Assignment corresponds to Unit No. 4

Question No.	Question	Objective No.	Outcome No.
1	Explain sol-gel method to synthesis nanomaterials with neat schematic diagram.	4	4
2	Explain synthesis of nanomaterials by using Ball milling with neat sketch and write its applications.	4	4
3	What is the principle behind the Transmission of Electron Microscope? Explain construction and working of TEM with neat sketch.	4	4

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

Department of Humanities and Sciences

ASSIGNMENT – 5

This Assignment corresponds to Unit No. 5

Question No.	Question	Objective No.	Outcome No.
1	Solve Einstein coefficients to demonstrate lasing action.	4	4
2	Analyze the operation of He-Ne Laser system using a neat energy level diagram	4	4
3	Explain acceptance angle and deduce the expression for numerical aperture.	4	4

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

TUTORIAL – 1

This tutorial corresponds to Unit No. 1 (Objective Nos.: 1, Outcome Nos.: 1)

Q1. 1 The phenomena of interference of light have proved

A) Wave nature B) Particle nature C) Wave and Particle nature D) None of the above

Q2. What is the phase difference between two points situated on a wave front?

A) $\pi/2$ B) 2π C) π D) 0

Q3. In Newton's Ring experiments, the diameter of dark rings is proportional to

A) Odd Natural numbers B) Natural Number

C) Even Natural Number D) Square root of natural number

Q4. Significant diffraction of x-rays can be obtained

A) by a single slit B) by a double slit C) by a diffraction D) by an atomic crystal

Q5.Polarised light can be produced by

A) reflection B) refraction C) Double refraction D) All of these

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

TUTORIAL – 2

This tutorial corresponds to Unit No. 2 (Objective Nos.: 2, Outcome Nos.: 2)

Q1. Dual nature [particle and wave] of matter was proposed by
A) de Broglie B) Planck C) Einstein D) Newton

Q2. Which of the following phenomena cannot be explained by the classical theory?
A) Photoelectric effect B) Compton effect C) Raman effect D) All the above

Q3. To electron gas, which of the following statistics is applicable?
A) Maxwell–Boltzmann B) Bose–Einstein C) Fermi–Dirac D) Stefan–Hawking

Q4.The Kronig–Penney model is based on the assumption
A) Electrons move in a periodic potential field C) Electrons move in a zero potential field
B) Electrons move in a constant potential field D) Electrons move with constant potential energy

Q5.Classical free electron theory failed to explain
A) Specific heat of metals B) Thermionic emission C) Magnetic susceptibility of metals D) All the above

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

TUTORIAL SHEET – 3

This tutorial corresponds to Unit No. 3 (Objective Nos.: 3, Outcome Nos.: 3)

Q1.Pure semiconductor behaves as an insulator at

A) 273 K B) -273 K C) 0 K D) None of these

Q2 N-type semiconductor is formed by adding ………… impurity atoms to a pure semiconductor

A) trivalent B) penta valent C) zero valent D) tetra valent

Q3. Which type of semiconductor material has negative Hall coefficient

A) p-type B) n-type C) intrinsic D) None of these

Q4.Which of the following devices convert light energy to electric energy?

A) LED B) Semiconductor laser C) Solar cells D) Optical fibers

Q5.The main application of a Photodiode is

A) Light sensing B) Power regulation C) Signal amplification D) Energy storage

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

TUTORIAL – 4

This tutorial corresponds to Unit No. 4 (Objective Nos.: 4, Outcome Nos.: 4)

Q1.Quantum dot is an example of
A) one-dimensional nanomaterial C) two-dimensional nanomaterial
B) three-dimensional nanomaterial D) zero-dimensional nanomaterial
Q2. For a cubic nano particle of side ‘a’, surface area to volume ratio is given by
A) 3/ a B) 5/ a C) 4/ a D) 6/ a
Q3. Crystal structure of nano materials is known by
A) XRD B) CVD C) SEM D) PVD

Q4.The size range of nano material is
A) 1 to 100 Å B) 1 to 100 nm C) 1 to 100 mm D) 1 to 100 μm

Q5.What is the standard form of TEM
A) Transmission Electron Microscope C) Transceiver Electrical Microscope
B) Transformer Electrode Microscope D) None of the above

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

TUTORIAL SHEET – 5

This tutorial corresponds to Unit No. 5 (Objective Nos.: 5, Outcome Nos.: 5)

Q1. Laser has a high degree of
A) mono chromacityB) coherence C) intensity D) All of these
Q2. Numerical aperture represents __________ capacity of a optical fiber.

A) light gathering B) light dissipation C) heat dissipation D) heat dissipation

Q3. Pick out the losses present in the optical communication system
A) absorption losses B) scattering losses C) distortion losses D) All of these

Q4.Population inversion cannot be achieved by
A) optical pumping B) chemical reaction C) electric discharge D) thermal process

Q5.In He–Ne laser, the ratio of He and Ne in gas mixture is
A) 1:10 B) 10:1 C) 20:1 D) 1:20

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

Department of Humanities and Sciences

EVALUATION STRATEGY

Target (s)

a. Percentage of Pass: 85%

Assessment Method (s) (Maximum Marks for evaluation are defined in the Academic Regulations)

a. Daily Attendance
b. Assignments
c. Online Quiz
d. Continuous Internal Assessment
e. Semester / End Examination

List out any new topic(s) or any innovation you would like to introduce in teaching the subjects in this semester

Case Study of any one existing application

Signature of HOD

Signature of faculty

COURSE COMPLETION STATUS: (AI&ML-A)

Actual Date of Completion & Remarks if any

Units	Remarks	Objective No. Achieved	Outcome No. Achieved
Unit 1	completed on 27.02.2024	1	1
Unit 2	completed on 15.03.2024	2	2
Unit 3	completed on 25.04.2024	3	3
Unit 4	completed on 07.05.2024	4	4
Unit 5	completed on 07.06.2024	5	5

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

Department of Humanities and Sciences

COURSE COMPLETION STATUS:(AI&ML-B)

Actual Date of Completion & Remarks if any

Units	Remarks	Objective No. Achieved	Outcome No. Achieved
Unit 1	completed on 22.02.2024	1	1
Unit 2	completed on 15.03.2024	2	2
Unit 3	completed on 26.04.2024	3	3
Unit 4	completed on 04.05.2024	4	4
Unit 5	completed on 11.06.2024	5	5

Signature of HOD

Date: 05-02-2024

Signature of faculty

Date: 05-02-2024

Department of Humanities and Sciences

Mappings

1. Course Objectives-Course Outcomes Relationship Matrix
(Indicate the relationships by mark "X")

Course-Outcomes / Course-Objectives	1	2	3	4	5
1	H		M		
2		H			
3			H		
4				H	
5					H

2. Course Outcomes-Program Outcomes (POs) & PSOs Relationship Matrix
(Indicate the relationships by mark "X")

P-Outcomes / C-Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO 1	PSO 2
1	H			M										
2	M	H	M											
3	H													
4	M	L	M	L										
5	H	L		M	M									

H-HIGH M-MODERATE L-LOW

Department of Humanities and Sciences

Rubric for Evaluation

Performance Criteria	Unsatisfactory	Developing	Satisfactory	Exemplary
	1	2	3	4
Research & Gather Information	Does not collect any information that relates to the topic	Collects very little information some relates to the topic	Collects some basic Information most relates to the topic	Collects a great deal of Information all relates to the topic
Fulfill team role's duty	Does not perform any duties of assigned team role.	Performs very little duties.	Performs nearly all duties.	Performs all duties of assigned team role.
Share Equally	Always relies on others to do the work.	Rarely does the assigned work - often needs reminding.	Usually does the assigned work - rarely needs reminding.	Always does the assigned work without having to be reminded
Listen to other team mates	Is always talking—never allows anyone else to speak.	Usually doing most of the talking-- rarely allows others to speak.	Listens, but sometimes talks too much.	Listens and speaks a fair amount.

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I B.TECH II SEMESTER I MID EXAMINATIONS - APRIL 2024

Branch : B.Tech. (CSE & CSE-AIML) **Subject : Applied Physics,AP202BS** **Max. Marks: 30**
Date : 01.04.2024 **Time: 120 Minutes**

PART - A

ANSWER ALL QUESTIONS **10 X 1M = 10M**

Q.No	Question		CO	BTL
1.	Brewster's law in terms of refractive index (μ) can be expressed as (A). μ=sin i_p (B). μ=tan i_p (C). μ=cos i_p (D). μ=cot i_p	( )	CO1	L1
2.	In Newton's Ring experiments, the diameter of dark rings is proportional to (A). Odd Natural numbers (B). Even Natural Number (C). Even Natural Number (D). Square root of natural number	( )	CO1	L1
3.	In Newton's rings, the central spot in reflection mode is ______ (A). Always bright (B). Always dark (C). Bright or Dark (D). of blue colour	( )	CO1	L2
4.	Huygens wave theory of light cannot explain (A). Interference (B). Photoelectric effect (C). Diffraction (D). Polarization	( )	CO1	L1
5.	First Brillouin zone corresponds to K value extending from (A). $-\frac{3\pi}{a}$ to $+\frac{3\pi}{a}$ (B). $-\frac{2\pi}{a}$ to $+\frac{2\pi}{a}$ (C). $-\frac{\pi}{a}$ to $+\frac{\pi}{a}$ (D). $-\frac{\pi}{a}$ to $+\frac{2\pi}{a}$	( )	CO2	L2
6.	Dual nature [particle and wave] of matter was proposed by (A). de Broglie (B). Einstein (C). Planck (D). Newton	( )	CO2	L1
7.	To electron gas, which of the following statistics is applicable? (A). Maxwell–Boltzmann (B). Fermi–Dirac (C). Bose–Einstein (D). Stefan–Hawking	( )	CO2	L3
8.	The Kronig–Penney model is based on the assumption (A). Electrons move in a periodic potential field (B). Electrons move in a constant potential field (C). Electrons move in a zero potential field (D). Electrons move with constant potential energy	( )	CO2	L2
9.	Which type of semiconductor material has negative Hall coefficient (A). p-type (B). n-type (C). intrinsic (D). None of these	( )	CO3	L2
10.	Fermi level in N-type semiconductor lies between (A). Valance band and conduction band (B). Valance band and donar level (C). Conduction band and donar level (D). Valance band and accepter level	( )	CO3	L2

PART - B

ANSWER ANY FOUR 4 X 5 M = 20 M

Q.No	Question	CO	BTL
11.	Analyse the intensity maxima and minimum conditions of Fraunhofer Diffraction at single slit with necessary derivation.	CO1	L4
12.	Analyze and describe the intensity distribution of a Fraunhofer diffraction of a single slit.	CO1	L4
13.	Demonstrate Davisson-Germer experiment with neat diagram mention its	CO2	L3
14.	Distinguish the solids based on band theory with neat energy level diagrams.	CO2	L2
15.	Differentiate between intrinsic and extrinsic semiconductors with energy level diagram.	CO3	L2
16.	what is Hall Effect and develop an expression for Hall coefficient (note illustrate with neat diagram	CO3	L3

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I B.TECH II SEMESTER II MID EXAMINATIONS - JUNE 2024

Branch : B.Tech. (CSE & AIML) **Max. Marks : 30M**
Date : 18-Jun-2024 **Session : Afternoon** **Time : 120 Min**
Subject : Applied Physics,AP202BS

PART - A

ANSWER ALL THE QUESTIONS **10 X 1M = 10M**

Q.No	Question		CO	BTL
1.	The function of a BJT (Bipolar Junction Transistor) is (A). Amplify signals (B). Regulate voltage (C). Generate alternating current (D). Store energy	( )	CO3	L1
2.	The working principle of a LED is (A). Photoelectric effect (B). electroluminescence (C). Photovoltaic effect (D). thermal breakdown	( )	CO3	L2
3.	For a cubic nanoparticle of side 'a', surface area to volume ratio is given by (A). 3/ a (B). 4/ a (C). 5/ a (D). 6/ a	( )	CO4	L2
4.	Quantum dot is an example of (A). one-dimensional nanomaterial (B). three-dimensional nanomaterial (C). two-dimensional nanomaterial (D). zero-dimensional nanomaterial	( )	CO4	L1
5.	The size range of nanomaterial is (A). 1 to 100 Å (B). 1 to 100 mm (C). 1 to 100 nm (D). 1 to 100 μm	( )	CO4	L1
6.	Widespread use of nano technology is due to (A). Small scale miniaturization (B). The fact that it is faster and cheaper (C). Its lower cost (D). All the above	( )	CO4	L2
7.	The refractive index of core and cladding are 1.563 and 1.498 respectively and then numerical aperture (NA) is (A). 0.346 (B). 0.199 (C). 0.246 (D). 0.446	( )	CO5	L2
8.	If an electron excites from lower state to higher state then that process is called (A). spontaneous emission (B). stimulated emission (C). absorption (D). systematic emission	( )	CO5	L2
9.	Step index fiber can be a (A). multimode fiber only (B). monomode fiber only (C). monomode as well as multimode fiber (D). either monomode or multimode (cannot be both)	( )	CO5	L1
10.	Numerical aperture represents __________ capacity of a optical fiber. (A). light gathering (B). heat dissipation (C). heat absorption (D). light dissipation	( )	CO5	L2

PART - B

ANSWER ANY FOUR **4 X 5M = 20M**

Q.No	Question	CO	BTL
11.	What is photo diode?. Explain the principle, working and characteristics of photo diode.	CO3	L3
12.	Discuss the V-I characteristics of zenar diode under forward & reverse bias conditions. Mention at least 2 differences between ordinary P-N junction diode and zenar diode.	CO3	L4
13.	Explain construction and working of Scanning Electron Microscope (SEM) with neat diagrams.	CO4	L3
14.	Explain sol-gel method to synthesis nanomaterials with neat schematic diagram	CO4	L3
15.	Solve Einstein coefficients to demonstrate lasing action	CO5	L3
16.	Explain the construction and working of Nd-YAG laser.	CO5	L4

Internal Marks :(AI&ML-A)

Continuous Internal Assessment (R-22)

Programme: **B.Tech. (CSE AI-ML)** Year: **I** Course: **Theory** **A.Y: 2023-24**

Course: **Applied Physics** Section: **A** Faculty Name: **Dr. RameshBabu Kunchala**

S. No	Roll No	MID-I (35M)	MID-II (35M)	Avg. of MID I & II	Viva-Voce/Poster Presentation (5M)	Total Marks (40)
1	23C11A6601	**15**	AB	8	2	10
2	23C11A6602	**14**	11	13	2	15
3	23C11A6603	**20**	24	22	4	26
4	23C11A6604	35	35	35	5	40
5	23C11A6605	**15**	21	18	4	22
6	23C11A6606	**18**	21	20	4	24
7	23C11A6607	**35**	26	31	5	36
8	23C11A6608	**14**	AB	07	AB	08
9	23C11A6609	**31**	31	31	5	36
10	23C11A6610	**20**	23	22	4	26
11	23C11A6611	**26**	30	28	AB	28
12	23C11A6612	**AB**	AB	AB	AB	AB
13	23C11A6613	**35**	35	35	5	40
14	23C11A6614	**22**	27	25	5	30
15	23C11A6615	**17**	28	23	AB	23
16	23C11A6616	**14**	14	14	3	17
17	23C11A6617	**7**	10	9	5	14
18	23C11A6618	**13**	20	17	2	19

19	23C11A6619	**14**	23	18	5	23
20	23C11A6620	**17**	23	20	5	25
21	23C11A6622	**13**	31	22	4	26
22	23C11A6623	**19**	23	21	4	25
23	23C11A6624	**22**	27	25	5	30
24	23C11A6625	**15**	15	15	3	18
25	23C11A6627	**5**	16	11	5	16
26	23C11A6628	**15**	20	18	3	21
27	23C11A6629	**33**	34	34	5	39
28	23C11A6630	**15**	20	18	3	21
29	23C11A6631	**17**	14	16	2	18
30	23C11A6632	**16**	19	18	3	21
31	23C11A6633	**23**	26	25	5	30
32	23C11A6634	**25**	28	27	5	32
33	23C11A6635	**13**	21	17	3	20
34	23C11A6636	**13**	16	15	4	19
35	23C11A6637	**14**	20	17	3	20
36	23C11A6638	**13**	14	14	3	17
37	23C11A6639	**26**	27	27	5	32
38	23C11A6640	**31**	30	31	5	36
39	23C11A6641	**34**	27	31	5	36
40	23C11A6642	**22**	27	25	5	30
41	23C11A6643	**23**	19	21	5	26
42	23C11A6644	**29**	28	29	5	34
43	23C11A6645	**29**	21	25	4	29
44	23C11A6646	**21**	14	18	AB	18

45	23C11A6647	**25**	27	26	4	30
46	23C11A6648	**18**	21	20	5	25
47	23C11A6649	**27**	29	28	5	33
48	23C11A6650	**26**	30	28	5	33
49	23C11A6651	**16**	18	17	5	22
50	23C11A6652	**31**	35	33	5	38
51	23C11A6653	**19**	23	21	4	25
52	23C11A6654	**27**	27	27	4	31
53	23C11A6655	**30**	25	28	5	33
54	23C11A6656	**24**	29	27	5	32
55	23C11A6657	**17**	19	18	3	21
56	23C11A6658	**27**	35	31	5	36
57	23C11A6659	24	21	23	4	27
58	23C11A6660	19	22	21	4	25
59	23C11A6661	20	21	21	4	25
60	23C11A6662	21	24	23	4	27
61	23C11A6663	**26**	35	31	5	36
62	23C11A6664	**16**	**19**	**18**	**3**	**21**

No. of Absentees: 01

Total Strength: 62

Signature of Faculty

Internal Marks :(AI&ML-B)

Continuous Internal Assessment (R-22)

Programme: **B.Tech. (AI&ML-B)** Year: **I** Course: **Theory** **A.Y: 2023-24**

Course: **Applied Physics** Section:**B** Faculty Name: **Y.SRIDEVI**

S. No	Roll No	MID-I (35M)	MID-II (35M)	Avg. of MID I & II	Viva-Voce/Poster Presentation (5M)	Total Marks (40)
1	23C11A6665	28	34	31	5	36
2	23C11A6666	4	AB	2	AB	2
3	23C11A6667	17	30	24	5	29
4	23C11A6668	27	33	30	5	35
5	23C11A6669	35	32	34	5	39
6	23C11A6670	24	23	24	5	29
7	23C11A6671	23	23	23	5	28
8	23C11A6672	23	34	29	5	34
9	23C11A6673	18	27	23	5	28
10	23C11A6674	11	AB	6	5	11
11	23C11A6675	24	24	24	5	29
12	23C11A6676	26	32	29	5	34
13	23C11A6677	17	19	19	5	24
14	23C11A6678	19	18	19	5	24
15	23C11A6679	18	18	18	5	23
16	23C11A6680	19	19	19	5	24
17	23C11A6681	21	29	26	5	31

18	**23C11A6682**	**23**	**25**	24	5	29
19	**23C11A6683**	**11**	**19**	15	5	20
20	**23C11A6684**	**18**	**24**	22	5	27
21	**23C11A6685**	**35**	**35**	35	5	40
22	**23C11A6686**	**13**	**25**	20	5	25
23	**23C11A6687**	**27**	**24**	26	5	31
24	**23C11A6688**	**14**	**23**	19	5	24
25	**23C11A6689**	**21**	**31**	26	5	31
26	**23C11A6690**	**22**	**22**	22	5	27
27	**23C11A6691**	**16**	**30**	24	5	29
28	**23C11A6692**	**19**	**24**	24	5	29
29	**23C11A6693**	**18**	**27**	23	5	28
30	**23C11A6694**	**25**	**31**	28	5	33
31	**23C11A6695**	**24**	**24**	24	5	29
32	**23C11A6696**	**19**	**20**	20	5	25
33	**23C11A6697**	**20**	**32**	26	5	31
34	**23C11A6698**	**AB**	AB	AB	AB	AB
35	**23C11A6699**	**13**	**18**	16	5	21
36	**23C11A66A1**	**27**	**33**	30	5	35
37	**23C11A66A2**	**23**	**27**	25	5	30
38	**23C11A66A3**	**31**	**33**	32	5	37
39	**23C11A66A4**	**26**	**29**	28	5	33
40	**23C11A66A5**	**28**	**26**	27	5	32
41	**23C11A66A6**	**24**	**27**	26	5	31
42	**23C11A66A7**	**15**	**17**	16	5	21
43	**23C11A66A8**	**27**	**35**	31	5	36

44	23C11A66A9	27	34	31	5	36
45	23C11A66B0	19	23	21	5	26
46	23C11A66B1	20	23	22	5	27
47	23C11A66B2	12	21	17	5	22
48	23C11A66B3	AB	AB	AB	AB	AB
49	23C11A66B4	27	34	31	5	36
50	23C11A66B5	20	24	22	5	27
51	23C11A66B6	30	28	29	5	34
52	23C11A66B7	33	33	33	5	38
53	23C11A66B8	28	29	29	5	34
54	23C11A66B9	24	27	26	5	31
55	23C11A66C0	29	34	32	5	37
56	23C11A66C1	30	25	28	5	33
57	23C11A66C2	23	29	26	5	31
58	23C11A66C3	14	19	17	5	22
59	23C11A66C4	19	24	22	5	27
60	23C11A66C5	19	25	22	5	27
61	23C11A66C6	24	31	28	5	33
62	23C11A66C7	31	34	33	5	38
63	23C11A66C8	31	30	31	5	36

No. of Absentees: 04

Total Strength: 63

Signature of Faculty

AP. Assignment

Name :- B. Mounika
class :- CSM-A 2nd yr
HTNO :- 23911A6654

(1) Explain Newton's Rings formation in an air film formed in b/w a plane convex lens and plane mirror.

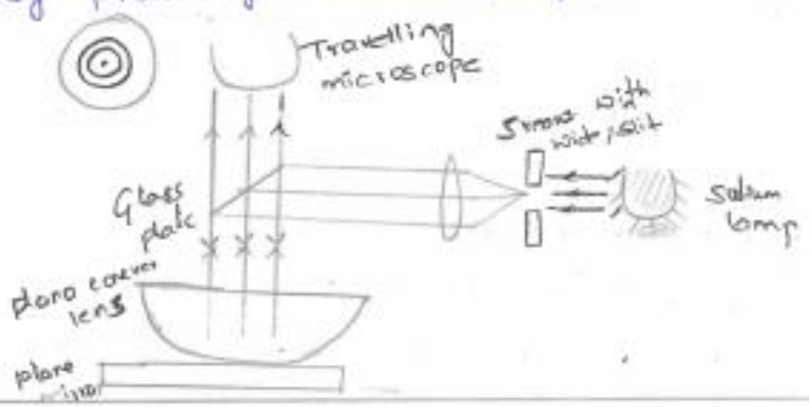
→ The phenomenon of the formation of newton's rings can be explainned base on the wave theory of light.

→ An air film of varity thickness is formed b/w lens and the glass sheet.

→ When a ray is incident on the surface of lens it is refflected as refracted.

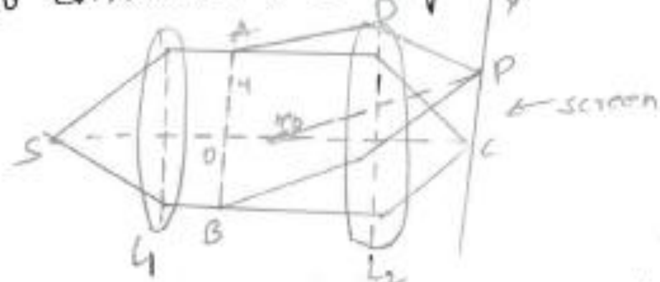
→ When the refracted ray strikes the glass sheet, it undergoes a phase change of 180° on refflection.

→ Interference occurs b/w two waves that interference constructivity of path difference b/w them e(m+½)λ and destructively if the path difference b/w them is mλ there by proceding alternate bright and dark rings



* These rings are produced as a result of interference b/w the light waves reflected from the upper and the lower surface of the air film form b/w the plano convex lens and the plane glass plate.

