Dr. N.G.P. ARTS AND SCIENCE COLLEGE (Autonomous)

REGULATIONS 2023-24 for Post Graduate Programme (Outcome Based Education model with Choice Based Credit System)

M.Sc. Degree

(For the students admitted during the academic year 2023-24 and onwards)

Programme: M.Sc. Physics

Eligibility:

A pass in the course of B.Sc. Degree Examination with Physics as Major and Mathematics and Chemistry as Ancillary subjects, or an examination accepted as equivalent there to accept by the academic council.

Programme Educational Objectives:

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To produce graduates with advanced knowledge in Physics and requisite skills, in order to use their knowledge in Physics in a wide range of practical applications.
2. To develop creative thinking and the power of imagination to enable graduates work in research in academia and industry for broader applications.
3. To relate the training of Physics graduates to the employment opportunities within the country.
4. To promote societal values through Physics related activities.

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	Apply theoretical knowledge of principles and concepts of Physicsto practical problems.
PO2	Develop skills in planning and carrying out advanced physics experiments.
PO3	Solve scientific problems by applying a combination of theory,numerical simulation, and experiments.
PO4	Relate critically to scientific models.
PO5	Examining specific phenomena theoretically and experimentally, to contribute to the generation of new scientific insights or to the innovation of new applications of physics research.

PG REGULATION (R5)

(2023-24 and onwards)

(OUTCOME BASED EDUCATION WITH CBCS)

Effective from the academic year 2023-24 and applicable to the students admitted to the Degree of Master of Arts/Commerce/Management/Science.

1. NOMENCLATURE

1.1 Faculty: Refers to a group of programmes concerned with a major division of knowledge. Eg. Faculty of Computer Science consists of Programmes like Computer Science, Information Technology, Computer Technology, Computer Applications, Cognitive Systems, Artificial Intelligence and Machine Learning and Cyber Security and Data Analytics etc.

1.2 Programme: Refers to the Master of Arts/Management/Commerce/Science Stream that a student has chosen for study.

1.3 Batch: Refers to the starting and completion year of a programme of study. Eg. Batch of 2023-2025 refers to students belonging to a 2-year Degree programme admitted in 2023 and completing in 2025.

1.4 Course: Refers to component of a programme. A course may be designed to involve lectures / tutorials / laboratory work / seminar / project work/ practical training / report writing / Viva voce, etc. or a combination of these, to effectively meet the teaching and learning needs and the credits may be assigned suitably.

a) Core Courses A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

b) Extra Departmental Course (EDC): A course chosen generally from a related discipline/subject, with an intention to seek exposure in the discipline relating to the core domain of the student.

c) Discipline Specific Elective Course (DSE): Elective courses are offered under main discipline/ subject of study.

d) Internship/Industrial Training (IT): Students must undertake industrial / institutional training for a minimum of 15 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

e) Project Work: It is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. The Project work will be given in lieu of a Core paper.

f) Extra credits: Extra credits will be awarded to a student for achievements in co-curricular activities carried out outside the regular class hours. The guidelines for the