9. Analysis and describe the intensity distribution of a fraunhofer diffraction of a single slit.



* Source or Screen or both area. Infinite distance from obstacle.
* combination of lenses is used
* Incident wave front is plane
* Diffraction pattern is an large of obstacle
* central point is always bright

for intensity to be maximum or/ minimum:-

condition for minimum intensity:- when $\sin\alpha/\alpha = 0$, then intensity is zero, so

$$\sin\alpha = 0 \Rightarrow \alpha = \pm m\pi \Rightarrow \frac{\pi a\sin\theta}{\lambda} = \pm m\pi$$

$$a\sin\theta = \pm m\lambda$$

Condition for maximum intensity:-

Principal maximum:- for central maximum $\alpha = 0$ so $(\sin\alpha)/\alpha \Rightarrow 1$ then, $I = A^2 = I_0$

secondary maxima:- $I_1 = \frac{A^2\sin^2(3\pi/2)}{(3\pi/2)^2} = A^2 \cdot \frac{4}{9\pi^2} = \frac{4}{9\pi^2} I_0$

i.e 4.5% of

$I_2 = \frac{4}{25\pi^2} I_0$ i.e, 1.5% of I_0

$I_3 = \frac{4}{49\pi^2} I_0$

$R = \frac{a\sin(n\delta/2)}{\sin(\delta/2)} = a\frac{\sin(\pi a \sin\theta/\lambda)}{\sin(\pi a \sin\theta/n\lambda)}$

$R = \frac{a\sin\alpha}{\sin(\alpha/n)}$

$R = \frac{a\sin\alpha}{\alpha/n} = na\cdot\frac{\sin\alpha}{a} \Rightarrow R = A\frac{\sin\alpha}{\alpha}$

$I = R^2 = A^2\frac{\sin^2\alpha}{\alpha^2}$

For Intensity to be maximum or minimum

$\frac{dI}{d\alpha} = 0 \Rightarrow \frac{d}{d\alpha}\left(A^2\frac{\sin^2\alpha}{\alpha^2}\right) = 0$

$A^2\left(\frac{\alpha^2 2\sin\alpha\cos\alpha - \sin^2\alpha\, 2\alpha}{\alpha^2}\right) = 0$

$A^2\left(\frac{2\sin\alpha\cos\alpha - \sin^2\alpha\, 2\alpha}{\alpha^2}\right) = 0$

$A^2\left(\frac{2\sin\alpha\cos\alpha}{\alpha^2} - \frac{2\sin\alpha}{\alpha^2}\right) = 0$

$A^2\left[\frac{2\sin\alpha}{\alpha}\left(\frac{\alpha\cos\alpha - \sin\alpha}{\alpha^2}\right)\right] = 0$

Now either $\Rightarrow \frac{\sin\alpha}{\alpha} = 0$ (or) $\left(\frac{\alpha\cos\alpha - \sin\alpha}{\alpha^2}\right) = 0$

Either $\sin\alpha = 0$ (or) $\alpha\cos\alpha = \sin\alpha = 0$

(a) $\sin\alpha = 0$ (or) (b) $\alpha = \tan\alpha$

Condition for minimum intensity:-

when $\sin\alpha/\alpha = 0$, then intensity is zero. So

$\sin\alpha = 0 \Rightarrow \alpha = \pm m\pi \Rightarrow \pi d\sin\theta = \pm m\pi$

$a\sin\theta = \pm m\lambda$

Principal maxima :- $\alpha = 0$ so $(\sin\alpha)/\alpha = 1$

$I = A^2 = I_0$

Secondary maxima:-

$$\alpha = \pm \frac{(2m+1)\lambda}{2}$$

$$\frac{\pi d \sin\theta}{\lambda} = \pm \frac{(2m+1)\lambda}{2} \Rightarrow a\sin\theta = \pm \frac{(2m+1)\lambda}{2}$$

Intensity of 1st secondary maxima:-

$$I_1 = \frac{A^2 \sin^2(3\pi/2)}{(3\pi/2)^2} = A^2 \frac{4}{9\pi^2} = \frac{4}{9\pi^2} I_0$$

$$\Rightarrow 4.5\% \text{ of } I_0$$

2nd secondary maxima:-

$$I_2 = A^2 \frac{\sin^2(5\pi/2)}{(5\pi/2)^2} = A^2 \cdot \frac{4}{25\pi^2} = \frac{4}{25\pi^2} I_0$$

$$= 1.5\% \text{ of } I_0$$

3rd secondary maxima:-

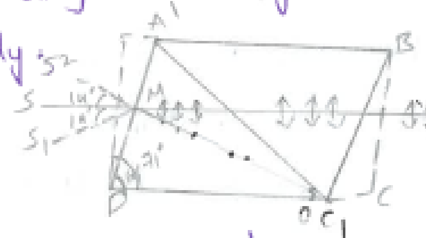
$$I_3 = \frac{A^2 \sin^2(7\pi/2)}{(7\pi/2)^2} = A^2 \cdot \frac{4}{49\pi^2} = \frac{4}{49\pi^2} I_0$$

$$I_0 = I_1 : I_2 : I_3 \cdots 1 = \frac{4}{9\pi^2} : \frac{4}{25\pi^2} : \frac{4}{49\pi^2} \cdots$$

3) Construct nicol's prism and explain its working to polarize the light

- For the construction of nicol's prism : a calcite crystal whose length is three times its width is taken. the two end faces AD and BC of the crystal are cut in such a way that make an gulas 68°. instead of 71° Resulting part of the crystal is then cut along A'C. so that it makes an angle 90°

both the two end faces as showing. The two surfaces are grounded. polished optically flat and the cemented balsam whose refractive index lies b/w the refractive index of o-ray and e-ray. canada balsam and e-ray, respectively



nicol prism.

→ If an ordinary light falls on the nicol parallel to the face DC'. It is clear that canada balsam larger is more dense calculate for E-ray and less dense for o-ray i.e>

Critical age = $\sin^{-1}(1.55/1.66) = \sin^{-1}(0.933) \approx 69°$

∴ o-ray is reffracted from larger of canada balsam by total internal reflection and absorbed by the lamp black surface DC' (fig)

The E-ray ham smitted from canada layer is plane polarized light. In this way Nicol prism acts as a polarizer.

4) Antity the concept of path difference to explain the bright and dark conditions of interference in this films by reflection.

maximum intensities (or) brightness:—

If the path difference $\Delta' = n\lambda$, where = 0, 1, 2, 3 .. then constructive interference takes place and the film appear bright in the reflected light.

$$2\mu r \cos r - \lambda/2 = n\lambda \Rightarrow 2\mu \cos r = (2n+1)\lambda/2$$

minimum intensities (or) darkness :-

If the path difference $\Delta' = (2n+1)\lambda/2$, where n=0, 1, 2, 3 ... then destructive interference takes place and the film appear dark in the reflected light

$$2\mu r \cos r - \lambda/2 = (2n+1)\lambda/2 \Rightarrow 2\mu r \cos r = (n+1)\lambda$$

since, n is an integer, therefore (n+1) can also be taken as n. thus $2\mu r \cos r = n\lambda$

5) Analyse the intensity maxima and minima condition of fraunhofer diffraction at single slit with necessary derivation.

let the apperature AB be divided into a large number n of equal parts, each part being the same amplitude of vibrations of secondary wave lets the amplitude of vibrations at p due to each part will be the same, say a, but their allavery gradually film 0 to $(2\pi/\lambda)\cdot a\sin\theta$ the phase difference b/w the wave from face constructure partsis

$$\delta = \frac{1}{n} \cdot \frac{2\pi}{\lambda} \times a\sin\theta.$$

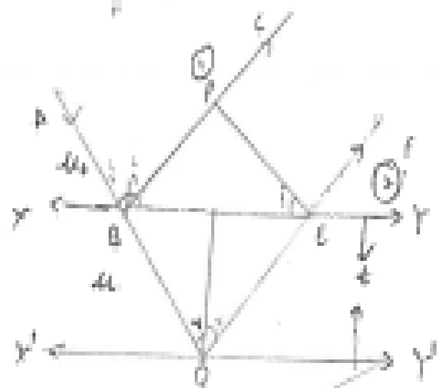
n = no. of vibrations.

Applied physics

Assignment-I :

Name :- K. Naveen Kumar
H.T.No:- 23C11A6665
Branch :- AIML-B

1) Explain the phenomenon of interference in thin films due to reflected light.



Consider 'i' is the angle of incident, 't' is the thickness of thin film and 'r' is the angle of refraction. 'μ' is the refractive index of thin film and 'μ₀' is the refractive index of air medium.

The path difference between two reflected rays

$= \mu_{(film)}(BD+DE) - \mu_0(BP)$

$\Delta = \mu(BD+DE) - BP \quad -(1)$

$\triangle^{le}$ BDQ :- $\cos r = \frac{QD}{BD} = \frac{t}{BD}$

$BD = \frac{t}{\cos r}$

Similarly $DE = \frac{t}{\cos r}$

$BD+DE = \frac{t}{\cos r} + \frac{t}{\cos r}$

$BD+DE = \frac{2t}{\cos r} \quad -(2)$

In Δ^{le} BPE $\Rightarrow$ $\sin i = \frac{BP}{BE} = \frac{BP}{BQ+QE}$

In Δ^{le} BDQ $\Rightarrow$ $\tan r = \frac{BQ}{QD}$

$$\tan r = \frac{BQ}{t}$$

$$BQ = t\tan r$$

Similarly $QE = t\tan r$

$$\sin i = \frac{BP}{(BQ+QE)}$$

$$\sin i = \frac{BP}{t\tan r + t\tan r}$$

$$\sin i = \frac{BP}{2t\tan r}$$

$$BP = \sin i \; 2t\tan r$$

$$= 2\mu t \frac{\sin r}{\cos r}(\sin i)$$

$$= 2\mu t \frac{\sin r}{\cos r}(\sin r)$$

$$= 2\mu t \frac{\sin^2 r}{\cos r} \quad \text{--- (3)}$$

$\left(\because \mu = \frac{\sin i}{\sin r},\ \sin i = \mu \sin r\right)$

from (2) & (3)

$$\Delta = \mu(BD+DE) - BP$$

$$= \mu\left(\frac{2t}{\cos r}\right) - 2\mu t\frac{\sin^2 r}{\cos r}$$

$$= \frac{2\mu t}{\cos r}\left[1 - \sin^2 r\right]$$

(2)

$$= \frac{2\mu t}{\cos r}\left[\cos^2 r\right]$$

$\boxed{\Delta = 2\mu t \cos r}$ Cosine law

total path difference $(\delta) = 2\mu t \cos r + \frac{\lambda}{2}$

(i) Constructive interference : $\delta \rightarrow$ even multiple of $\frac{\lambda}{2}$

$2\mu t \cos r \pm \frac{\lambda}{2} = n\lambda$

$2\mu t \cos r + \frac{\lambda}{2} = n\lambda$

$2\mu t \cos r = n\lambda - \frac{\lambda}{2}$

$2\mu t \cos r = (2n-1)\frac{\lambda}{2}$

$2\mu t \cos r - \frac{\lambda}{2} = n\lambda$

$2\mu t \cos r = n\lambda + \frac{\lambda}{2}$

$2\mu t \cos r = (2n+1)\frac{\lambda}{2}$

$\boxed{\therefore 2\mu t \cos r = (2n \pm 1)\frac{\lambda}{2}}$

Maxima film appears as bright.

(ii) Destructive interference

δ - odd multiple of $\frac{\lambda}{2}$

$2\mu t \cos r \pm \frac{\lambda}{2} = (2n+1)\frac{\lambda}{2}$

$2\mu t \cos r + \frac{\lambda}{2} = (2n+1)\frac{\lambda}{2} - \frac{\lambda}{2}$

$= [2n+1-1]\frac{\lambda}{2}$

$= (2n)\left(\frac{\lambda}{2}\right)$

$\boxed{2\mu t \cos r = n\lambda}$

$2\mu t \cos r - \frac{\lambda}{2} = (2n+1)\frac{\lambda}{2}$

$2\mu t \cos r = (2n+1)\frac{\lambda}{2} + \frac{\lambda}{2}$

$= (2n+1+1)\frac{\lambda}{2}$

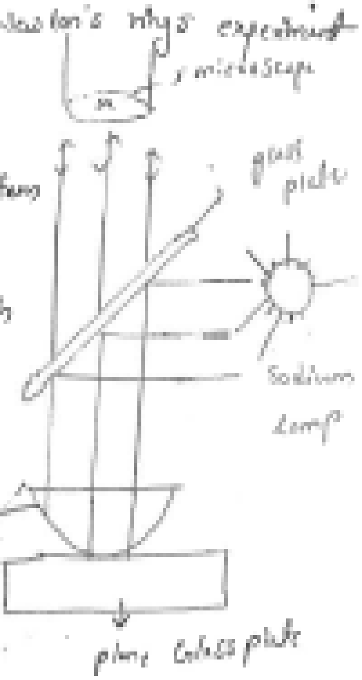
$= (2n+2)\frac{\lambda}{2}$

$\boxed{2\mu t \cos r = (n+1)\lambda}$

for destructive interference film appears dark in colour.

2) How do you obtain circular rings in Newton's rings experiment

A) Explanation:-



The two reflected rays 1 & 2 are derived from the same ray AB. As the rings are observed in reflected light, the path difference is $= 2\mu t\cos r + \lambda/2$

For air medium $\mu = 1$ and for normal incidence $r = 0$

$\Delta = 2(1)t\cos(0) + \frac{\lambda}{2}$

$\Delta = 2t + \frac{\lambda}{2}$ $[\because \cos 0 = 1]$

At the point of contact $t=0$, path difference

$\Delta = \lambda/2$

Hence the central spot is dark.

For constructive interference (bright ring)

$2t + \frac{\lambda}{2} = n\lambda$

$2t = (2n-1)\frac{\lambda}{2}$ — (i) when $n = 1, 2, 3 \ldots$

For destructive interference (dark ring)

$2t + \frac{\lambda}{2} = (2n+1)\frac{\lambda}{2}$

$2t = n\lambda$ —(ii)

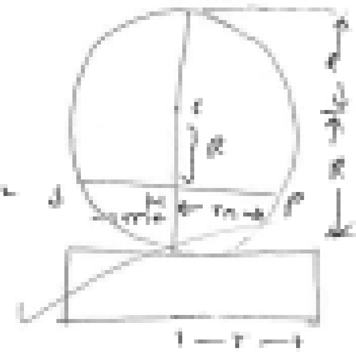
when $n = 0, 1, 2, 3$.

3

Theory :-

The curved surface SOP is a part of the spherical surface with center at 'C'. Let R be the radius of Newton ring corresponding to a constant thickness 't' of the circle film.

From the property of the circle,



$SN \times NP = ON \times NO$

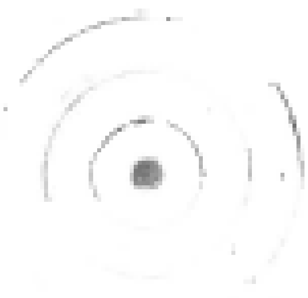
$r_n \times r_n = t(2R - t)$

$r_n^2 = 2Rt - t^2$ (∵ t is small, so $t^2 \lll r_n$)

$r^2 = 2Rt$

$\frac{D_n^2}{4} = 2Rt$ (∵ $r = \frac{D_n}{2}$)

$2t = \frac{D_n^2}{4R}$ —(iii)



from equations (ii) & (iii)

$2t = n\lambda$

$\frac{D^2}{4R} = n\lambda$

$D_n^2 = 4Rn\lambda$ —(iv)

This is the diameter of the n^{th} ring.

for $(n+p)^{th}$ ring $D_{n+p}^2 = 4R(n+p)\lambda$ —(v)

v - iv

$D_{n+p}^2 - D_n^2 = 4R(n+p)\lambda - 4Rn\lambda$

$D_{n+p}^2 - D_n^2 = 4Rn\lambda + 4Rp\lambda - 4Rn\lambda$

$D_{n+p}^2 - D_n^2 = 4R\lambda p$

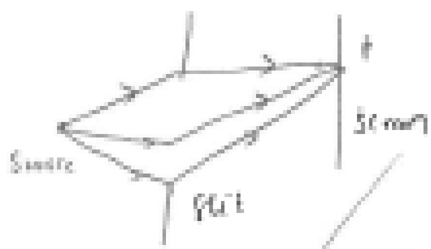
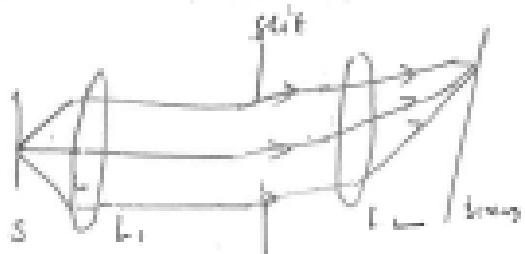
$$\lambda = \frac{D_{n+p}^2 - D_n^2}{4Rp}$$

wave length of light source.

$$R = \frac{D_{n+p}^2 - D_n^2}{4P\lambda}$$

Radius of curvature of plano convex lens.

5) Distinguish between fresnel and fraunhoffer diffraction!

Fresnel Diffraction	Fraunhoffer diffraction
	
→ more application used in fresnel Diffraction	→ less application used in fraunhoffer diffraction.
2) The incident wave front is cylindrical (or) spherical wave front	2) The incident wave front is plane wave front.
3) It is use point source (or) Narrow source	3) Distance between source and screen infinite.
4) maxima & minima are not well defined	→ maxima & minima are well defined.
→ The distance between the source and screen finite.	→ Distance between source and screen infinite.
→ No lens are used	→ two convex lens are used.

4) Demonstrate the construction and working of Nicol's prism

Nicol's Prism:-

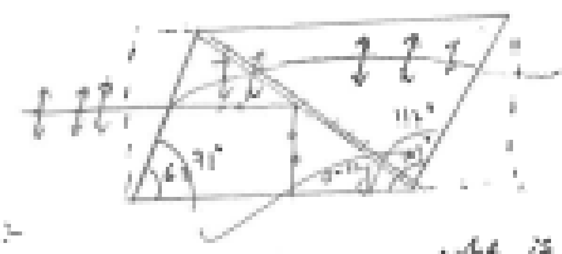
The phenomenon of double refraction can be used to produced plane polarized light.

Principle:-

Nicol prism is an optical device for producing and analyzing plane polarized light, with the help of total internal reflection phenomenon.

Construction:-

A calcite crystal whose length is three times as it's width is taken. The end faces of calcite are grounded in such way that the angles in the principle section becomes 68° & 112°, instead of 71° and 109°.



Working:-

→ When a beam of unpolarized light is incident on the nicol prism's face, it splits up into two refracted rays ordinary ray (O-ray) and extraordinary ray (E-ray), being plane polarized.

→ The when the for ordinary ray is incident at the proper angle, it can also be total internally reflected by the canada balsam as shown in the above figure.

→ The refractive indices for ordinary ray, canada balsam and extraordinary ray for calcite crystal are $\mu_o = 1.658$, $\mu_{cB} = 1.55$ and $\mu_E = 1.486$.

→ The ordinary ray is absorbed by the tube, containing Nicol's prism.

→ However the extraordinary ray on reacting at calcite - canada balsam layer, is transmitted.

→ Since the extraordinary for ray is plane polarized, the light emerging from the Nicol's prism is plane polarized, with vibrants parallel to the principle sections.

Applied physics

Assignment - II

Name :- K. Naveen Kumar
H.T No:- 23C11A6665
Branch : CSE (AI&ML)-B

1) Demonstrate the wave nature of electron by davisson & germer experiment with neat diagram

Principle :- The electrons which are coming from the source incident on the target and the electrons get diffracted. These diffracted produced a diffraction pattern. It shows the wave nature of matter wave.

Construction :-

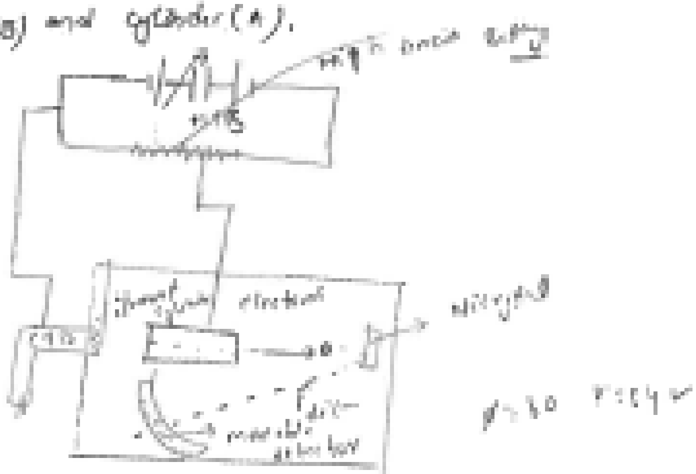
It consists of mainly 3 - parts

(i) filament

(ii) Target

(iii) circular scale arrangement.

It also consists of lower tension battery (LTB) higher tension battery (HTB) and cylinder (A).



→ low tension battery the function of the low tension battery which produces electrons

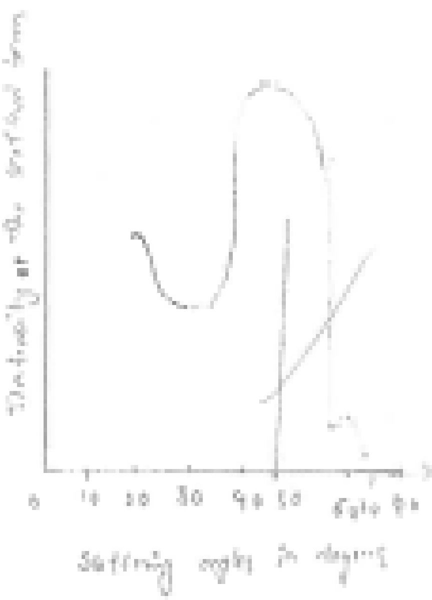
→ High tension battery produced electrons are raised by using battery.

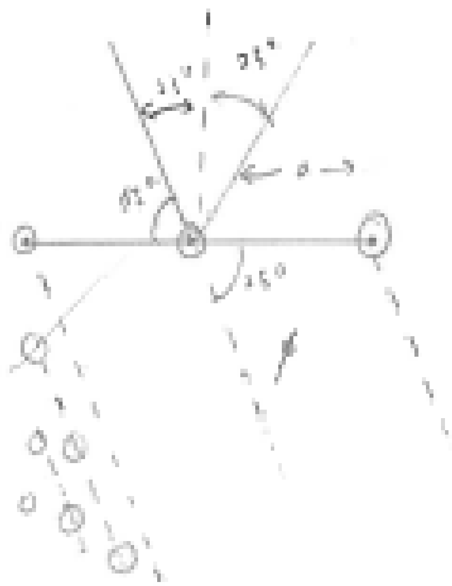
→ The revolved electrons produced from the filament enters into the faraday cylinder. They are straighten to the nickel crystal.

→ They are accelerated by the H.T.B the straightened electrons to the nickel crystal.

→ The graph shows that the electrons are in dual nature. They are diffracted if it is observed by movable detector.

→ more no. of electrons connected to movable detector





Electron diffraction by nickel crystal.

Calculation of wavelength λ associated with electrons:-

$$2d\sin\theta = n\lambda$$

$$2 \times 0.909 \times \sin 65^\circ = 1 \times \lambda$$

$$\lambda = 1.65\ A^\circ$$

de-Broglie wavelength (λ) of electron is given by

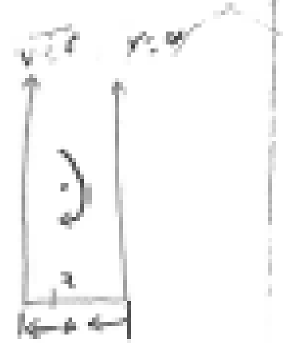
$$\lambda = \frac{12.27}{\sqrt{V}}\ A^\circ$$

But at $V = 54\ V$, $\lambda = \frac{12.27}{\sqrt{54}} = 1.67\ A^\circ$

2) Apply Schrodinger's wave equation for particle in one dimensional potential box.

Apply Schrodinger wave equation for electron in infinite potential box (or) particle in 1D box (or) particle in an infinite square well box

→ The particle is electron should propagate



Boundary conditions:

$V(x) = 0 \quad 0 \le x \le a$ (inside)

$V(x) = \infty \quad 0 \ge x \ge a$ (outside)

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E-V)\psi = 0$$

(i) $\psi = 0 \quad x = 0$

$\psi = 0 \quad x = a$

→ $V = 0 \Rightarrow \frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E-V)\psi = 0$

$$\frac{d^2\psi}{dx^2} + \left(\frac{2mE}{\hbar^2}\right)\psi = 0$$

$$\frac{d^2\psi}{dx^2} + k^2\psi = 0 \quad -(A), \quad k^2 = \frac{2mE}{\hbar^2} \quad -(a)$$

The solution of equation (A) is

$$\psi(x) = A\sin kx + B\cos kx$$

(i) $\psi = 0 \quad x = 0$

$$0 = A\sin k(0) + B\cos k(0)$$

$$0 = 0 + B$$

$$\boxed{\therefore B = 0}$$

$\Rightarrow \psi = 0 \quad x = a$

$$0 = A\sin ka$$

$$0 = A\sin ka$$

$$A \neq 0; \quad \sin ka = 0$$

$$\sin(ka) = \sin(n\pi) \qquad n = 0, 1, 2, 3 \ldots$$

$$ka = n\pi$$

$$k = \frac{n\pi}{a}$$

$$k^2 = \frac{n^2\pi^2}{a^2} \quad -(b)$$

(A) = (b)

$$\frac{2mE}{\hbar^2} = \frac{n^2\pi^2}{a^2}$$

$$E = \frac{n^2\pi^2\hbar^2}{2ma^2}$$

$$E = \frac{n^2\pi^2h^2}{2ma^2 4\pi^2} = \frac{n^2h^2}{8ma^2} \Rightarrow \boxed{E = \frac{n^2h^2}{8ma^2}}$$

particle in 1D box.

$$\int_0^a |\psi|^2 dx = 1$$

$$\int_0^a A^2 \sin^2\left(\frac{n\pi}{a}\right) x \cdot dx = 1$$

$$A^2 \int_0^a \frac{1 - \cos\left(\frac{2n\pi x}{a}\right)}{2} \cdot dx = 1$$

$$\frac{A^2}{2}\left[\int_0^a 1 \cdot dx - \int_0^a \cos\left(\frac{2n\pi}{a}\right) x \cdot dx\right] = 1$$

$$\frac{A^2}{2}\left[(x)_0^a - \frac{a}{2n\pi}\left[\sin\left(\frac{2n\pi}{a}\right) x\right]_0^a\right] = 1$$

$$\frac{A^2}{2}\left\{(x)_0^a - \frac{a}{2n\pi}\left[\sin \frac{2n\pi}{a}\right)(a) - \sin\left(\frac{2n\pi}{a}\right)0\right\} = 1$$

$$\frac{A^2}{2} a - \frac{a}{2n\pi}[0 - 0] = 1$$

$$\frac{A^2}{2} a = 1$$

$$A^2 = \frac{2}{a}$$

$$A = \sqrt{\frac{2}{a}}$$

$$\psi(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi}{a}\right) x$$

$$\psi = \psi(x)\psi(y)\psi(z) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi}{a}\right) x \cdot \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi}{a}\right) y \cdot \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi}{a}\right) z$$

$$= \sqrt{\frac{2}{a}}\sqrt{\frac{2}{a}}\sqrt{\frac{2}{a}}$$

Unit - II B

1. Discuss the various drawbacks, merits and demerits of classical free electron theory of metals

Advantages:-

(i) It verifies ohm's law.

(ii) It explains electrical conductivity of metals

(iii) It explains thermal conductivity of metals.

(iv) It derives widemann - franz law.

(v) i.e the relation between electrical and thermal conductivity.

Limitations:

The classical free electron theory was not able to completely explain the following properties

(i) Specific heat of metals.

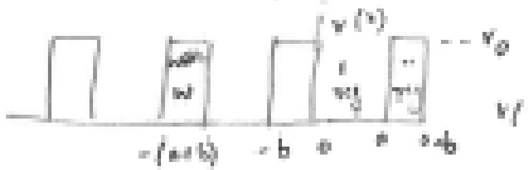
(ii) Superconducting properties of materials.

(iii) photoelectric effect, compton effect, black body radiation and so on.

(iv) Temperature dependence of electrical conductivity of metals.

(2) Explain the kronig - penny model for the motion of electrons in a periodic potential.

The kronig - penny model is a simplified model for an electron in a one - Dimensional periodic potential kronig and penny examined the behaviour of electrons in a periodic potential by considering a relatively simple and one - dimensional model. It is assumed that the potential energy of an electron has shape of a square well as shown in fig.



Boundary conditions

$V(x) = 0$, when $0 < x < a$ — I region

$V(x) = V_0$, when $-b < x < 0$ — II region

Schrodinger equations for the two regions,

$$\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E - 0)\psi = 0 \quad \text{for } 0 < x < a \quad -(1)$$

$$\frac{\partial^2\psi}{\partial x^2} + \frac{2m}{\hbar^2}(E - V_0)\psi = 0 \quad \text{for } -b < x \le 0 \quad -(2)$$

Again,

$$\frac{\partial^2\psi}{\partial x^2} + \alpha^2\psi = 0 \quad -(3)$$

where, $\alpha^2 = \frac{2m}{\hbar^2}E$

$$\frac{\partial^2\psi}{\partial x^2} - \beta^2\psi = 0 \quad -(4)$$

where, $\beta^2 = \frac{2m}{\hbar^2}(V_0 - E)$

The solution for the equations (3) and (4) can be written as

$$\psi(x) = U_k(x)\, e^{ikx} \quad -(5)$$

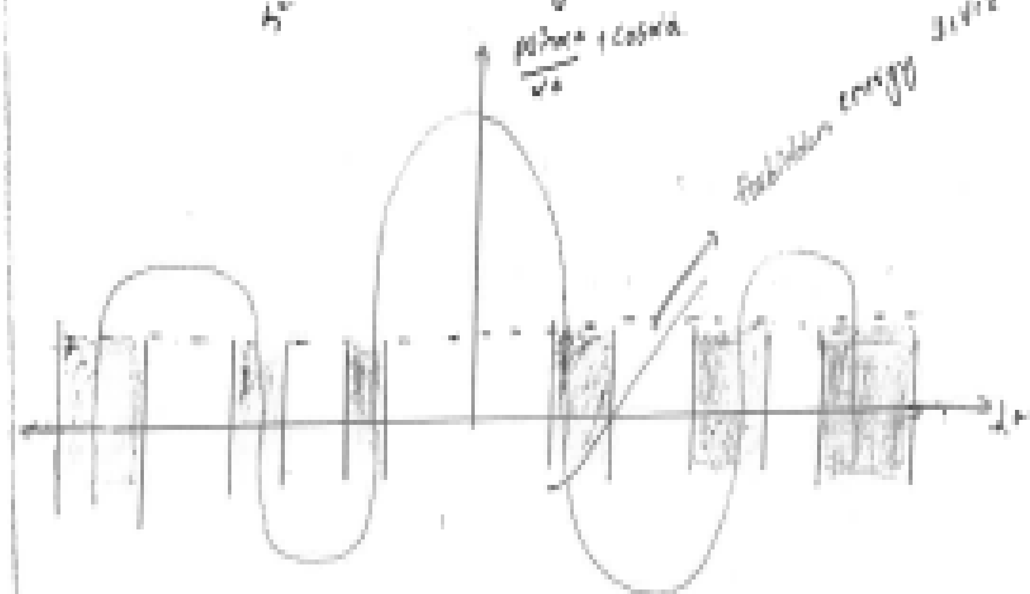
$$\psi(x) = U_k(x + a) \quad -(6)$$

Differentiate equation (5) twice with respect to x, and substituting in equation (3) and (4), two independent second order linear differential equations can be obtained for the region

Applying the boundary conditions to the solution of above equations, we get the following expression

$$\frac{P \sin \alpha a}{\alpha a} + \cos \alpha a = \cos k a \quad - (9)$$

where, $P = \frac{4\pi^2 m a}{h^2} V_0 V$ is scattering power.



Unit – III(A)

Applied Physics

Name :- K. Naveen Kumar

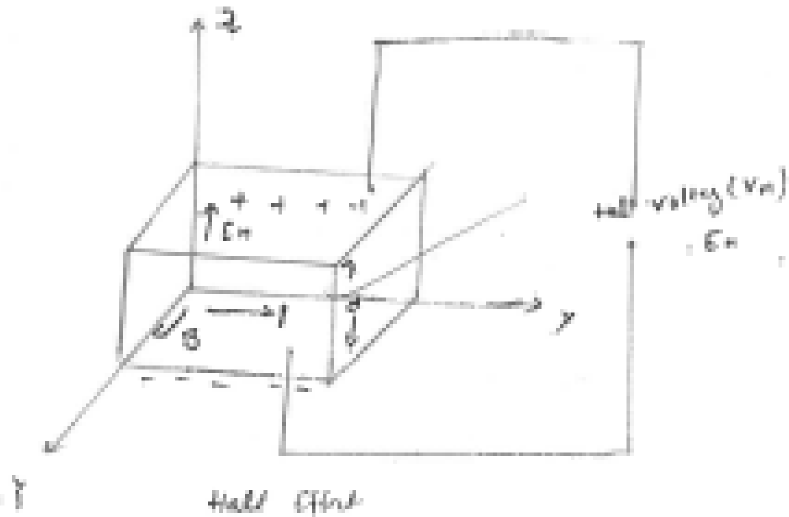
H.T NO:- 23C11A6665

Branch: AIML - B

1) Explain Hall effect with neat sketch:-

When a current carrying semiconductor is subjected to a transverse magnetic field, then a potential difference or electric field is developed across the semiconductor or conductor in a direction perpendicular to both current and applied magnetic field. This phenomenon is known as Hall effect.

∙ The established potential difference is known as Hall voltage and the electric field becomes Hall electric field.



Hall Effect

Let E_H be the Hall electric field on the semiconductor. The force on the electron due to E_H.

$= eE_H$

Where 'e' is the charge of electron.

The force on electron due to magnetic field B.

$= Bev$

Where v is the electron velocity.

At steady state, $eE_H = Bev$

$$E_H = Bv$$

If V_H is the Hall voltage, then $E_H = \frac{V_H}{d}$

from the above equations, we get

$$\frac{V_H}{d} = Bv$$

$$V_H = Bvd$$

If 'n' is the concentration of electrons in the semiconductor,

then current density, $J = nev$

$$v = \frac{J}{ne}$$

$$\therefore \quad V_H = \frac{BJd}{ne}$$

But $J = \frac{I}{A}$

where A is the area of cross section of a semiconductor

$$= \frac{I}{dw} \quad [\because A = dw]$$

$$V_H = \frac{Bd}{ne} \times \frac{I}{dw} = \frac{BI}{new}$$

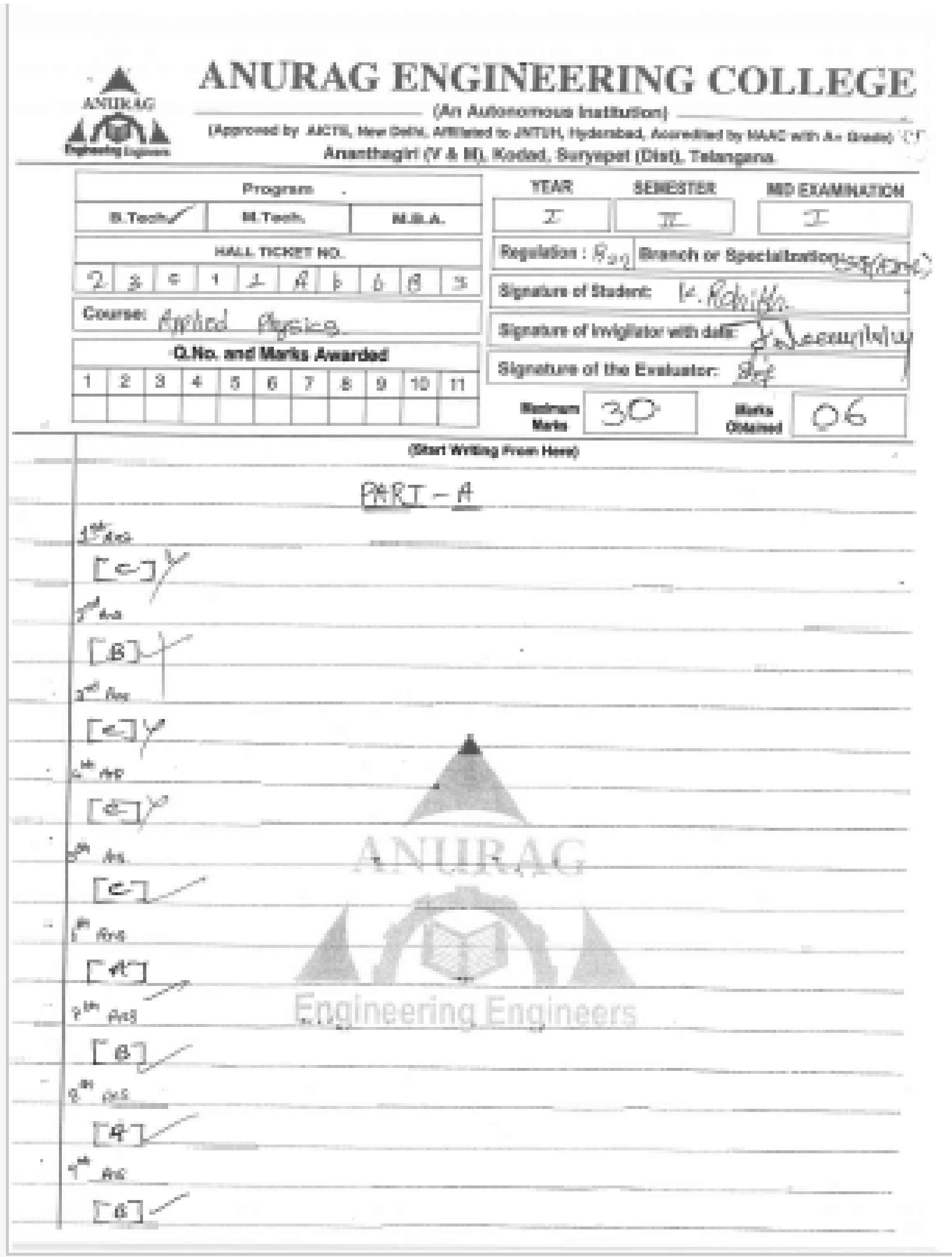
The Hall coefficient R_H is given by

$$R_H = \frac{1}{ne}$$

$$\boxed{V_H = \frac{BIR_H}{w}} \quad \text{Hall voltage}$$

$$\boxed{R_H = \frac{V_H w}{BI}}$$

Hall coefficient.



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Program			YEAR	SEMESTER	MID EXAMINATION
B.Tech ✓	M.Tech.	M.B.A.	I	II	I

HALL TICKET NO.: 2 3 C 1 1 A 6 6 8 5

Regulation : R23 Branch or Specialization: CSE(AIML)

Course: Applied Physics

Signature of Student: K. Rohith

Signature of Invigilator with date:

Signature of the Evaluator:

Q.No. and Marks Awarded

1	2	3	4	5	6	7	8	9	10	11

Maximum Marks: 30 Marks Obtained: 06

(Start Writing From Here)

PART – A

1st Ans [C]

2nd Ans [B]

3rd Ans [C]

4th Ans [C]

5th Ans [C]

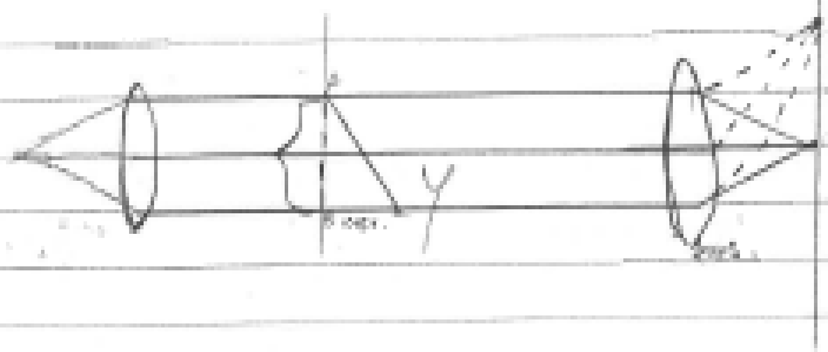
6th Ans [A]

7th Ans [B]

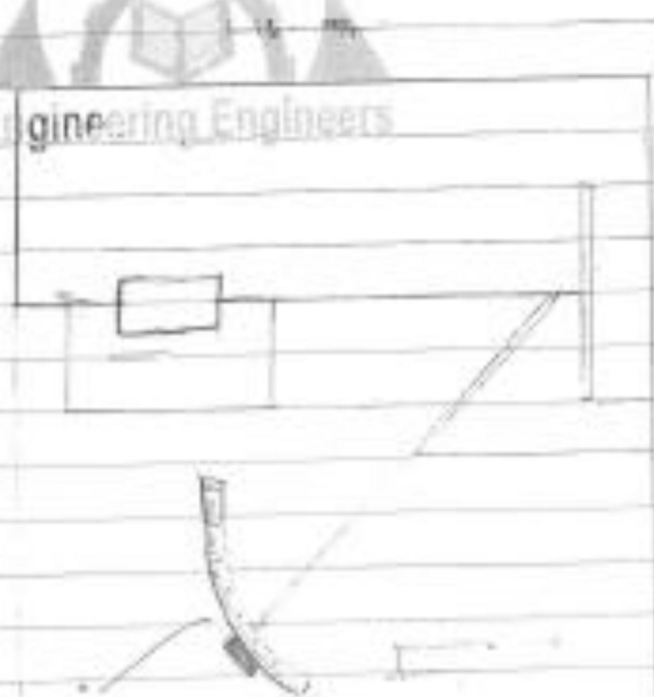
8th Ans [A]

9th Ans [B]

PART -(B)



13 6th Answer



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Program			YEAR	SEMESTER	MID EXAMINATION
B.Tech. ✓	M.Tech.	M.B.A.	I st	II nd	I st

HALL TICKET NO.: 2 3 0 1 1 A 6 6 6 9

Regulation: R22 **Branch or Specialization:** AIML(B)

Course: Applied physics.

Signature of Student: B Nikhil

Signature of Invigilator with date: [signature]

Signature of the Evaluator: [signature]

Q.No. and Marks Awarded

1	2	3	4	5	6	7	8	9	10	11

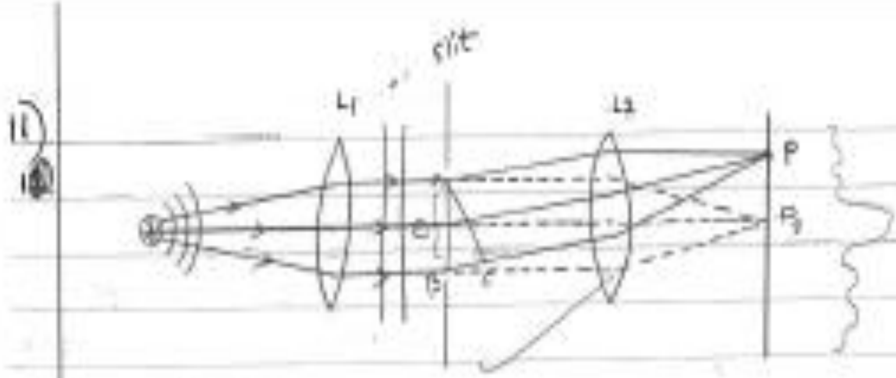
Maximum Marks: 30 **Marks Obtained:** 30

(Start Writing From Here)

PART-A

1) B ✓
2) D ✓
3) B ✓
4) B ✓
5) C ✓
6) A ✓
7) B ✓
8) A ✓
9) B ✓
10) C ✓

11)



- The lenses L_1 and L_2 are placed.
- The light comes from a monochromatic light source lens L_1 is use to make the wavelets wavefront to plane wave front.
- The primary wavelet from the slit refleck at point P_0 on the screen that is bright.
- The secondary wavelets from the slit deviated by an angle θ these are refleted at point P_1.
- Draw a perpendicular line to BC from A.

$\therefore$ ~~$\sin\theta = \frac{AB}{BC}$~~ $\quad \sin\theta = \frac{BC}{AB}$

~~$AB = BC\sin\theta$~~ $\quad BC = AB\sin\theta$

$BC = e\sin\theta$

$\therefore$ The path difference $= e\sin\theta$.

phase difference $\delta = \frac{2\pi}{\lambda}(e\sin\theta)$.

$\therefore$ There are 'n' number of diffactiot.

$$\delta = d = \frac{1}{n}\left[\frac{2\pi e \sin\theta}{\lambda}\right]$$

By vector addition resultant (R) $= \dfrac{a \sin n\left(\frac{d}{2}\right)}{\sin\left(\frac{d}{2}\right)}$

$$R = \frac{a \sin n\left(\frac{2\pi e \sin\theta}{2n\lambda}\right)}{\sin\left(\frac{2\pi e \sin\theta}{2n\lambda}\right)}$$

$$R = \frac{a \sin\left(\frac{\pi e \sin\theta}{\lambda}\right)}{\sin\left(\frac{\pi e \sin\theta}{n\lambda}\right)}$$

$\therefore$ let $[\pi e \sin\theta / \lambda = \beta]$

$$R = \frac{a \sin\beta}{\sin\left(\frac{\beta}{n}\right)} \qquad \sin\frac{\beta}{n} \approx \frac{\beta}{n}$$

$$R = \frac{a \sin\beta}{\beta}$$

$$R^2 = A^2\left[\frac{\sin\beta}{\beta}\right]^2$$

$$\boxed{I = I_0\left[\frac{\sin\beta}{\beta}\right]^2}$$

Maxima:-

let $\beta = 0$.

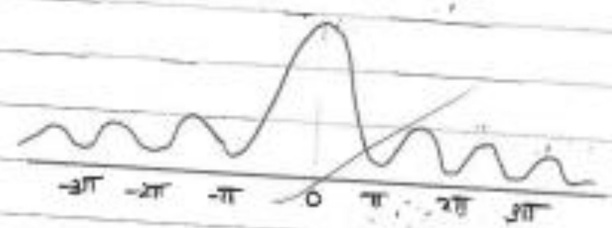
Minima :-

$\sin\theta = \pm m$

$m \neq 0$

$m = 1, 2, 3, 4.$

Intensity distribution :



13. Davisson - Germer experiment.

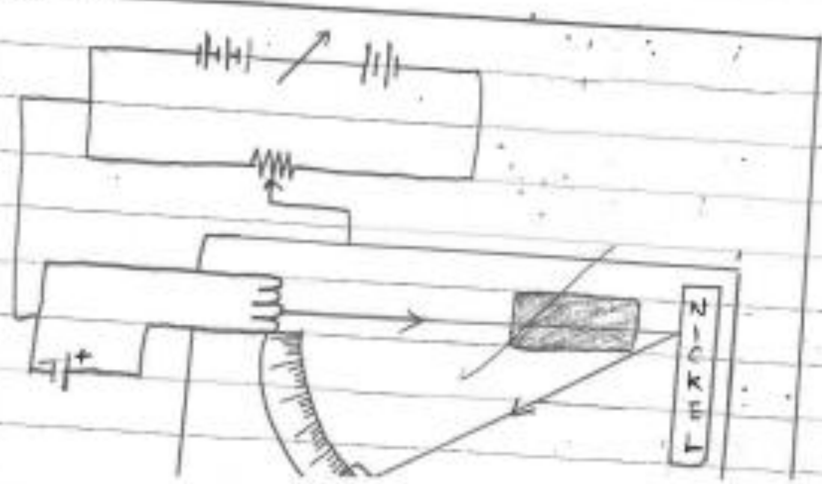
Main parts :-

i) Electron gun

ii) Electrostatic particle accelerator

iii) accelerator

iv) target



• Davission and Germer experiment the setup goes on in a closed vaccum chamber.

There are few main parts
i) HTB → High tensile battery.
ii) LTB
iii) cylinder
iv) Nickel crystal.
v) Galvanometer etc.

i) Electron gun :- The electron gun has a filament it ejects the electrons into the path when it is heated up to particular temperature.

) Electrostatic accelerator :- Two unlike charged plates are used and kept and this is used as electrostatic particle accelerator.

) Accelerator :- The accelerator is kept the electrons in a narrow line and emitts one by one with acceleration.

) Nickel crystal :- when the electrons came and hit the nickel crystal. they gets into all the directions. and that are collected and measured by movable scale connected to galvanometer.

The significance of davission and germer experiment is to know the wave nature of matter of the electron.

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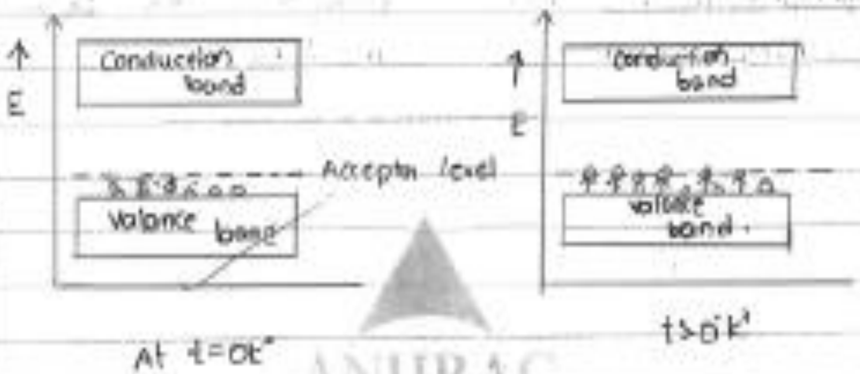
Hall Ticket No: 23C11A6669 | ADDITIONAL SHEET NO. 1
Date of Examination: 01-04-24 | SIGNATURE OF INVIGILATOR

(Start Writing From Here)

energy level digram for P-type Semi Conductors.

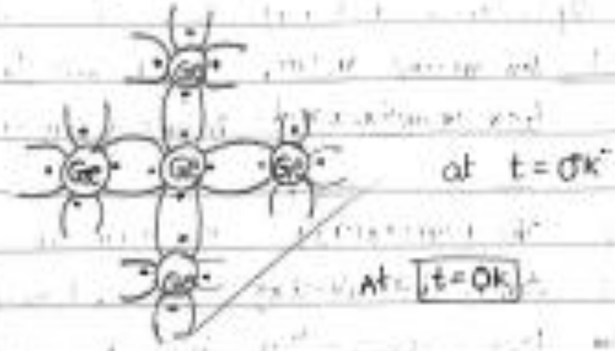


energy level diagram for N-type Semiconductors.

Intrinsic Semiconductors	Extrinsic Semiconductors.
1) Intrinsic Semiconductors are available in pure form	Extrinsic Semiconductors are available in impure form.
2) Intrinsic Semiconductor conducts electricity	Extrinsic Semiconductors are conducts electricity more than that of intrinsic Semiconductors

Intrinsic semi conductors

energy level diagram of Intrinsic semi conductors



Extrinsic semiconductors

P-type semiconductors :-

P-type Semi Conductors are formed by doping with trivale impurities.

Ex:- Al, B,

N-type Semiconductors :-

N-type Semi conductors are formed by doping with pentavalent impurities.

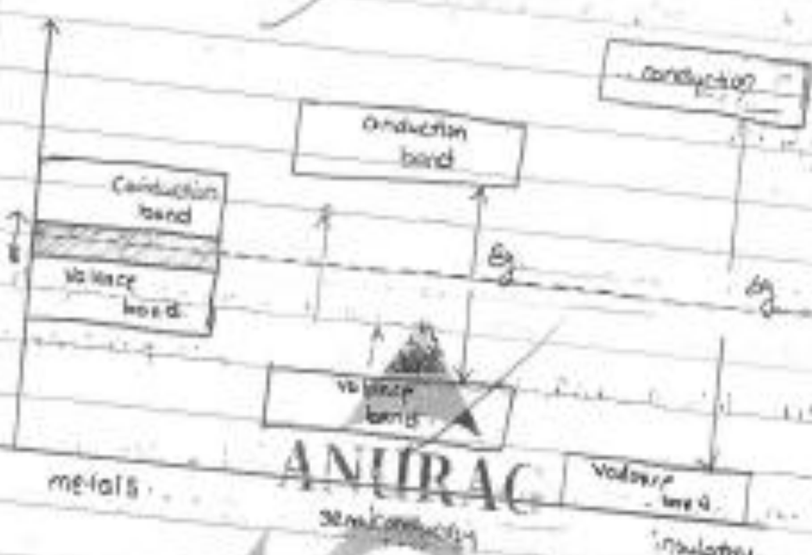
Ex:- P, Sb

14. Based on band theory there are 3 solids.

i) Conductors/metals.

ii) semiconductor

iii) Insulators.

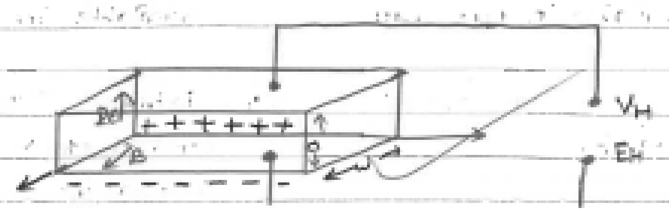


Metals.	Semiconductors	Insulators.
a) 		
b) In metals the energy gap is not there.	In semiconductors there is a very small energy gap (Eg)	In insulators there is a very large energy gap (Eg)
i) In metals there are	In semicond...	

16. Hall effect :-

- When a current carrying semiconductor is subjected to the transverse magnetic field or electric field across the semiconductor or conductor. It is in the same direction of the applied magnetic field and electric field this phenomenon is called as Hall effect.

- It was discovered by Hall in 1927.



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Hall Ticket No:	2	3	C	1	1	A	6	6	6	7

ADDITIONAL SHEET NO.	02
SIGNTURE OF INVIGILATOR	01/04/24

Date of Examination: 01-04-24.

(Start Writing From Here)

- The Hall electric field is represented as = eE_H

  e, is the charge of electron.

- The Hall magnetic field is represented as = BeV

$$eE_H = BeV$$

$$\boxed{E_H = BV} \rightarrow ④ \quad \text{But } E_H = \frac{V_H}{d} \Rightarrow \boxed{BV = \frac{V_H}{d}} \rightarrow ①$$

The density of current $J = neV$

$$\boxed{V = \frac{J}{ne}} \rightarrow ②$$

eqn ② in ①

By $\frac{V_H}{d} = \frac{BJ}{ne}$

$$V_H = \frac{BJd}{ne} \quad \text{--- (3)}$$

But $J = \frac{I}{A}$ — a

also $A = dw$ — b

substitute a,b in (3)

$$V_H = \frac{BI}{new}$$

But $R_H = \frac{1}{ne}$

$$V_H = \frac{BR_H}{w}$$

∴ Hall voltage $(V_H) = \frac{BR_H I}{w}$ $\quad (V_H) = \frac{BIR_H}{w}$

also

$$(R_H) = \frac{V_H w}{BI} \quad (R_H) = \frac{V_H w}{BI}$$

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Program			YEAR	SEMESTER	MID EXAMINATION
B.Tech. ✓	M.Tech.	M.B.A.	I	II	II

HALL TICKET NO.: 2 3 C 1 1 A 6 6 9 9

Regulation: R22 | Branch or Specialization: CSM

Course: A.P

Signature of Student: D.Shivanagaraju

Signature of invigilator with date:

Signature of the Evaluator:

Q.No. and Marks Awarded

1	2	3	4	5	6	7	8	9	10	11

Maximum Marks: 30 | Marks Obtained: 13

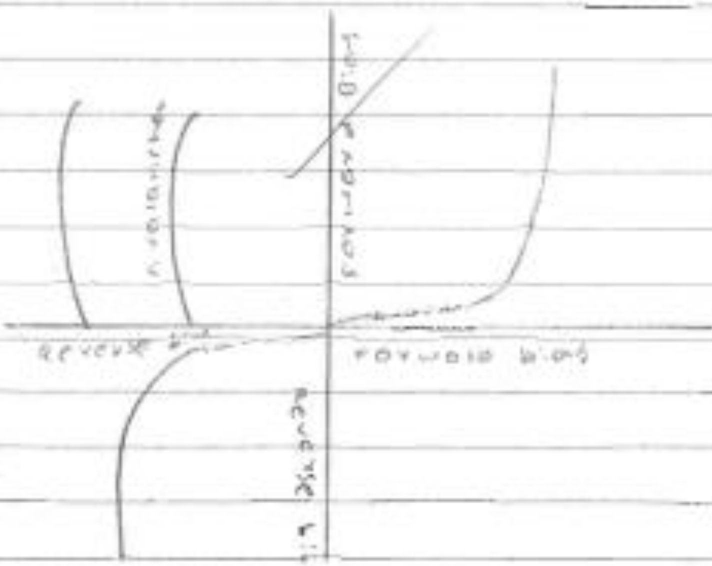
(Start Writing From Here)

1. A ✓
2. B ✓
3. D ✓
4. D ✓
5. C ✓
6. A ✓
7. D A
8. B C ✓
9. C ✓
10. A ✓

n(a) zenar diode:-

A zenar diode is a doped semiconductor which is ~~used~~ designed to operate the Reverse direction.

* It works like simple normal diode when it was in forward Biased.
* A small flow of current passes through the diode when it was in the reverse biased mode.
* It is impredictable when the ionised photons occur while the Reverse bias
* It is predictable when the ionised photons occur while the Forward bias.



Avalanche :

11. Photo diode :-
Photo Diode is a Photovoltaic source

(6) i) NCI YAG stands for: newton dynamic yalum alumn grand

ii) the light source for nd YAG lase is lepton ray

iii) The laser contended from partially reapted nucleus

iv)

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Program			YEAR	SEMESTER	MID EXAMINATION
B.Tech.	M.Tech.	M.B.A.	I	2nd	2nd

HALL TICKET NO.: 2 3 C 1 1 A 6 6 8 5

Regulation: R22 Branch or Specialization: CSE (AI&ML)-1

Course: Applied physics

Signature of Student: B. Sai chandrika

Signature of Invigilator with date:

Signature of the Evaluator:

Q.No. and Marks Awarded

1	2	3	4	5	6	7	8	9	10	11

Maximum Marks: 30 Marks Obtained: 30

(Start Writing From Here)

Part-A

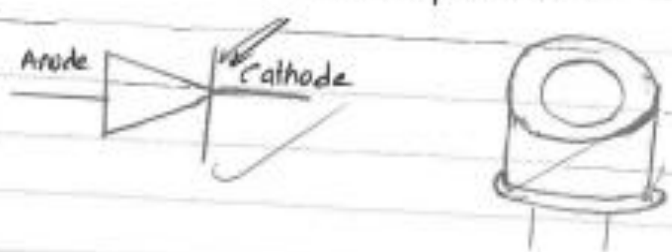
1) A
2) B
3) D
4) D
5) C
6) A
7) D
8) C
9) C
10) A

Part-B

1) Photo diode:-

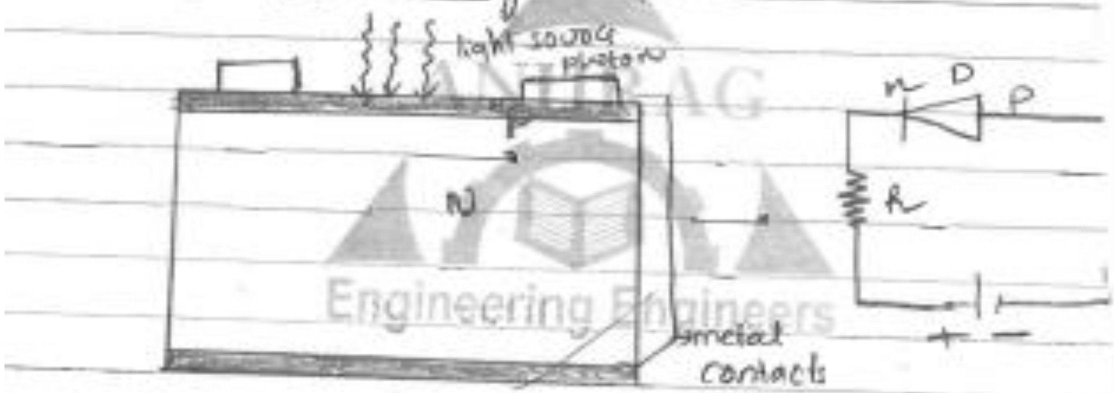
It produces current when it absorbs photons.

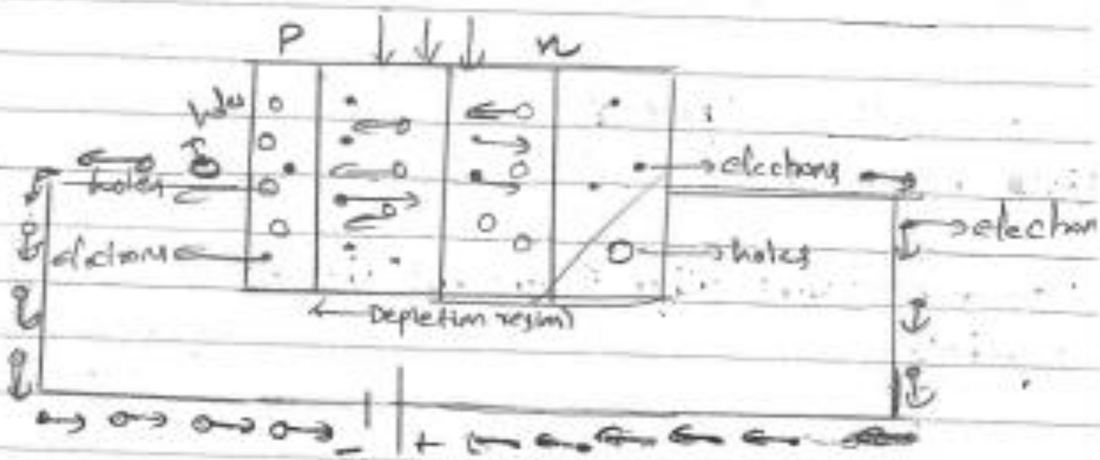
Symbol:-



→ A photo diode is a light sensitive semiconductor d
→ It produces light when it absorbs photons.
→ When photons of sufficient energy falls on the cell it produces Electron hole pair. It is called inner photoelectric effect
→ Photo diode allows the sufficient light to reach the sensitive part of the diode
→ Photo diode is PIN structure or PN Junction.
→ When photon falls on the intrinsic semiconductor it generates electron and hole pair in the depletion region

Construction and working:-





→ Electrons are attracted by the positive terminal of the Battery

→ Holes are attracted by the negative terminal of the Battery

→ when a photon is incident on the cell, the photos are absorbed by the junction and the electrons are excited from valency band to conduction band

→ The electron-hole pair generated due to the incident photons is called photo carriers

→ The photo carriers in the depletion region are draft opposite to the induced emf in reverse condition

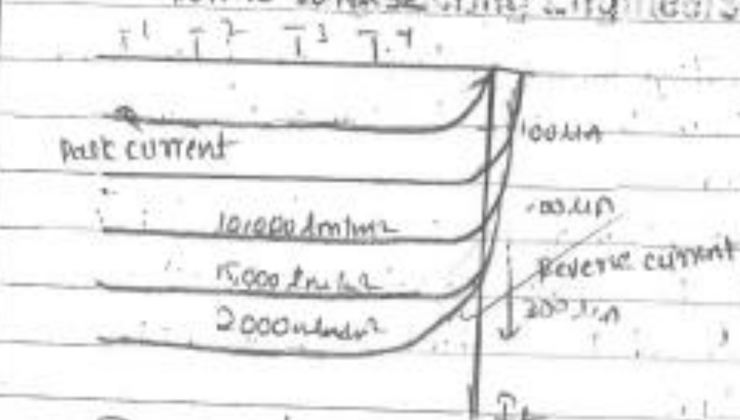
→ A photo current is produced in the reverse condition.

→ It has high doping level

→ It does not obey ohms law.

→ And the photo current is produced by the accumulation of charge carriers.

I-V characteristics of photo diode:



I-V characteristics of photo diode

→ IV characteristics of a photo diode is just like a normal pn Junction diode

→ The I-V characteristics are passed through the second

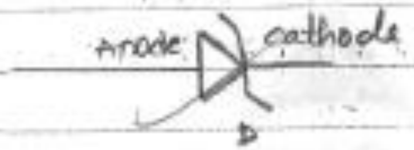
Applications of photo diode:-

1) It is used in compact disk (CD)
2) It is used in smoke detectors
3) It is used in Tele communication
4) It is used in space applications.
5) It is used in Medical field.

12) Zener diode:-

→ The diode which is designed to operate in reve direction is called zener diode

Symbol:-



working:-

→ It is used as a normal pn Junction diode in forward Biased condition

→ A small lekage of current flows when it is connected in Reverse direction

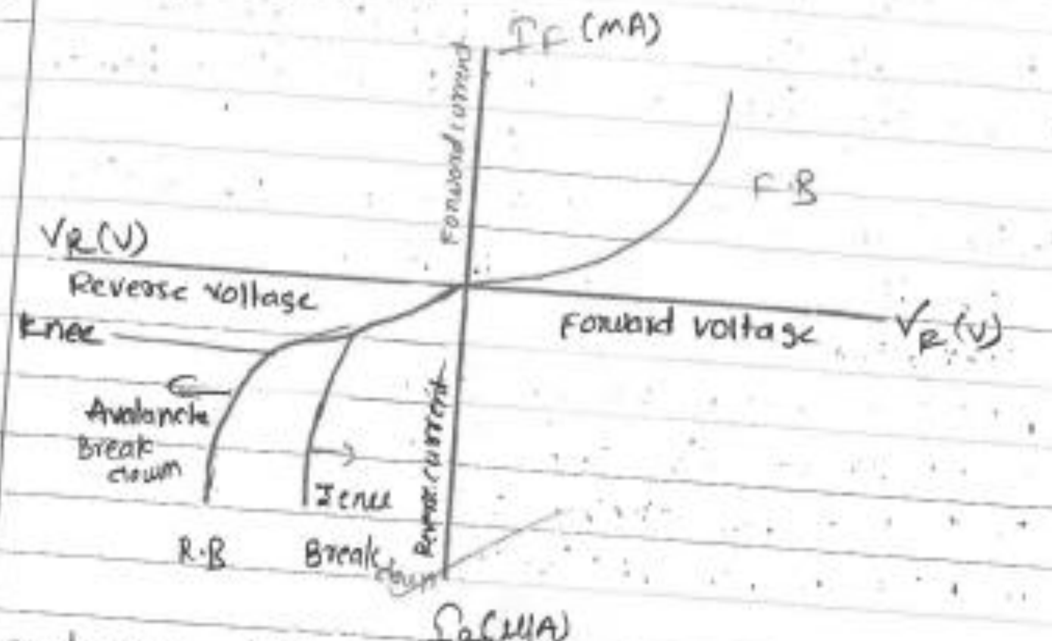
→ When ever voltage increases to the predetermine Breakdown voltage the current starts flowing through the diode

→ When the current increases to Maximum, it is determined by the series Resistor. After that the current should be constant over a wide range of voltage

→ zener diode is a heavily doped pn Junction diode

→ It is used as a voltage Regulator to conta

I-v characteristics:-



Forward Bias:- In Forward Bias the Zener diode characteristics same as pN Junction diode characteristics

Reverse Bias:- In Reverse Bias there are two types of Breakdown in v-I characteristics of Zener diode

Avalanche Breakdown:- It is beacuse of ionization of electrons and holes, After the Breakdown the junction does not regain its original shape Beacuse it is Brun off

Zener Breakdown:- It is Beacuse the Breaking of covalent Bond By strong electric field in the depletion region By reverse direction.

⇒ It is used to control voltage in Reverse Bias and There are some difference Between the pN Junction and Zener diode

Differences Between pN Junction and Zener diode.

PN Junction	Zener diode

1)	... one direction ... current	2) It allows the ... in Both the dire...
2)	3) It obeys Ohms law	3) It does not obey ... law
3	4) Damages the circuit	4) Does not dama... circuit

Applications:-

1) It is used as voltage regulator
2) It does not allow over voltage
3) It is used in clipping circuit
4) It is used to shift voltage

5) Einstein Coefficients:-

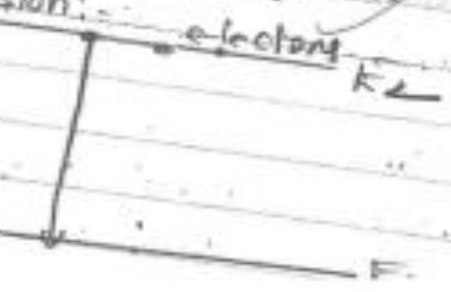
1) absorbtion:-

By absorbing the Energy the electron excites from E_1 energy state to the E_2 energy state this phenomenon is called absorption

absorption rate $\propto N_1 f(v) dv$

absorption rate $= B_{12} N_1 f(v) dv$

Spontaneous Emission:-

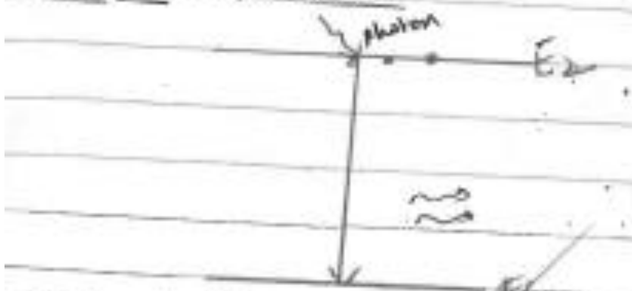


There is no life time for the electron's in spontaneous Emission. That is why the electrons falls from higher Energy state to lower energy state

Spontaneous Emission rate $\propto N_2$

Spontaneous Emission rate $= A_{21} N_2$

Stimulated Emission:-



→ By absorbing energy the electrons fall from E_2 Energy state to E_1 Energy state By Emitting photons

Stimulated Emission rate $\propto \rho(\nu)\,d\nu \cdot N_2$

Stimulated emission rate $= B_{21} N_2 \rho(\nu)\,d\nu$

At Equilibrium

$$B_{12} N_1 \rho(\nu)d\nu = A_{21} N_2 + B_{21} N_2 \rho(\nu)\,d\nu$$

$$\rho(\nu)\left[B_{12} N_1 - B_{21} N_2\right] = A_{21} N_2$$

$$\rho(\nu) = \frac{A_{21} N_2}{B_{12} N_1 - B_{21} N_2}$$

$$\rho(\nu) = \frac{\frac{N_2}{N_2} \cdot \frac{A_{21}}{B_{21}}}{\left[\frac{N_1}{N_2} \cdot \frac{B_{12}}{B_{21}} - 1\right]}$$

$$\rho(\nu) = \frac{A_{21}}{B_{21}}$$

By Maxwell Boltzmann constant

$$N_1 = N_0 \exp\left[\frac{-E_1}{KT}\right]$$

$$N_2 = N_0 \exp\left[\frac{-E_2}{KT}\right]$$

$$\frac{N_1}{N_2} = \exp\left[\frac{E_2 - E_1}{KT}\right]$$

$$\frac{N_1}{N_2} = \exp\left[\frac{h\nu}{KT}\right]$$

$$\rho(\nu) = \frac{\frac{A_{21}}{B_{21}}}{\left[\exp\left(\frac{h\nu}{KT}\right)\frac{B_{12}}{B_{21}} - 1\right]} \quad \text{—(1)}$$

By planks constant.

$$\rho(\lambda) = \frac{\frac{A_{21}}{B_{21}}}{c} \qquad \rho(\nu) = \frac{8\pi h\nu^3/c^3}{\exp\left(\frac{h\nu}{KT}\right) - 1} \quad \text{—(2)}$$

From Equation (1) & (2)

$$\frac{A_{21}}{B_{21}} = \frac{8h\pi\nu^3}{c^3} \quad \text{—(3)}$$

$$\boxed{\frac{B_{12}}{B_{21}} = 1} \quad \text{—(4)}$$

Equation (3) & (4) are called the einstein Relations.

16) Nd-YAG Laser (Neodynamium-Ytrium Aluminium garnet):-

Active Medium:- The Active Medium for Nd-YAG laser is NA-YAG rod

pumping Source:- The pumping source is krypton flash

Hall Ticket No: 23C11A6685

ADDITIONAL SHEET NO. 01

SIGNTURE OF INVIGILATOR

Date of Examination:

(Start Writing From Here)

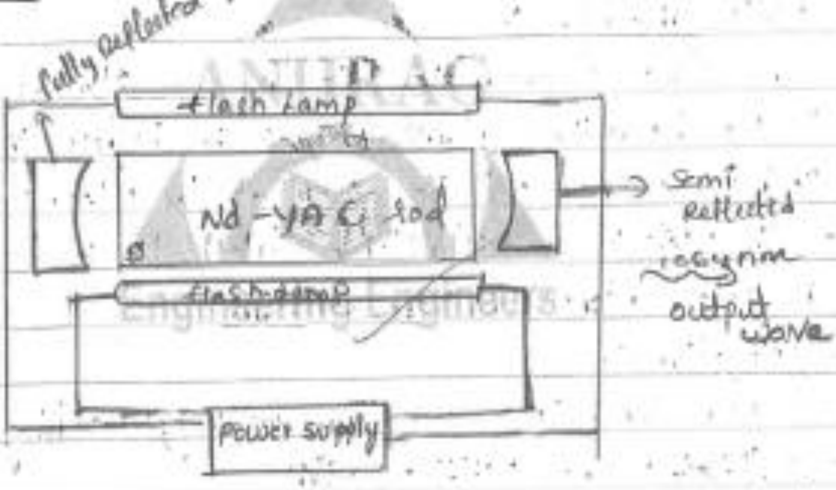
output wave:- The output wave of wave length 1064nm.

The lasing medium The lasing Medium in the Nd-YAG laser is colourless, the crystal is made by the Nd-YAG

→ The main dopant in the laser is Neodynamium(Nd^{+3})

→ YAG is called yttrium-Aluminum garnet ($Y_3Al_5O_{12}$)

construction and working:-



→ It consists of a Nd-YAG rod of length and diameter

→ krypton flash lamp is placed in the material of 30 mm

→ one mirror is semi reflected and other is fully reflected

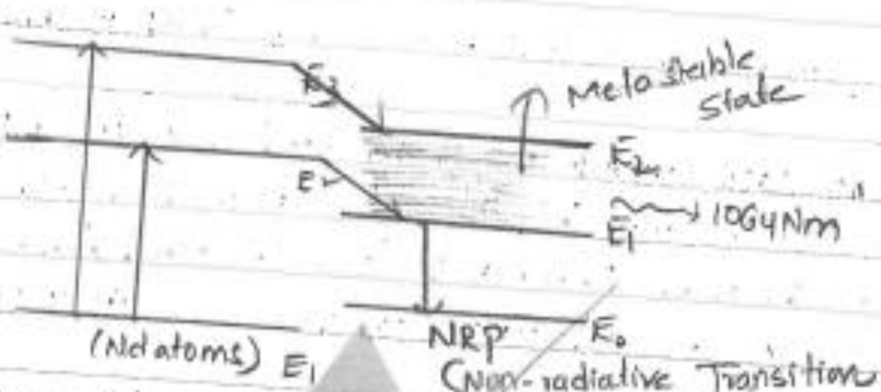
→ During the formation of laser, Neodynamium at 1% is replaced by the yttrium it gives light Blue colour

→ and the power is 1 KW and in pulsing mode.

By the water.

→ Nd-YAG laser is used for produce high distance Communication

Energy level diagram:-



Meta Stable State:-

The State at which the life time of Atoms is more

→ Neodynamium atoms to go to the higher energy levels and the output will be given at the Meta stable state

→ The next lower Metastable State E₁ to E₀ state is called Non radiative Transition

Applications:-

→ Nd-YAG Laser used in cutting, welding etc

→ It is used in Military for

→ It is used in Medical field Endoscopy.

→ It is used in teeth whitening process

→ It is used in Industrial purposes.

Uses:-

→ Nd-YAG Laser is used to Communicate for long distances

→ Nd-YAG Laser gives high quality output of 1064 nm.

→ It gives the proper cutting and well.

B. Sai Vyshnavi
23C11A6691 (1)
AIML-B AP.

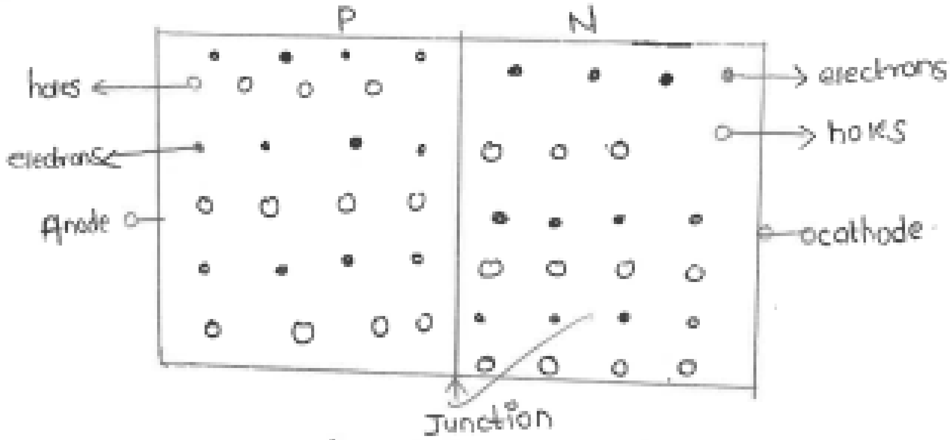
5

Applied physics.

1. Describe the formation of PN junction diode and explain the I-characteristics of PN junction diode in forward and reverse bias conditions.

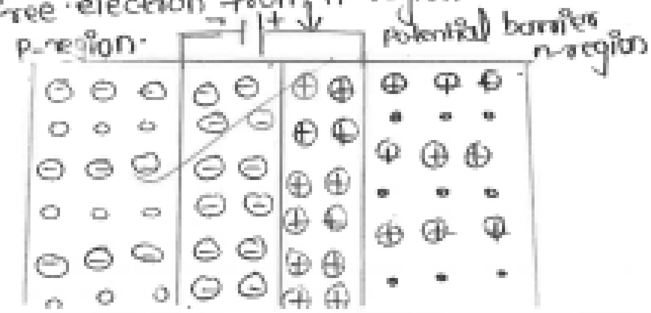
PN junction diode.

when a layer of p-type semiconductor material is joined with the layer of n-type semiconductor meterial the atoms of p-type combine with the atoms n-type at the surface of contact such surface junction where combination has occurred is called PN junction.



Formation of P-N junction diode:=

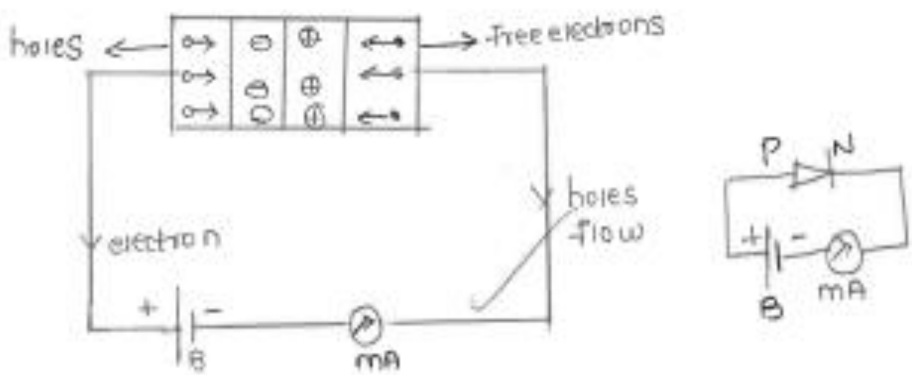
when a n-type and p-type semiconductors are brought together in the region of conductor the free electron from n-region combine with holes in p-region.



- Due to this the boundary near the n-region is positively charged. and p-region is negatively charged.
- As a result electric field EB appears on either side of the junction This region is called depiection region.
- Due to the electric field EB potential difference appears across the depiection the potential VB is called barrier potential or junction barrier.

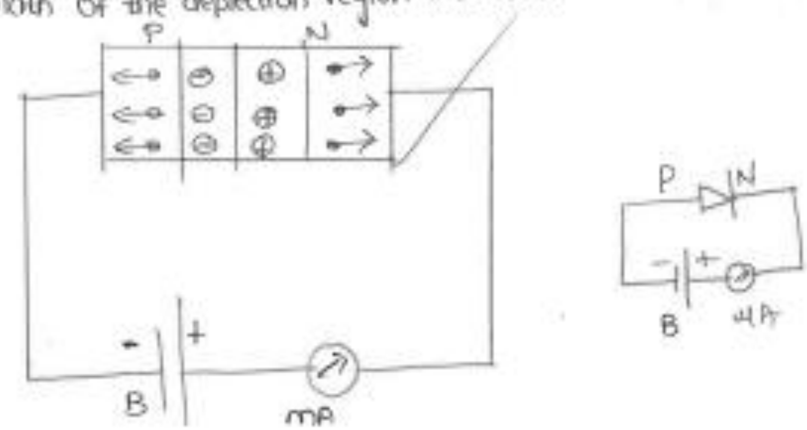
P-N junction under forward bias:-

The width of the depiection region reduced.

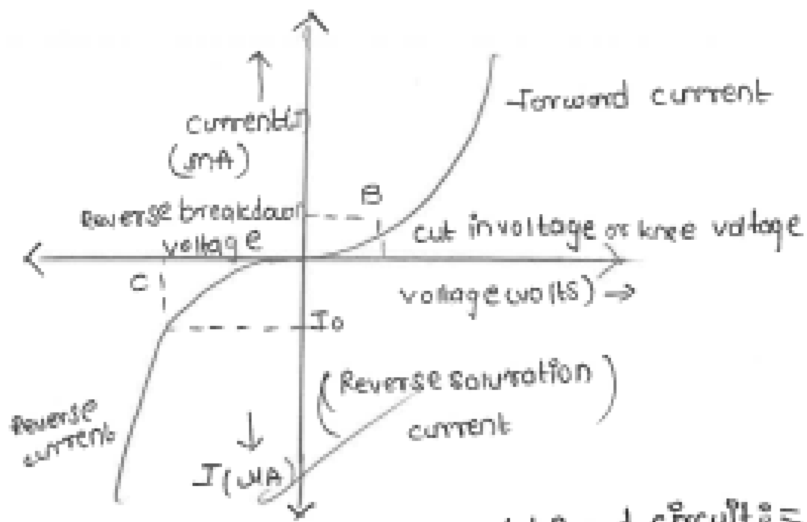


P-N junction under reverse bias:-

The width of the depiection region increases.



I-V characteristics of PN Junction.



I-V characteristics of PN junction in forward biased circuit:-

In forward biased circuit small increases of applied voltage larg increase of circuit current is called forward current when the applied voltag V is above the barrier potential the forward current increase linearly with the applied voltage.

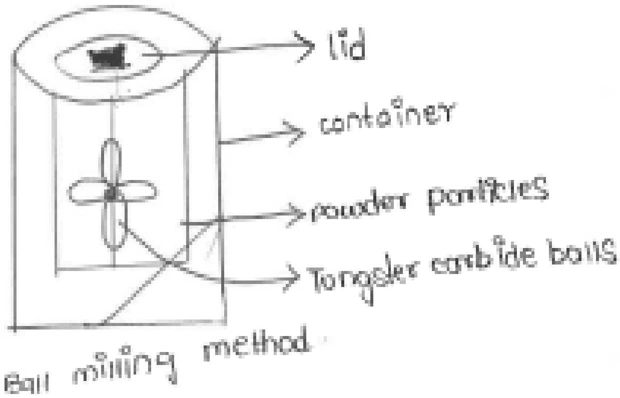
I-V characteristics of PN junction in Reverse biased circuit.

In Reverse biased condition a slight reverse current (in μA) flows in the circuit even for large increase in bias voltage There is negligible increase in reverse current.

IV - NaNo Technology

1. Describe ball milling method used for nanoparticle synthesis

Ball milling:-



- simplest method
- Hardened steel or tungsten carbide balls are put in containers along with powder or flakers (<50m) of a materials of interest
- container is closed with tight lids
- usally 2:1 mass ratio of balls to material is advisable
- larger balls used for milling produce smaller grain size but larger defects in the particles A temperature rise in the range of 100-1100°c is expected to the place during the collisions.
- The containers are rotated at high speed around their own axis
- when the containers are rotating around the central axis is forced is forced to the walls and is pressed against the walls.
- Some of the materials like Co, Cr, W, Ni-Ti; Al-Fe and Ag-Fe are made nanocrystaline using ball mill.

Applications of Ball milling.

(3)

- This method is usfull in the preparation of elemental and metal oxi nonocrystals such as co/cr AlFe AgFe and Fe
- A variety is usefull in intermetalic compounds of Ni and Al can formed
- The method is usefull in producing new types of building material fireproof materials glass ceramic etc.

(2) what are the applications of nano materials

Application of nanomaterials.

- Environmental
- Textiles
- Health care
- Biomedical
- Industrial
- Agriculture
- electronics
- Renewable energy.

material Technology

- cutting tools made of nanocrystaline materials are much harder much more wear-resistant and last longer
- Nanocrystalline materials are used for high energy density batteries
- Nanoengineered membranes could potentialy lead to more energy efficient water purification processes.

Information Technology

- Nanoscale fabricated magnetic materials are used is data storage

Nanocrystalline light emitting phosphers are used for flat panel displays.

- Nanoparticles are used for information stroage.
- Nanophotonic crystals are used in chemical optical computers
- Nano thickness controlled cooling are used in opteelectronic devices.

Bio medicals:-

- Biosenstive nano materials are used for tagging of DNA and DNA chip
- in the medical field nanomaterials are used for disease diagnosis drug delivery and molecular imaging
- Nanostructured ceramics readily interach with bove cells and hence are used as implant material.

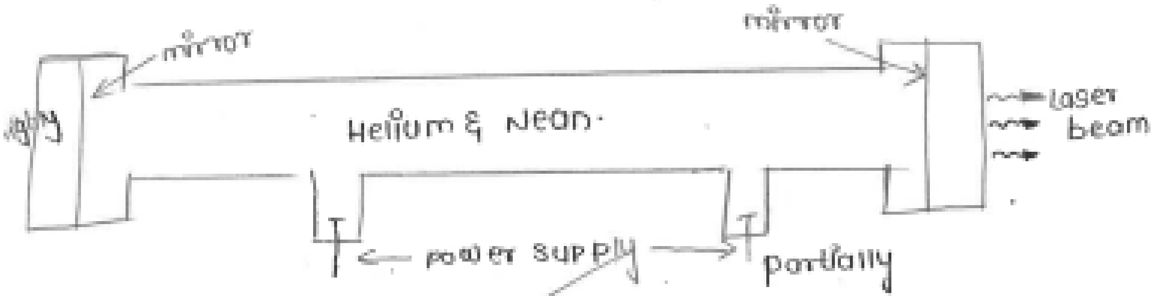
energy storage.

- Addition of nanoparticles to diesel fuel improves fuel economy by reducing the degradation of fuel consumption.
- Nanoparticles are used in hydrogen storage devices.
- Nanoparticles are used in magnetic refrigration
- metal nanoparticles are usefull in fabrication of ionic batteries.

V lasers and optical fibers:=

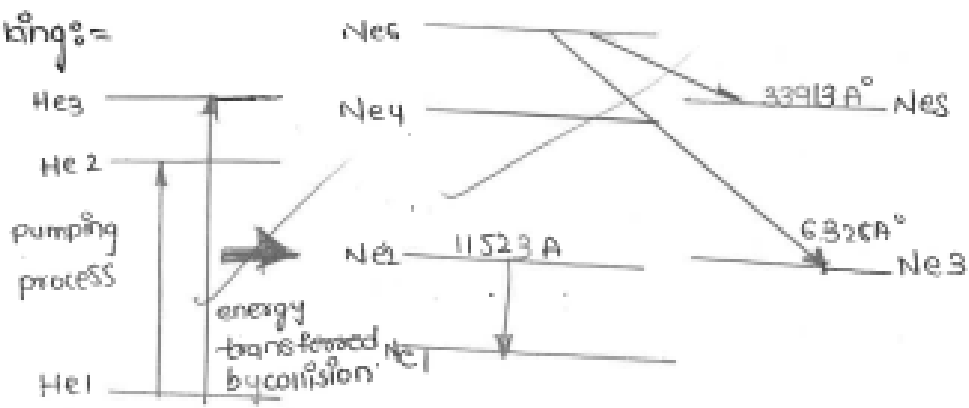
(1) Explain the construction and working of He-Ne laser with neat sketch.

construction of He-Ne lasers:=



- consists of a glass tube of length 10-100cm and a narrow diameter of about 2-10mm.
- The tube contains the mixture of helium and neon gases
- one end of the glass tube is highly silvered whereas other is partially silvered
- Two electrodes are inserted in the tube to give high power to achieve population inversion by electric discharge method.

working:=

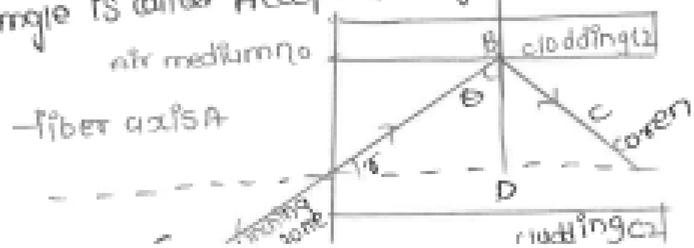


- A high voltage is applied across the electrodes to ionize the gas.
- Due to high concentration of the He atoms the probability of collision of electron and ions with He atoms is higher than that with Ne atoms.
- As a result He atoms reach the higher energy states.
- Some of the excited He atoms collide with Ne atoms and transfer their energy to the atom which excite to Ne_4 and Ne_6 levels to achieve population inversion.
- Ne_3 Ne_4 Ne_6 all are the metastable states for Ne atoms.
- The radiation from lower metastable Ne_2 state to the ground to state Ne is non-radiative transition.
- Optical elements placed insides the laser system are used to absorb the infrared laser wave lengths 3.39 μm and 1.15 μm.
- Output of He-Ne laser contains only a single wave length of 6328Å

(2) Deduce the expression for NA and acceptance angle of an optical fiber

Acceptance angle:-

This maximum angle of launch at air-core interface for which the angle at core-cladding interface equals to critical angle is called Acceptance angle.



(5)

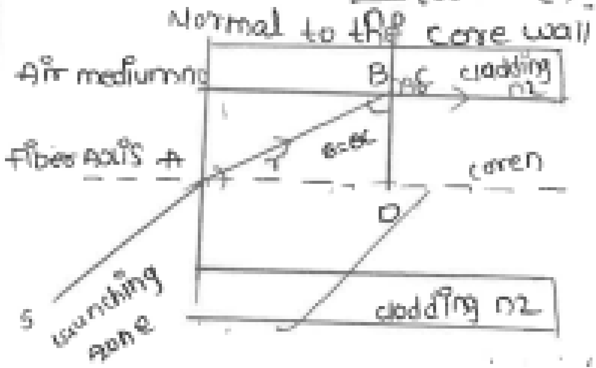
from the ΔABD; $r+\theta+90^\circ=180^\circ$

$$r=90-\theta \quad \text{---(1)}$$

According to snells law $n_0 \sin i = n_2 \sin r$ ---(2)

from eqn (2) & (1) $n_0 \sin i = n_2 \sin(90-\theta)$

$$\sin i = \frac{n_2}{n_0}\cos\theta \quad \text{---(3)}$$



Light ray incident at critical angle to at core - cladding interface.

when $i = i_{max}$ and $\theta=\theta_c$

$$\sin i_{max} = \frac{n_1}{n_0}\cos\theta_c \quad \text{---(4)}$$

applying snell's law at core and cladding interface

$$n_1 \sin\theta_c = n_2 \sin 90$$

$$\sin\theta_c = \frac{n_2}{n_1} \quad \text{---(5)}$$

we know that $\cos\theta_c = \sqrt{(1-\sin^2\theta_c)}$ ---(6)

from eqn's (4)(5) & (6)

$$\sin i_{max} = \frac{n_1}{n_0}\sqrt{\left(1-\frac{n_2^2}{n_1^2}\right)}$$

$$\sin i_{max} = \frac{\sqrt{n_1^2-n_2^2}}{n_0}$$

$$i_{max} = \sin^{-1}\left(\frac{\sqrt{(n_1^2-n_2^2)}}{n_0}\right)$$

above equation represents the acceptance angle.

Numerical Aperture(NA):=

Numerical aperture is defined as the sine the of the acceptance angle it is a measure of light that can be accepted by the fiber.

$$NA = \sin(i_{max})$$

$$NA = \sin\left(\sin^{-1}\left(\frac{\sqrt{n_1^2 - n_2^2}}{n_0}\right)\right)$$

$$\therefore NA = \frac{\sqrt{n_1^2 - n_2^2}}{n_0}$$

for air $n_0 = 1$

$$NA = \sqrt{(n_1^2 - n_2^2)}$$

Numerical aperture is dependent on refractive indices of core and cladding

3. write the applications of laser and optical fibers?

Applications of laser:=

1. Medicine:= lasers are used in various medical procedures such as layer eye surgery dermatology dental treatments and cancer therapy

2. Manufacturing:= lasers are used in industries for cutting welding and drilling various materials such as metals plastics and ceramics They are also used for making and engraving on materials.

3. communications:= laser are used in fiber optic communication systems for transmitting data over long distances They are also used in CD/DVD players and barcode scanners.

4. Military and Defence:= laser are used in rangefinders target designators and missile guidance systems.

5. scientific Research:= lasers are used in Spectroscopy for the analysis of matter and its composition They are also used in interferometry for precise measurements of distance. angles and shapes intertainment lasers are used in light to shows and performances create stunning displays of light and color.

7 Environment monitoring:= laser and used in LIDAR systems for mapping the earths surface and monitoring changes in topography

Application of optical fibers:-

1. Telecommunications:= optical fibers are widely used in telecommunication for data transmission providing providing high-speed internet and voice communication services.

2. Medical Equipment:= optical fibers are used in medical equipment such as endoscopes fibre-optic lasers and illuminators for surgeries.

3. sensing and monitoring:= optical fiber are used for sensing and monitoring applications such as structural health monitoring temperature sensing and chemical analysis.

4. Industrial process control := optical fibers are used in industric process control to transmit signals and data between control system and sensors.

5. Military and Defense: optical fibers are used in military and defense applications such as communication system and optical target acquistion.

6. scientific Research: optical fibers are used in scientific Research for spectroscopy sensing and illumination applicatio

7. lighting := optical fibers are used in lighting design providing flexible and creative lighting solution

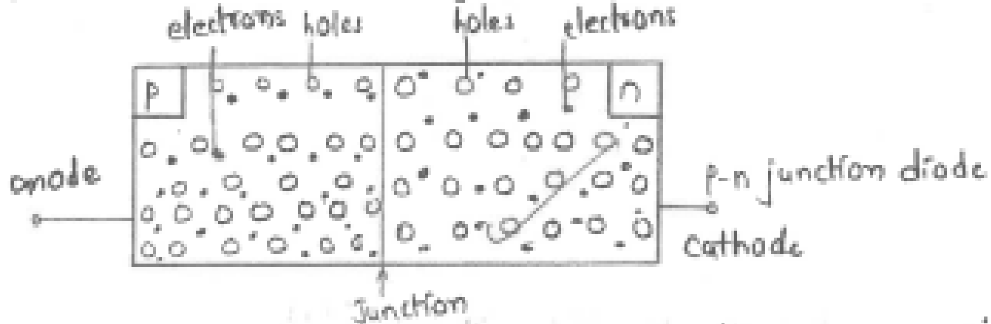
Automotives := optical fibers are used in automatic applicatio such as in car entertainment and communication system.

Assignment - III (B)

J. Neha Sri AIML-B 23C11A6668

1. Describe the formation of PN Junction diode and explain the I-V characteristics of PN junction diode in forward and reverse bias conditions.

When a layer of p-type semiconductor materials is joined with a layer of n-type semiconductor material, the atoms of p-type combine with the atoms of n-type, at the surface of contact, such surface junction, where combination has occured is called "P-N junction".



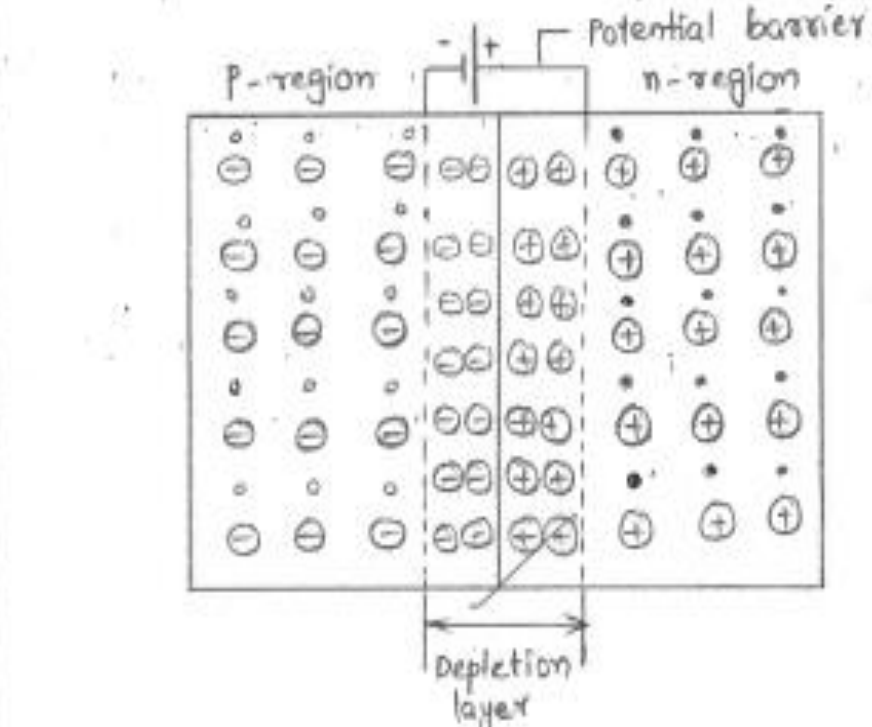
Formation of P-N junction :

→ When a n-type and p-type semiconductors, are brought together in the region of contact, the free electrons from n-region combine with holes in p-region.

→ Due to this the boundary near the n-region is positively charged and p-region is negatively charged.

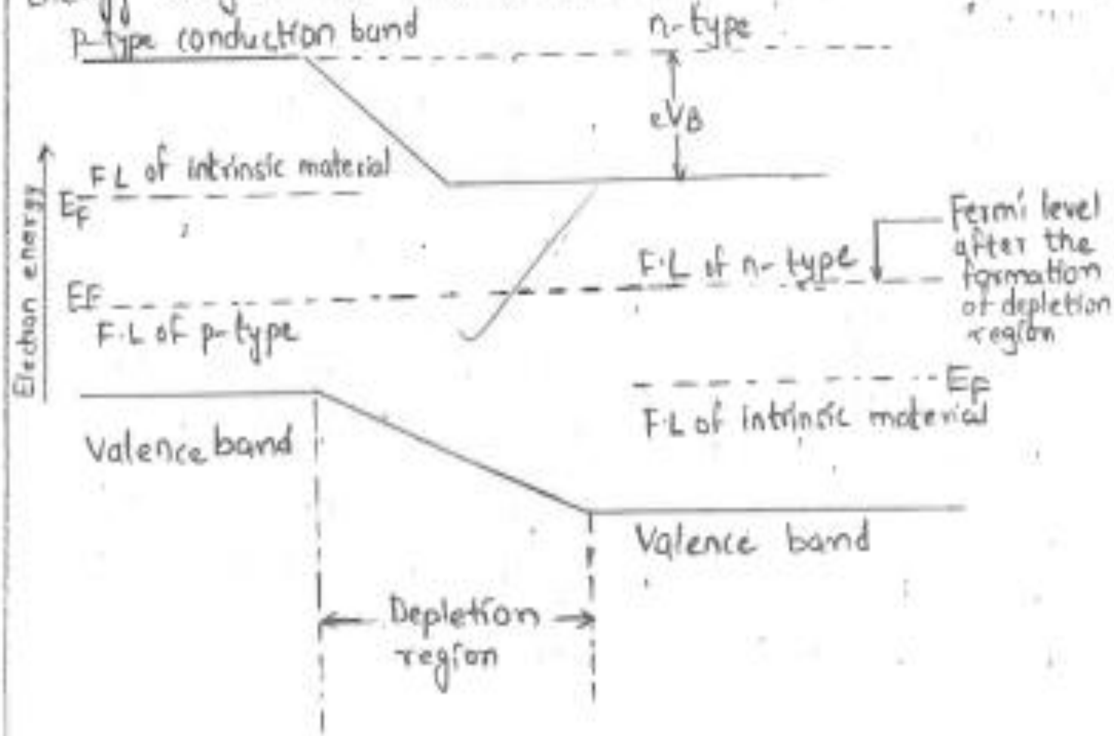
→ As a result, electric field E_B appears on either side of the junction, This region is called 'depletion region'.

→ Due to the electric field E_B, potential difference appears across the depletion region. This potential V_B is called 'barrier potential' or 'junction barrier'.



Formation of depletion layer in p-n diode

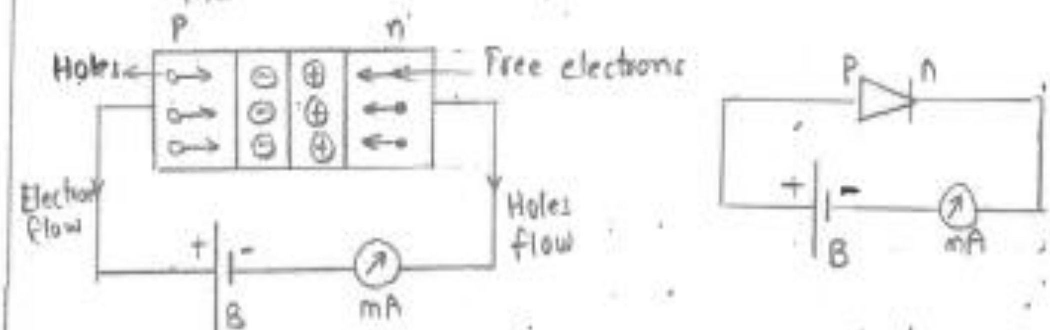
Energy Diagram of PN Junction Diode



Energy diagram of p-n diode

P-N junction under Forward bias

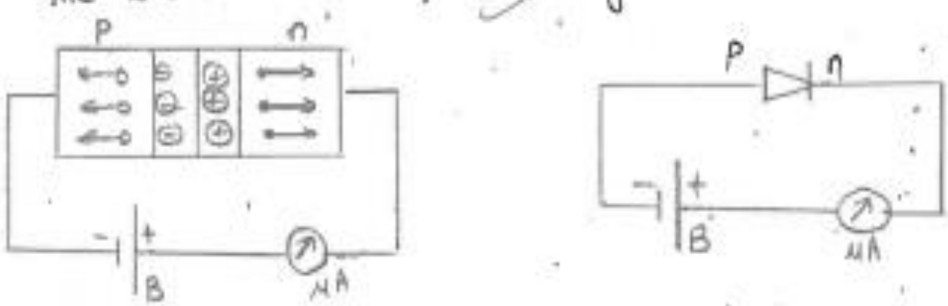
The width of the depletion region reduced



Forward biasing of a p-n junction diode.

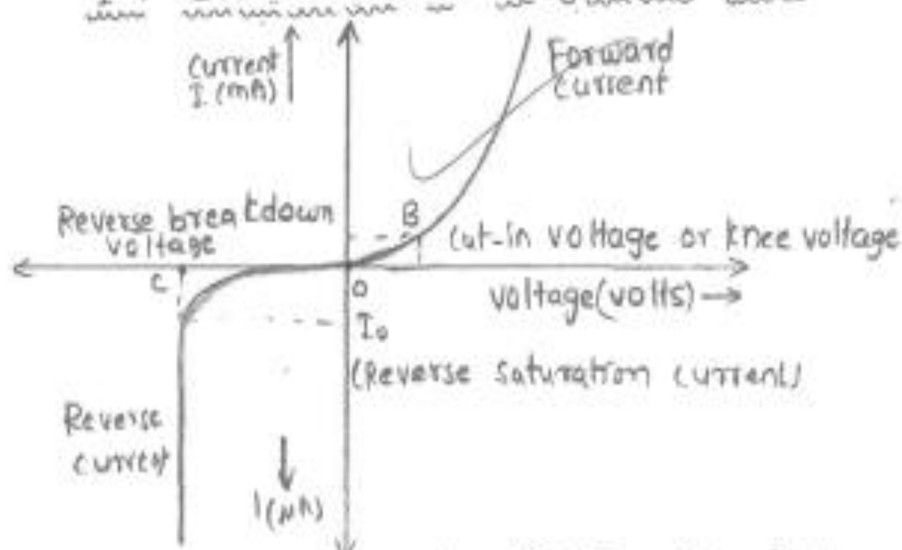
P-N junction under reverse bias

The width of the depletion region increases.



Reverse biasing of a P-n junction diode

I-V characteristics of PN Junction diode



V-I characteristics of a P-n Junction diode

Forward biased circuit :-

In forward biased circuit, small increase of applied voltage large increase of circuit current is called forward current. When the applied voltage 'v' is above the barrier potential, the forward current increases linearly with the applied voltage.

Reverse biased circuit :-

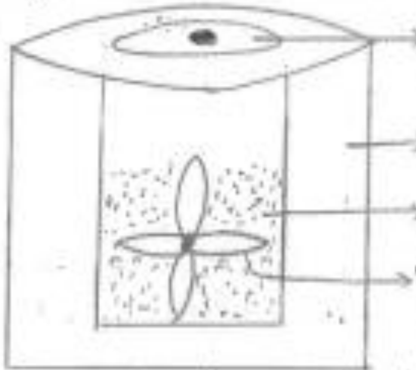
In Reverse biased condition, a slight reverse current (in μA) flows in the circuit. Even for large increase in bias voltage, there is negligible increase in Reverse current.

Applications of PN Junction Diode :-

- P-N junction diode can be used as a photodiode.
- As power or rectifier diodes. They convert ac current into dc current for dc power supplies of electronic circuits.
- As signal diodes in communication circuits for modulation and demodulation of small signals.
- It is used as rectifier in many electric circuits and as a voltage-controlled oscillator in varactors.
- In logic circuits used in computers.

J. Neha Sri   Unit-IV AP Assignment   AIML-B   23C11A6668

Describe ball milling method used for nanoparticle system.



Ball milling method

→ Simplest method
→ Hardened steel or tungsten carbide balls are put in containers along with powder or flakes (<50m) of a material of Interest
→ container is closed with tight lids
→ Usually 2:1 mass ratio of balls to material is advisable
→ Larger balls used for milling produce smaller grain size but larger defects in the particles.
→ A temperature rise in the range of 100-1,100°c is expected to take place during the collisions.
→ Lower temperatures favour amorphous particle formation.
→ The containers are rotated at high speed (a few hundreds of rpm) around their own axis.
→ Additionally they may rotate around some central axis and are therefore called as planetary ball mill.
→ When the containers are rotating around the central axis as well as their own axis, the material is forced to the walls and is pressed against the walls.
→ By controlling the speed of rotation of the central axis and container as well as duration of milling it is possible to ground the material to fine powder (few nm to few tens of nm) whose size can be quite uniform.

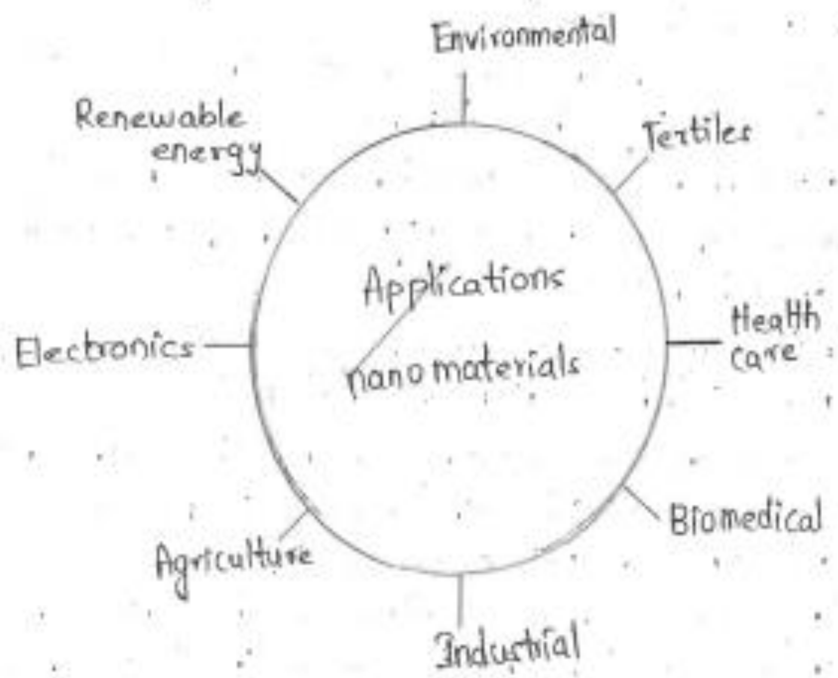
→ Some of the materials like Co, Cr, W, Ni-Ti, Al-Fe and Ag-Fe are made nanocrystalline using ball mill.

→ Few milligrams to several kilograms of nanoparticles can be synthesized in a short time of a few minutes to a few hours.

Applications of Ball milling

1. This method is useful in the preparation of elemental and metal oxide nano crystals such as Co, Cr, Al Fe, Ag Fe and Fe.
2. A variety of intermetallic compounds of Ni and Al can be formed.
3. This method is useful in producing new types of building materials, fireproof materials, glass ceramics, etc.

What are the applications of nano materials



Material Technology :-

* Cutting tools made of nanocrystalline materials are much harder, much more wear-resistant, and last longer.
* Sensors made from nanocrystalline materials are sensitive to changes in their environment. Thus, they are used for smoke detectors, ice detectors on aircraft wings, etc.
* Nanocrystalline materials are used for high energy-density batteries.
* Nanoengineered membranes could potentially lead to more energy efficient water-purification processes.

Information Technology

* Nanoscale-fabricated magnetic materials are used in data storage.
* Nanocrystalline light-emitting phosphors are used for flat panel displays.
* Nanoparticles are used for information storage.
* Nanophotonic crystals are used in chemical optical computers.
* Nano thickness-controlled coating are used in opto electronic devices.

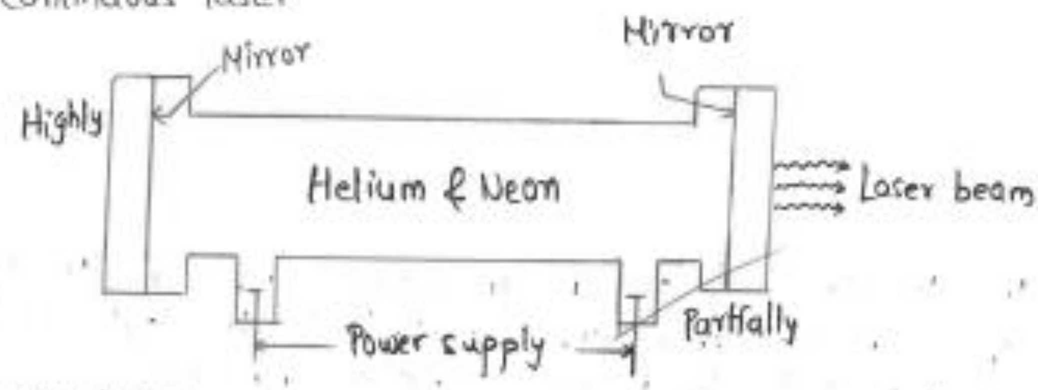
Bio-medicals

* Nanocrystalline silicon carbide is used for artifical heart valves due to its low weight, high strength and inertness.
* Biosensitive nanomaterials are used for tagging of DNA and DNA chips.
* In the medical field, nanomaterials are used for disease diagnosis, drug delivery and molecular imaging.

J. Neha Sri AP Unit-5 Assignment AIML-B 23C11A6668

1. Explain the construction and working of He-Ne Laser with neat sketch.

* Fabricated by Ali Javan and R. Bennett
* The gas laser based on four-level laser systems
* Used a mixture of He and Ne in the ratio of 10:1 or 7:1 at a low pressure
* Continuous laser



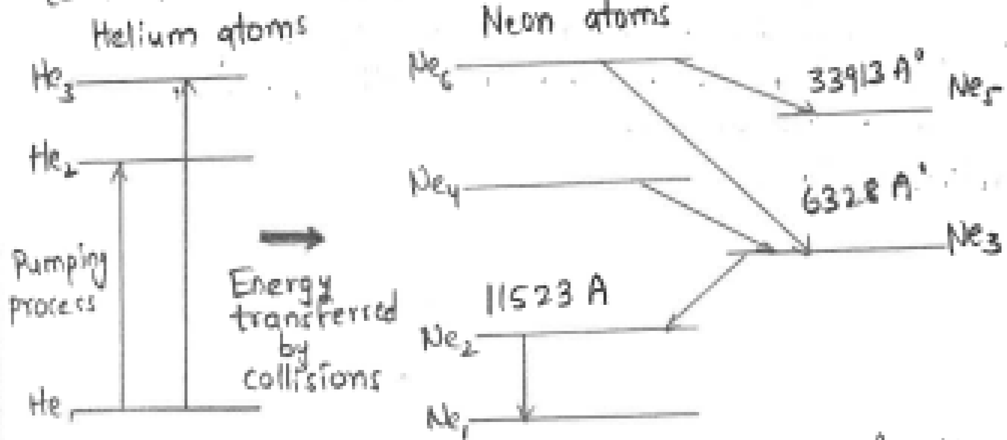
Construction :-

* Consists of a glass tube of length 10-100 cm and a narrow diameter of about 2-10 mm.
* The tube diameter contains the mixture of helium and neon gases.
* One end of the glass tube is highly silvered whereas other is partially silvered
* Two electrodes are inserted in the tube to give high power to achieve population inversion by electric discharge method.

Working :-

* A high voltage is applied across the electrode to ionize the gas
* Due to high concentration of He atoms, the probability of collision of electron and ions with He atoms is higher than with Ne atoms.

* As a result, He atoms reach the higher energy states
* Some of the excited He atoms collide with Ne atoms and transfer their energy to Ne atoms which excite to Ne_4 and Ne_6 levels to achieve population inversion



* Ne_2, Ne_4, Ne_6 all are the metastable states for Ne atoms.
* The radiation from lower metastable Ne_2 state to the ground state Ne is non-radiative transition.
* Optical elements placed insides the laser system are used to absorb the infrared laser wave lengths 3.39 μm and 1.15 μm.
* Output of He-Ne laser contains only a single wave length of 6328 A°.

Advantages of He-Ne laser:-
* He-Ne laser emitts laser light in the visible portion of the spectrum.
* High stability and low cost
* Operates without damage at higher temperatures.

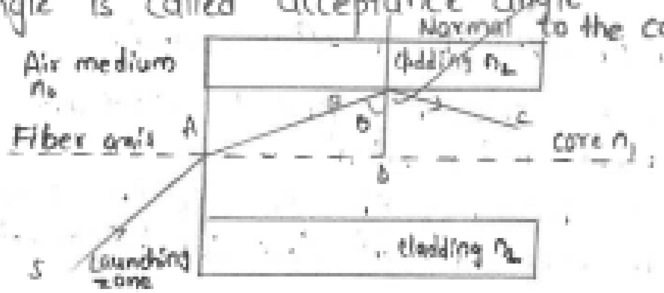
Limitations of He-Ne laser:-
* Low efficiency
* Low gain
* He-Ne lasers are limited to low power tasks

Applications of helium-neon lasers:-

* Barcode scanners
* Tool alignment
* Non-contact measuring and monitoring
* Blood analysis
* Particle counting and food sorting
* Alignment of high power CO_2 and YAG treatment lasers and pointing beams.

Deduce the expression for NA and acceptance angle of an optical fiber

The maximum angle of launch at air-core interface for which the angle at core-cladding interface equals to critical angle is called acceptance angle.



Propagation light ray through optical fiber.

From Snell's law

$n_2 \sin\theta_2 = n_1 \sin\theta_1$ — ①

from ①

$n_1 \sin\theta_c = n_2 \sin 90^\circ = n_2$

$\sin\theta_c = \frac{n_2}{n_1}$ — ②

From the ΔABD; $r + \theta + 90^\circ = 180^\circ$

$r = 90^\circ - \theta$ — ③

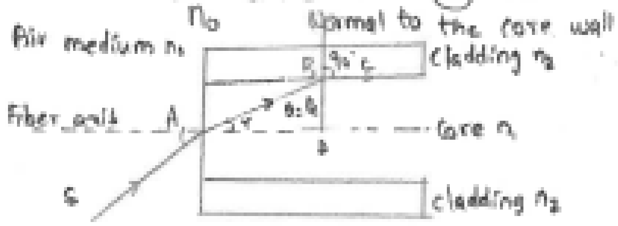
According to Snell's law

$n_0 \sin i = n_1 \sin r$ — ④

From equations ③ and ④

$n_0 \sin i = n_1 \sin(90^\circ - \theta)$

$\sin i = \frac{n_1}{n_0} \cos\theta$ — ⑤



Light ray incident at critical angle at core-cladding interface

When, $i = i_{max}$ and $\theta = \theta_c$

$$\sin i_{max} = \frac{n_1}{n_0}\cos\theta_c \quad \text{—⑥}$$

Applying Snell's law at core and cladding interface

$$n_1 \sin\theta_c = n_2 \sin 90^\circ$$

$$\sin\theta_c = \frac{n_2}{n_1} \quad \text{—⑦}$$

we know that $\cos\theta_c = \sqrt{(1-\sin^2\theta_c)}$ —⑧

From ⑥,⑦ and ⑧ equations

$$\sin i_{max} = \frac{n_1}{n_0}\sqrt{\left(1-\frac{n_2^2}{n_1^2}\right)}$$

$$\sin i_{max} = \frac{\sqrt{(n_1^2-n_2^2)}}{n_0}$$

$$i_{max} = \sin^{-1}\left(\frac{\sqrt{n_1^2-n_2^2}}{n_0}\right)$$

above equation represents the acceptance angle

A cone whose semi vertex angle is equal to acceptance angle (i_{max}) is known as acceptance cone

Numerical aperture is defined as the sine of the acceptance angle. It is a measure of light that can be accepted by the fiber

$$NA = \sin(i_{max})$$

$$NA = \sin\left(\sin^{-1}\left(\frac{\sqrt{(n_1^2-n_2^2)}}{n_0}\right)\right)$$

$$\therefore NA = \frac{\sqrt{(n_1^2-n_2^2)}}{n_0}$$

For air, $n_0 = 1$

$$NA = \sqrt{(n_1^2-n_2^2)}$$

Numerical aperture is dependent on refractive indices of core and cladding.

3. Write the applications of lasers and Optical fibers

Applications of lasers:

1. Medicine :- Lasers are used in various medical procedures such as laser eye surgery, dermatology, dental treatments and cancer therapy.

2. Manufacturing :- Lasers are used in industries for cutting, welding and drilling various materials such as metals, plastics and ceramics. They are also used for marking and engraving on materials.

3. Communication :- Lasers are used in fiber optic communication systems for transmitting data over long distances. They are also used in CD/DVD players and barcode scanners.

4. Military and Defence :- Lasers are used in rangefinders, target designators, and missile guidance systems.

5. Scientific Research :- Lasers are used in spectroscopy for the analysis of matter and its composition. They are also used in interferometry for precise measurements of distance, angles and shapes.

6. Entertainment :- Lasers are used in light shows and performances to create stunning displays of light and color.

7. Environmental Monitoring :- Lasers are used in LIDAR system for mapping the Earth's surface and monitoring changes in topography.

Applications of Optical fibers:

1. Telecommunications :- Optical fibers are widely used in telecommunications for data transmission, providing high-speed internet and voice communication services.

2. Medical Equipment :- Optical fibers are used in medical equipment such as endoscopes, fiber-optic lasers, and illuminators for surgeries.

3. Sensing and Monitoring :- Optical fibers are used for sensing and monitoring applications, such as structural health monitoring, temperature sensing and chemical analysis.

4. Industrial Process Control :- Optical fibers are used in industrial process control to transmit signals and data between control systems and sensors.

5. Military and Defence :- Optical fibers are used in military and defense applications such as communication systems and optical target acquistion.

6. Scientific Research :- Optical fibers are used in scientific research for spectroscopy, sensing and illumination applications.

7. Lighting :- Optical fibers are used in lighting design providing flexible and creative lighting solutions.

8. Automotive :- Optical fibers are used in automotive applications, such as in-car entertainment and communication systems.

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Affiliated to JNTUH, Hyderabad, Accredited by NAAC with A+ Grade)

Ananthagiri (V & M), Kodad, Suryapet (Dist), Telangana.

Program			YEAR	SEMESTER	MID EXAMINATION
✓ B.Tech.	M.Tech.	M.B.A.	I	II	II

HALL TICKET NO.: 2 3 C 1 1 A 6 6 1 3

Regulation: R-22 Branch or Specialization: AIML

Course: Applied Physics

Signature of Student: V. Bhavitha

Signature of Invigilator with date: [signature]

Signature of the Evaluator: [signature]

Q.No. and Marks Awarded

1	2	3	4	5	6	7	8	9	10	11

Maximum Marks: 30 Marks Obtained: 30

(Start Writing From Here)

Part-A

1) A
2) B
3) D
4) D
5) C
6) D
7) D
8) C
9) D
10) A

10

Part-B

1) Photo Diode is a p-N Junction Diode which converts light (photon) to electric current.
The working of photo Diode is opposite to the Light emitting Diode.
photo Diode works in reverse bias condition.
Examples are Si, Ge.

Working:

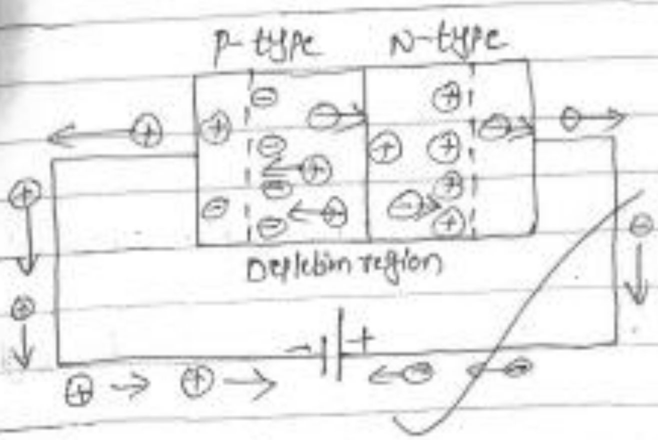
when light is falls on the photodiode. photons absorb energy and in exited electrons move from valence band to conduction band.

⇒ the energy of photon greater than energy band gap of semiconductor material, electron-hole pair created at depletion region and these known as photo carriers.

⇒ the electron-hole pair created and seperated before conduction due to electric field.

⇒ the direction of electric field, movement of electrons towards n-side and holes towards p-side. As number of increases in electrons and holes electromotive force is observed.

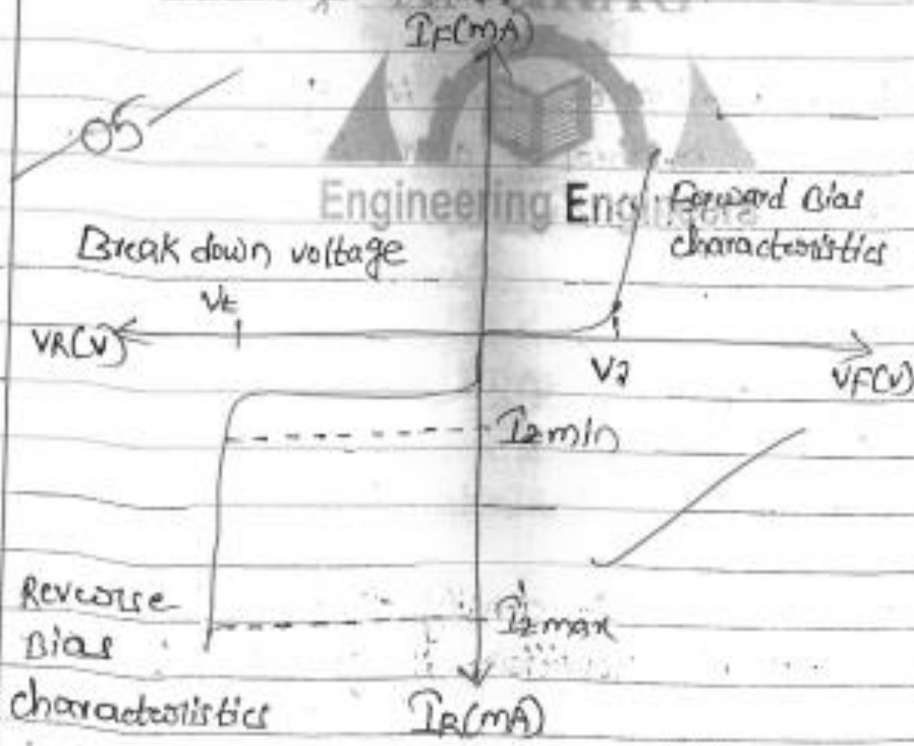
⇒ Electromotive force is large then more current produces. the magnitude of electromotive force is depends incident of intensity light with change in photocurrent by change in intensity light we can observe when it is in reverse Bias.



characteristics:

(12) Zener Diode is heavily doped p-N Junction Diode. If reverse Bias voltage is less than Break down voltage or if it is Forward bias acts as an ordinary Diode. then the forward bias allows electric current to flow and reverse bias blocks current from flowing.

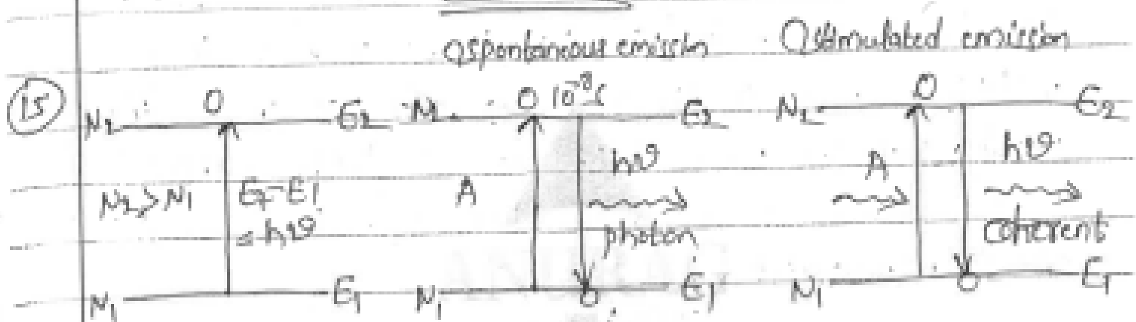
V-I characteristics:



Difference between p-N Junction Diode & Zener Diode

p-N Junction Diode	Zener Diode
1) It is operated in Forward biased condition.	1) It is operated in reverse Breakdown condition.
2) electric current flows in only one Direction.	2) Electric current flows in both Directions.
3) It is used for Rectification.	3) It is used for voltage Regulation.

(15)



Let 'N_1' be the number of atoms in ground state and 'N_2' be the number of atoms in exited state

By Boltzman's Kinetics

$$N_1 = N_0 e^{-E_1/K_BT}$$

$$N_2 = N_0 e^{-E_2/K_BT}$$

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

$$\frac{N_1}{N_2} = e^{h\nu/K_BT}$$

let $u(\nu)$ is the energy density of incident radiation in case of upward Transition. is given by $\alpha \cdot N_1 u(\nu)$

Probability of upward Transition in case of absorption

Probability of downward Transition is

$A_{21} N_2 + B_{21} N_2 u(\nu)$.

Here 'A_{21}' is Einstein coefficient for spontaneous emission and 'B_{21}' is Einstein coefficient for stimulated emission.

At equilibrium both are equal

$$N_1 u(\nu) B_{12} = A_{21} N_2 + B_{21} N_2 u(\nu)$$

$$u(\nu) [N_1 B_{12} - N_2 B_{21}] = A_{21} N_2$$

$$u(\nu) = \frac{A_{21} N_2}{[N_1 B_{12} - N_2 B_{21}]}$$

$$u(\nu) = \frac{A_{21} N_2}{N_2 B_{21} \left[\frac{N_1 B_{12}}{N_2 B_{21}} - 1\right]}$$

$$u(\nu) = \frac{A_{21}}{B_{21} \left[\frac{N_1}{N_2} \cdot \frac{B_{12}}{B_{21}} - 1\right]}$$

$$u(\nu) = \frac{A_{21}}{B_{21} [e^{h\nu/k_B T} - 1]}$$

According to planck's radiation law

$$\text{energy density} = \frac{8\pi h \nu^3}{c^3} \left(\frac{1}{e^{h\nu/k_B T} - 1}\right)$$

on comparing with $u(\nu)$'s

$$\boxed{\frac{A_{21}}{B_{21}} = \frac{8\pi h \nu^3}{c^3}}$$

$$\boxed{B_{12} = 1}$$

Inference - 1

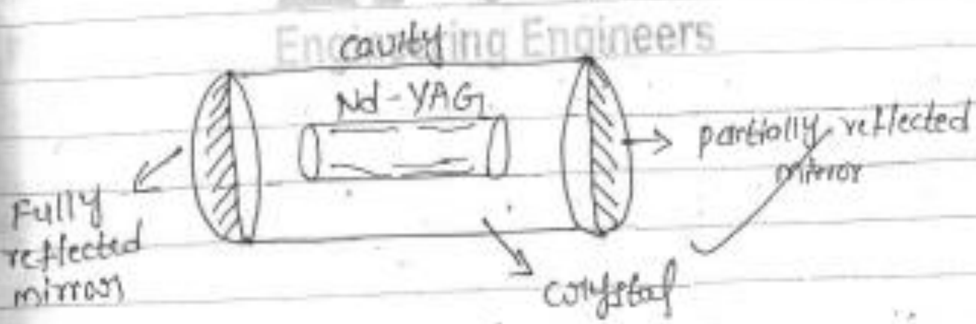
$\frac{A_{21}}{B_{21}} \propto \nu^3$

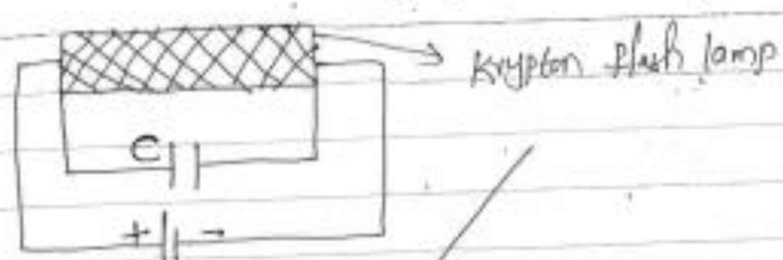
Inference - 2

$\frac{B_{12}}{B_{21}} = 1$

when atom absorb energy and goes to exited state but it should come from exited to ground state by emitting coherent.

(16) Nd-YAG Laser is deodymium based laser. Nd stands for Neodymium and YAG stands for Yttrium, Aluminium, Garnet. It is four level solid state laser.



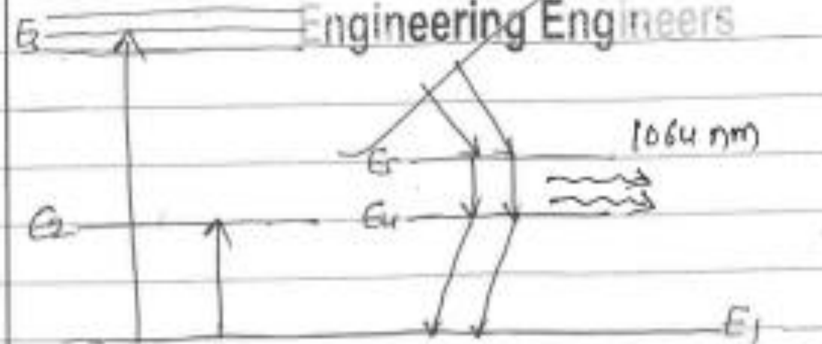


⇒ there are two mirrors one is fully reflected mirror and another is partially reflected mirror.
⇒ there is crystal which is placed in pure surrounding surface.
⇒ Krypton flash lamp is also placed illuminate the crystal.

Working:

⇒ switch on the power supply flash lamp goes and heated and then exited after goes to exited state. neodymium atoms in exited state so the population inversion is takes place in it.
⇒ the output laser come from two exited levels with wavelength 1064 nm.
⇒ the output of laser is high.

Energy level Diagram:



Limitation!

1) It generates a lot of heat.

Applications:

1) For military applications.

UNIT-I WAVE OPTICS

Huygens Principle
Superposition of waves
Interference
Coherence
Interference in thin films
Newton's Rings (T&E)

Diffraction
Fraunhoffer Diffraction
Fresnel Diffraction
Diffraction due to single slit
Diffraction Grating
Resolving power of a Grating

Polarization
Pol. by relection
Brewster's law
Double refraction
Nicol prism

Unit-I : Wave Optics

Optics is the branch of physics in which we study the nature of light and the phenomenon exhibited by it

1. Newton's corpuscular theory – Light is a particle
2. Huygen's wave theory – Light is a wave
3. Maxwell's electromagnetic theory – Light is EM wave
4. Planck quantum theory of light – Light is a Photon

Introduction

Wave:

A wave is a disturbance in a medium that carries energy without a net movement of particles

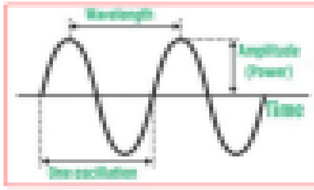
The characteristics /properties of waves are 1) Amplitude 2) Time period
3) Frequency 4) Wavelength 5)Phase 6)Intensity.

Particle:

A particle is a point in space which has mass & occupies space or region

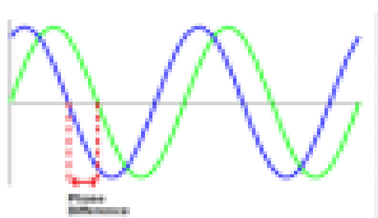
The characteristics/properties of a particle are
1) Mass 2) velocity 3) Momentum 4) Energy etc.

Characteristics of Wave



- **Amplitude (A):** Amplitude is the maximum displacement of the elements of the medium from their equilibrium positions as wave passes through them.
- **Phase (ϕ):** Phase of a wave describes the state of motion as the wave sweeps through an element at a particular position.
- **Wavelength(λ):** Wavelength is defined as the minimum distance between two consecutive crests or two consecutive troughs when in the same phase.
- **Time Period of a wave (T):** Time Period of a wave is the time taken through one complete oscillation.
- **Frequency of a wave (ν):** Frequency of a wave is defined as number of oscillations per unit time. It is denoted by ν.

Path Difference and Phase difference

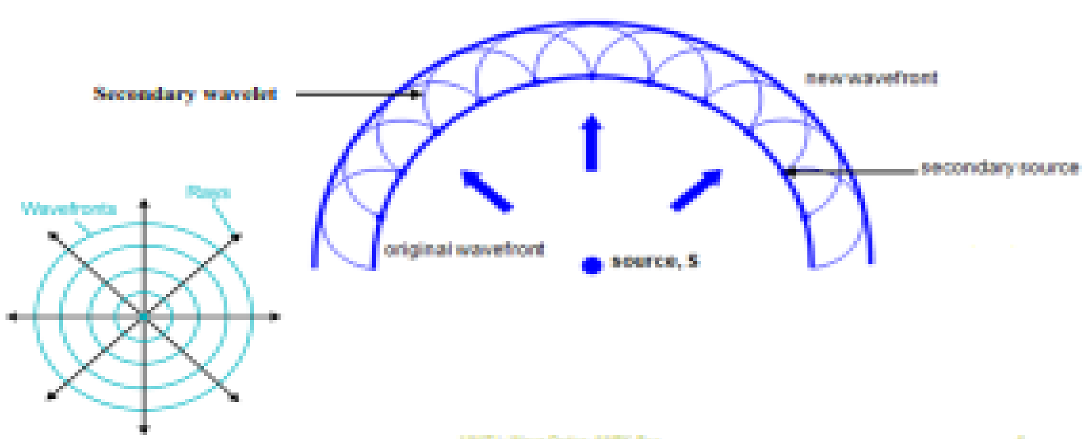


Path difference refers to ***the difference in the lengths of the paths taken by two waves*** from their respective sources to a given point.

Phase difference refers to ***the difference in their position within their respective cycles***.

$$\text{Phase Difference (rad)} = \frac{(2\ \pi)(\text{Path difference in m})}{(\lambda \text{ in m})}$$

Wavelet and wave front



Huygen's Principle

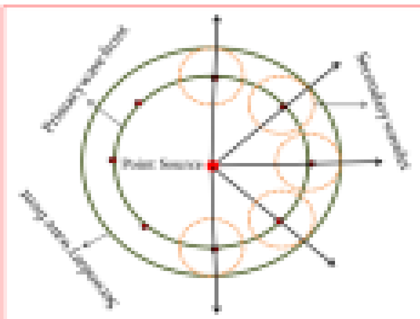
- Proposed by Christiaan Huygens in 1678
- Statement:

Every point on a wave front is in itself the source of spherical wavelets which spread out in the forward direction at the speed of light. The sum of these spherical wavelets forms the wave front".

Examples of Huygen's Principle

- If a stone is thrown into the river it will create waves around that point.
- These waves look like circular rings and are called wave front waves.
- Gradually, the wave fronts disperse in all directions.

Huygen's Principle



Assumptions

- Secondary wavelets amplitude is maximum in forward direction and is zero in backward direction
- Surface touching the secondary wavelets tangentially in forward direction gives the direction of secondary wave front.

Huygen's Principle

Advantages:

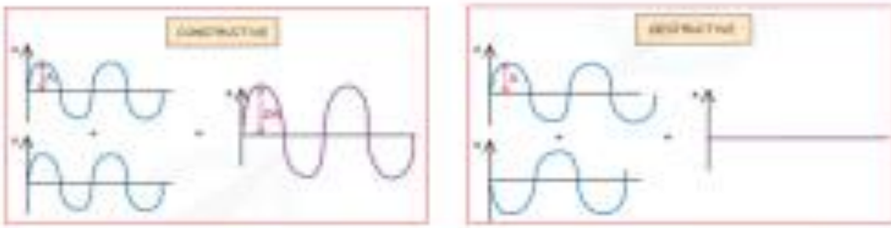
- Huygens concept proved the reflection and refraction of light.
- The concepts like diffraction of light, as well as interference of light, were proved by Huygens.

Disadvantage:

- Concepts like emission of light, absorption of light and polarisation of light were not explained by Huygens principle.
- Huygens principle failed to explain the photoelectric effect.
- A serious drawback is that the theory proposes an all-pervading medium required to propagate light called luminiferous ether. This was proved to be false in the 20th century.

Principle of superposition of waves

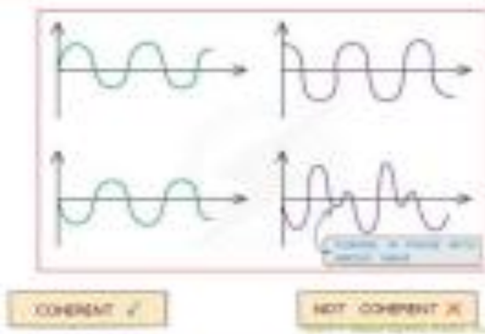
"when two or more waves with the same frequency travelling in opposite directions overlap, the resultant displacement is the sum of displacements of each wave"



Waves in superposition can undergo constructive or destructive interference

Coherence

"Two waves are said to be coherent if their waves have same wavelength, same amplitude and constant phase difference"



Interference of Light

- The modification in the intensity of light, due to the superposition of two or more wave trains is called interference.
- If the intensity is increased, we call it constructive interference and if there is reduction in intensity we call it destructive interference.

Conditions for Interference

- The two sources must emit continuous light waves are having same wavelength, amplitude and frequency.
- The two light sources should be monochromatic.
- The separation between the source and screen will be large.
- The two light sources emitting light waves should be coherent.
- The separation between the two light sources will be small.

Types of Interference

I. Constructive interference

Path difference (Δ)=nλ

i.e, integral multiple of λ (or) even multiple of λ/2

II. Destructive interference

Path difference (Δ)=(2n+1)λ/2

i.e, half integral multiple of λ (or) odd multiple of λ/2

Examples of Interference

Blue Morpho Butterfly

Soap Bubbles

Colour Patches on Wet Roads

Anti-reflective Coating

Oil on the Surface of Water

Hologram

Interference in Thin Film Due to Reflected Light

- Consider a thin film of refractive index μ and thickness t (see Fig.).
- Let a ray SA fall on the upper surface of the film at incident angle i.
- The ray is partly reflected along AE and partly refracted along AB at angle r.
- Lower surface also reflects the ray along BC and finally, the ray emerges out from the upper surface of the film along CD.
- To evaluate the path difference between AE and CD, we draw perpendiculars CF and AG on AE and BC, respectively
- The optical path difference between AE and CD is

$$\Delta = \mu(AB + BC) - AF \quad \rightarrow \quad (1)$$

Interference in Thin Film Due to Reflected Light

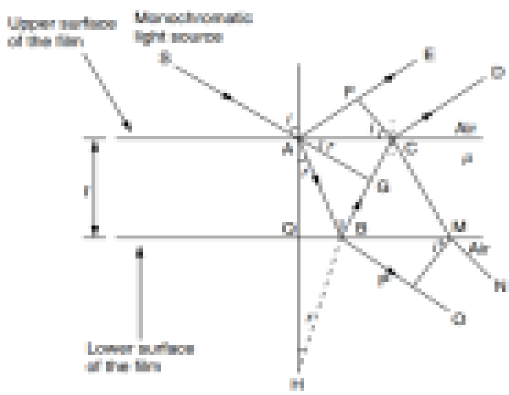


Figure Thin film interference.

From Snell's law, in triangles AFC and AGC

$$\mu = \frac{\sin i}{\sin r} = \frac{AF/AC}{CG/AC} = \frac{AF}{CG}$$

therefore we have

$$AF = \mu\, CG \quad \rightarrow \quad (2)$$

Putting the value of AF from Eq. **(2)** in Eq. **(1)** , we have

$$\Delta = \mu\,(AB + BC) - \mu\, CG$$

$$= \mu\,(AB + BC - CG) = \mu\,(HC - CG)$$

$$= \mu\, HG \quad \rightarrow \quad (3)$$

In the triangle AGH,

$$\cos r = \frac{HG}{AH} \Rightarrow HG = AH\cos r = 2t\cos r$$

(Since triangle AQB congruent triangle BQH, hence AQ = QH = 2t.) Now $\Delta = 2\mu t \cos r$. A phase change of π equivalent to a path difference of $\lambda/2$ is produced when a ray of light is reflected from the denser medium (Stokes' theorem). Therefore, the effective path difference in this case is

$$\Delta' = 2\mu t\cos r - \frac{\lambda}{2}$$

Condition for Constructive Interference

If the path difference $\Delta' = n\lambda$ where n = 0, 1, 2, 3, … then constructive interference takes place and the film appears bright in the reflected light:

$$2\mu t\cos r - \frac{\lambda}{2} = n\lambda \quad \Rightarrow \quad 2\mu t\cos r = (2n+1)\frac{\lambda}{2}$$

Condition for Destructive Interference

If the path difference $\Delta' = (2n+1)\lambda/2$, where $n = 0, 1, 2, 3, \ldots$, then destructive interference takes place and the film appears dark in the reflected light:

$$2\mu t\cos r - \frac{\lambda}{2} = (2n+1)\frac{\lambda}{2} \quad \Rightarrow \quad 2\mu t\cos r = (n+1)\lambda$$

Since n is an integer, therefore $(n+1)$ can also be taken as n. Thus

$$2\mu t\cos r = n\lambda$$

NEWTON'S RINGS

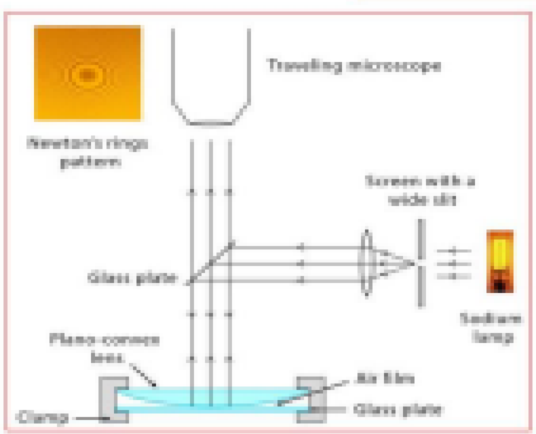
- Newton's rings have been named after English physicist and mathematician Sir Isaac Newton, who was the first to observe the effect in 1704.
- Newton's rings are a series of concentric circular rings consisting of bright- and dark-colored fringes.
- When a plano-convex lens lies on top of a plane lens or glass sheet, a small layer of air is formed between the two lenses.
- Newton's rings are formed by the interference phenomenon when monochromatic and coherent rays of light are reflected from the top and bottom surfaces of this air film.

Principle of Newton's Rings Formation

The phenomenon of the formation of Newton's rings can be explained based on the wave theory of light.

- An air film of varying thickness is formed between lens and the glass sheet.
- When a ray is incident on the surface of the lens, it is reflected as well as refracted.
- When the refracted ray strikes the glass sheet, it undergoes a phase change of 180° on reflection.
- Interference occurs between two waves that interfere constructively if path differences between them is $(m+1/2)\lambda$ and destructively if the path difference between them is $m\lambda$, thereby producing alternate bright and dark rings.

NEWTON'S RINGS



Newton's ring experiment.

Newton's Rings by Reflected Light

Fig. Formation of rings.

- Explained by Young.
- These rings are produced as a result of interference between the light waves reflected from the upper and the lower surfaces of the air film formed between the plano-convex lens and the plane glass plate as shown in Fig.

The effective path difference between the interfering rays in reflected light is

$$\Delta = 2\mu t\cos(r+\theta) - \frac{\lambda}{2}$$

For normal incidence, $r = 0$ and for a very small angle $\theta = 0$. So

$$\cos(r+\theta) = 1$$

Hence, net path difference between rays 1 and 2 is

$$\Delta = 2\mu t - \frac{\lambda}{2}$$

For constructive interference (bright ring)

$2t + \lambda/2 = n\lambda$

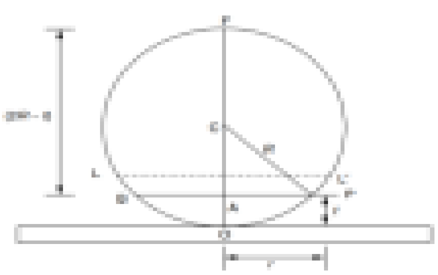
$2t = (2n-1)\lambda/2$,............(i) where n=1,2,3...

For destructive interference (dark ring)

$2t + \lambda/2 = (2n+1)\lambda/2$

$2t = n\lambda$,.............(ii) where n=0,1,2,3,...

Diameters of Dark and Bright Rings



- To evaluate the diameter of bright and dark rings, a plano-convex lens is placed on the plane glass plate.
- Let R be the radius of the curved surface of the lens and t be the thickness of the film at the certain point

Fig. Determination of diameter of Newton's ring

From the property of the circle

$$AP \times AB = OA \times AF$$

But AP = AB = r, the radius of the ring passing through P. We have

$$r^2 = t(2R - t) = 2Rt - t^2$$

In actual practice R is quite large and t is very small. Therefore t^2 may be neglected in comparison with 2Rt. Now

$$r^2 = 2Rt \Rightarrow t = \frac{r^2}{2R}$$

For **bright rings**, substituting this value of t from Eq. ( ) in Eq. ( ), we get

$$2\mu t = (2n + 1)\frac{\lambda}{2}$$

$$\Rightarrow 2\mu\frac{r^2}{2R} = (2n + 1)\frac{\lambda}{2}$$

$$\Rightarrow r^2 = \frac{(2n+1)\lambda R}{2\mu}$$

This denotes the radius of nth bright ring. Thus we have

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

If D_n is the diameter of the nth bright ring, we have

$$r_n = \frac{D_n}{2}$$

Therefore Eq. (3.40) becomes

$$\left(\frac{D_n}{2}\right)^2 = \frac{(2n+1)\lambda R}{2\mu} \Rightarrow D_n^2 = \frac{4(2n+1)\lambda R}{2\mu} \Rightarrow D_n^2 = \frac{2(2n+1)\lambda R}{\mu}$$

For air film μ = 1. So

$$D_n^2 = 2(2n+1)\lambda R \Rightarrow D_n = \sqrt{2(2n+1)\lambda R} \Rightarrow D_n = \sqrt{2\lambda R}\sqrt{2n+1} \Rightarrow D_n \propto \sqrt{2n+1}$$

As n = 0, 1, 2, 3 … (2n + 1) is an odd number, the diameters of successive bright rings are proportional to the square root of the odd natural numbers.

For **dark rings**, substituting the value of t in Eq. , we get

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

If D_n is the diameter of the nth dark ring, we have

$$r_n = \frac{D_n}{2}$$

Therefore

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

For air film μ = 1. So

$$D_n^2 = 4n\lambda R \Rightarrow D_n = \sqrt{4n\lambda R}$$

$$\Rightarrow D_n = \sqrt{4\lambda R}\sqrt{n}$$

$$\Rightarrow D_n = \sqrt{4\lambda R}$$

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

Determination of Radius of curvature of plano-convex lens

We know that the diameter of nth dark ring is given by

$$D_n^2 = 4n\lambda R$$

Diameter of $(n+p)$th dark ring is given by

$$D_{n+p}^2 = 4(n+p)\lambda R$$

From Eqs. (3.41) and (3.42), we have

$$D_{n+p}^2 - D_n^2 = 4(n+p)\lambda R - 4n\lambda R \Rightarrow D_{n+p}^2 - D_n^2 = 4p\lambda R$$

$$\Rightarrow R = \frac{D_{n+p}^2 - D_n^2}{4p\lambda}$$

Applications of Newton's Rings

Newton's rings are a phenomenon that can be viewed daily. Some of its applications are as follows.

- For testing the uniformity of a polished surface by studying the interference pattern the surface makes when placed in contact with a perfectly flat glass surface
- To control the thickness of paint that is used on posters. Too much paint would exceed total weight requirements, and too little would result in faint imprints.

UNIT-I WAVE OPTICS

Concept: Diffraction-I

Light Diffraction Through Clouds

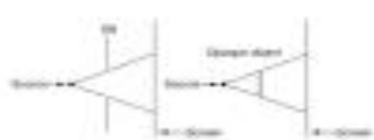
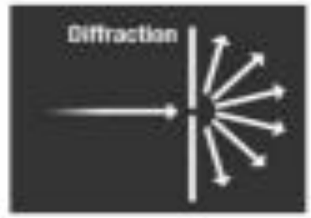


Figure 1 The bending of light round corners of an object.

Diffraction

Definition:

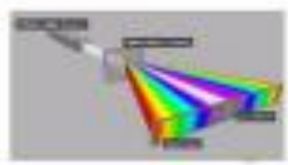
The bending of light waves around the corners of an obstacle and spreading of light waves into geometrical shadow is called diffraction.



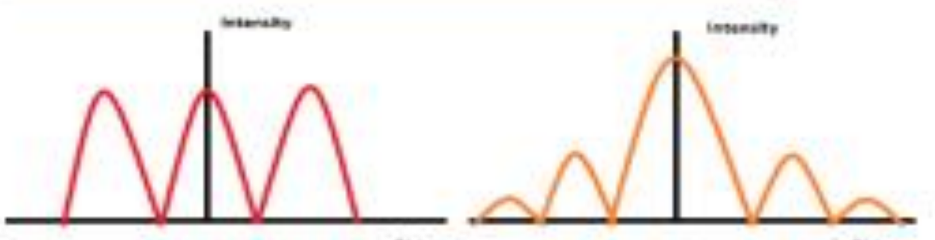
- First observed by Francesco Maria Grimaldi, an Italian mathematician and physicist.
- Diffraction effect depends upon the size of the obstacle.
- Diffraction of light takes place if the size of the obstacle is comparable to the wavelength of light.

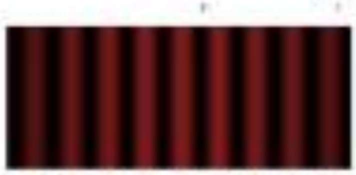
Daily life examples of Diffraction

1. CD reflecting rainbow colours
2. Holograms
3. Sun appears red during sunset
4. From the shadow of an object
5. Bending of light at the corners of the door
6. Spectrometer
7. X-ray diffraction
8. To separate white light

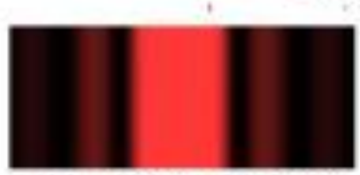


Difference between Interference and Diffraction





Interference from two narrow slits

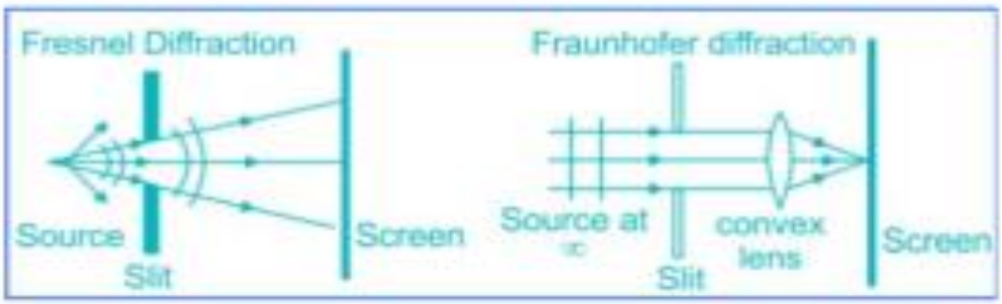


Diffraction from one (wider) slit

Difference between Interference and Diffraction

Interference	Diffraction
It is due to superposition of two source different wavefronts originating from two coherent sources.	It is due to superposition of secondary wavelets originating from the different parts of the same wavefront.
Interference bands are of equal width.	Diffraction bands decrease in their widths as the order increases.
All the bright fringes are of the same intensity.	The bright fringes are of varying intensity.
All the dark fringes have zero intensity.	The intensity of dark fringes is not zero.

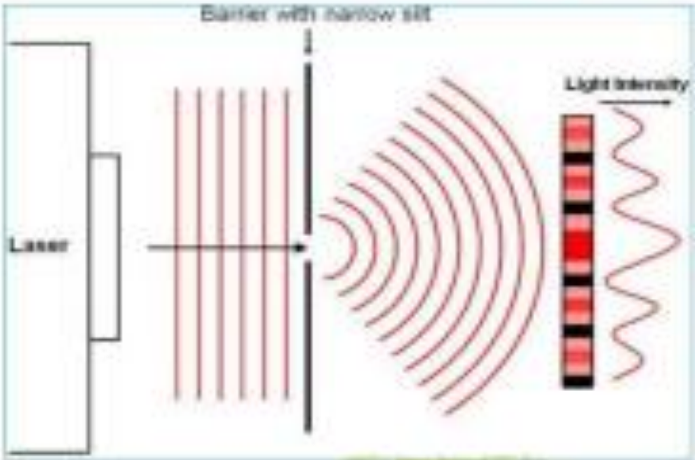
Types of Diffraction



https://testbook.com/learn/physics-diffraction-of-light/

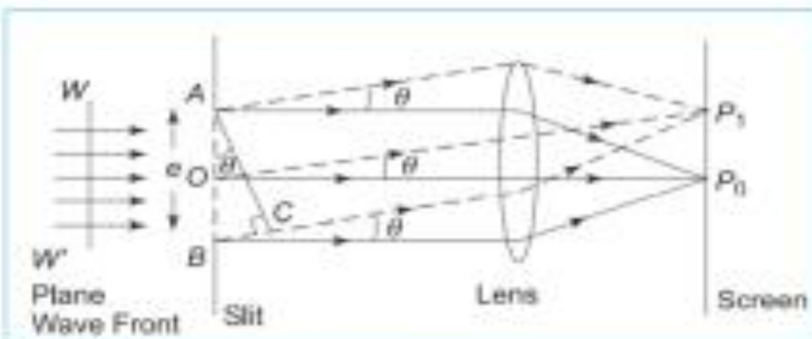
Fraunhofer diffraction	*Fresnel's diffraction*
1. For diffraction to occur, the light source and screen are at infinite distance from the obstacle.	1. For diffraction to occur, the light source and screen are at finite distance from the obstacle.
2. To study diffraction, lenses are necessary.	2. No lenses are necessary to study the diffraction.
3. Study of the diffraction is easy.	3. Study of the diffraction is complicated.
4. Diffraction can be studied in any direction of propagation of light.	4. Diffraction can be studied only in the direction of propagation of light.
5. In this case, the incident wavefronts are plane.	5. In this case, the incident wavefronts are either spherical or cylindrical.

Fraunhofer Diffraction at Single Slit



Fraunhofer Diffraction at Single Slit

Theory:



Fraunhofer Diffraction at Single Slit

In order to find out intensity at point 'p ' draw a perpendicular AC on BR. The path difference between the secondary wavelets is

From ΔABC

$$\text{Sin}\,\theta = \frac{BC}{AB}$$

$$BN = AB\,\text{Sin}\,\theta$$

$$\therefore BC = e\,\text{Sin}\,\theta$$

The phase difference δ = 2π/λ (path difference)

Fraunhofer Diffraction at Single Slit

Let us consider the width of the slit is divided into 'n' equal parts and the amplitude of wave is 'a'.

The phase difference between any two consecutive waves from these parts is

$$\frac{1}{n}\,[\text{Total phase}] = \frac{1}{n}\left[\frac{2\pi}{\lambda}\,e\,\sin\,\theta\right] = d\ (\text{say})$$

From the method of vector addition of amplitudes the resultant amplitude 'R' is given by

$$R = \frac{a \sin n\frac{d}{2}}{\sin\frac{d}{2}} \ldots\ldots\ldots(3)$$

Fraunhofer Diffraction at Single Slit

Sub(2)in(3)

$$R = \frac{a\sin[n.\frac{1}{n}\frac{\frac{2\pi}{\lambda}(e\operatorname{Sin}\theta)}{2}]}{\sin[\frac{1}{n}\frac{\frac{2\pi}{\lambda}(e\operatorname{Sin}\theta)}{2}]}$$

$$R = \frac{a\sin[\frac{\pi e\operatorname{Sin}\theta}{\lambda}]}{\sin[\frac{\pi e\operatorname{Sin}\theta}{n\lambda}]}$$

$$R = \frac{a\sin\beta}{\sin\frac{\beta}{n}}\ (\text{let } \beta = \frac{\pi e\operatorname{Sin}\theta}{\lambda})$$

$$R = \frac{a\sin\beta}{\frac{\beta}{n}}\ (\because n >> \frac{\beta}{n} \Rightarrow \sin\frac{\beta}{n} = \frac{\beta}{n})$$

$$\therefore R = \frac{na\sin\beta}{\beta}$$

$$R = \frac{A\sin\beta}{\beta}\ (\because na = A)$$

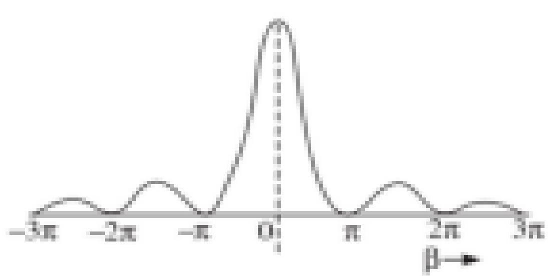
Fraunhofer Diffraction at Single Slit

Intensity at point P is $I=R^2$

$$\therefore I = (\frac{A\sin\beta}{\beta})^2$$

$$I = A^2(\frac{\sin\beta}{\beta})^2$$

$$\therefore I = I_0(\frac{\sin\beta}{\beta})^2$$



Intensity pattern of single slit pattern

Fraunhofer Diffraction at Single Slit

Positions of Maximum and Minimum Intensities

For intensity to be maximum or minimum $\frac{dI}{d\beta} = 0$

The solution of above expression leads to $\sin\beta = 0$ or $\beta = \tan\beta$

Condition for Minimum Intensity: When $\sin\beta/\beta = 0$, then intensity is zero

$$a\sin\theta = \pm m\lambda$$

The above Equation gives the position of 1st, 2nd, 3rd,... minima corresponding to m = 1, 2, 3 and so on. Here $m \neq 0$ because when m = 0 then a sinθ =0 which is the condition of maximum intensity.

Condition for Maximum Intensity

For maximum intensity $\beta = \tan\beta$

The solution of the above Eq. can be obtained graphically. The graphical solution gives

$\beta = 1.43\pi, 2.46\pi, \ldots$

These are referred to as the first maximum, second maximum and so on. The zero intensity positions are $\beta = \pm 1\pi, \pm 2\pi, \pm 3\pi, \ldots$.

Plane Diffraction Grating

An arrangement consisting of large number of parallel slits of equal width and separated from each other by equal opaque spaces is called a 'diffraction grating'.

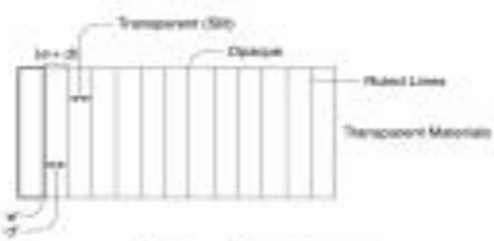


Figure Diffraction grating

From Fraunhofer diffraction at single slit all the secondary waves proceeding from slits in a direction θ are equivalent to a single wave of amplitude

$$R = \frac{A \sin \alpha}{\alpha} \text{ where } \alpha = \frac{\pi a \sin \theta}{\lambda}$$

Path difference between two successive waves $= (a + b)\sin\theta$

The corresponding phase difference $= \frac{2\pi}{\lambda}(a + b)\sin\theta = 2\beta$

In order to find the amplitude in a direction θ we have to find the resultant amplitude of N waves each having amplitude R and common phase. Using the standard result, the resultant amplitude in a direction θ is given by

$$R' = R\frac{\sin N\beta}{\sin\beta} = A\frac{\sin\alpha}{\alpha}\frac{\sin N\beta}{\sin\beta}$$

The resultant intensity at point P is given by

$$I = R'^2 = \frac{A^2 \sin^2\alpha}{\alpha^2}\frac{\sin^2 N\beta}{\sin^2\beta}$$

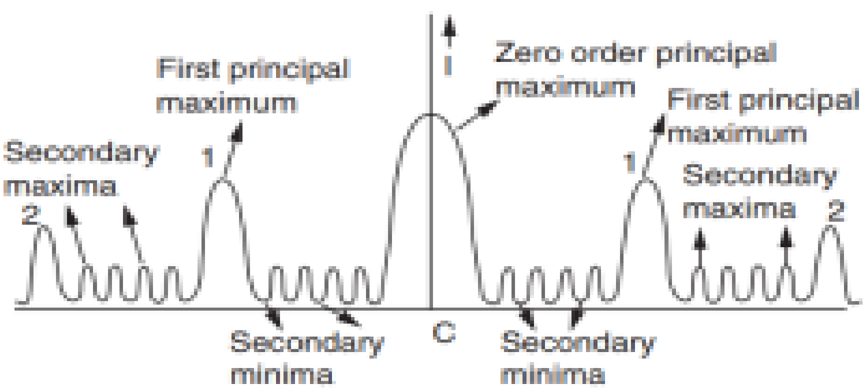


Figure The intensity distribution curve.

Resolving Power of Plane Transmission Grating

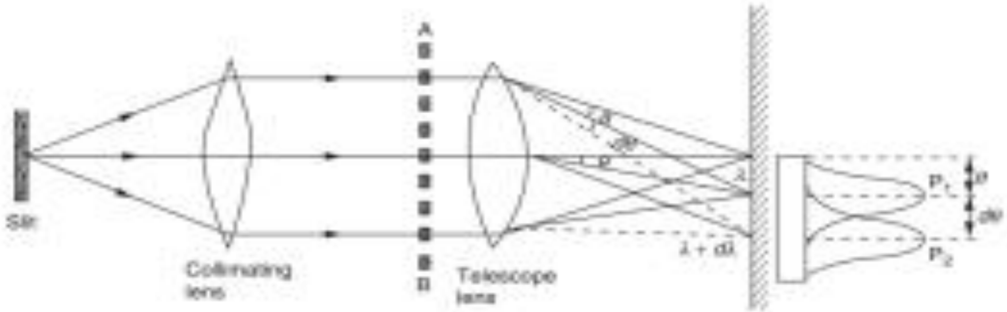


Figure Resolving power of a plane transmission grating.

The direction of (say) nth principal maxima is given by

$$(a+b)\sin\theta = n\lambda$$

The direction of minima is given by

$$N(a+b)\sin\theta = m\lambda$$

where m can take any integer value except m = 0, N, 2N, 3N, …, nN (for nth order maxima).

The first minima adjacent to this n^{th} principal maxima in θ increasing direction (i.e.,θ + d θ) with m = n N + 1 will be obtained by

$$N(a+b)\sin(\theta + d\theta) = (nN+1)\lambda \longrightarrow \quad (1)$$

From, Rayleigh's criterion

For just resolution of spectral lines λ and λ + d λ, the n^{th} maxima of λ + d λ and first minima of λ (adjacent to its nth maxima) should be formed in the same direction (condition of overlapping), that is, θ + dθ

Further, we have nth order maxima of $\lambda + d\lambda$ in $\theta + d\theta$ direction given by

$$(a+b)\sin(\theta + d\theta) = n(\lambda + d\lambda)$$

or

$$N(a+b)\sin(\theta + d\theta) = Nn(\lambda + d\lambda) \longrightarrow \quad (2)$$

Now, applying Rayleigh's criterion implies nth order maxima of λ + d λ by Eq. (1) and first minima of θ by Eq. (2) should overlap, that is, mathematically both Eqs. (1) and (2) must hold simultaneously.

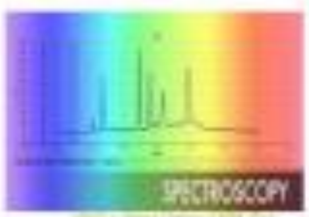
$$(nN+1)\lambda = Nn\,(\lambda + d\lambda)$$

$$\lambda/d\lambda = nN = N(a+b)\sin\theta/\lambda$$

The resolving power of grating is the product of the order of spectrum with total number of lines on the grating.

UNIT-I WAVE OPTICS

Chapter: Polarization-I



Index

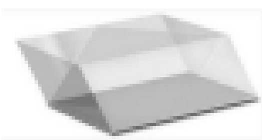
- **Polarization**
- **Polarization by reflection (Brewster's law)**
- **Polarization by double refraction**
- **Nicol's prism.**

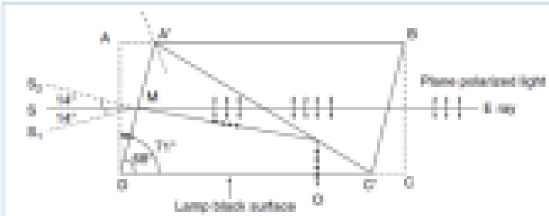
Nicol's prism

Principle

- Nicol prism is based on the phenomenon of double refraction.
- If unpolarised light passes through calcite crystal, it splits into O-ray which has vibrations perpendicular to the principal section of the crystal and E-ray which has vibrations parallel to the principal section inside the crystal.
- If somehow one of the two beams is eliminated then only one beam is transmitted through the crystal.
- In Nicol, O-ray is eliminated by the total internal reflection and E-ray is transmitted through the crystal which is plane polarized light.

Construction of Nocol Prism





- A calcite crystal whose length is three times as its width is taken
- The two end faces A´D and BC´ of the crystal are cut in such a way that they make an angle of 68° instead of 71°.

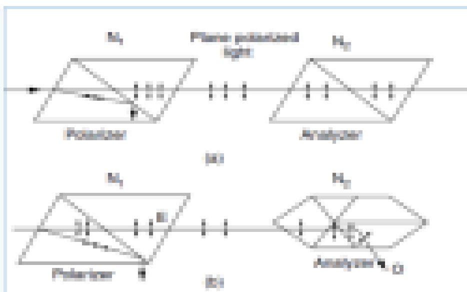
- Resulting part of the crystal is then cut along A´C´ so that it makes an angle 90° with the two end faces as shown in Fig.
- The two surfaces are grounded, polished optically flat and then cemented together with a transparent material called Canada balsam whose refractive index lies midway between the refractive index of O-ray and E-ray.
- For sodium light, refractive indices are 1.66, 1.55 and 1.49 for O-ray, Canada balsam and E-ray, respectively.

Nicol prism as Polariser

- If an ordinary light falls on the face A'D parallel to the face DC', it splits into O-ray and E-ray having vibrations parallel and perpendicular to the principal section inside the crystal.
- It is clear that Canada balsam layer is more dense than calcite for E-ray and less dense for O-ray (because for O-ray, the angle of incidence at the Canada balsam layer is higher than the critical angle of calcite and Canada balsam), that is

  Critical angle $= \sin^{-1}(1.55/1.66) = \sin^{-1}(0.933) = 69^\circ$
- O-ray is reflected from the layer of Canada balsam by total internal reflection and absorbed by the lamp black surface DC'
- The E-ray transmitted from Canada balsam layer is plane polarized light. In this way Nicol prism acts as a polarizer.

Nicol prism as Analyser



- If two Nicol prisms N1 and N2 are parallel to each other then only E-ray passes through both the Nicol prisms.
- In this case, the first Nicol acts as a polarizer and the other acts as an analyzer as shown in Fig. (a).

- When the second Nicol N2 is gradually rotated then the intensity of E-ray decreases and if N1 and N2 are perpendicular to each other then no light comes out from the second Nicol N2 [Fig.(b)].
- Further, if N2 is rotated, the intensity of emergent light increases. In this way we can say that Nicol prism acts as an analyzer.

Polarizers are widely used in

- liquid crystal displays (LCDs)
- sunglasses
- photography
- microscopy
- many of scientific and medical purposes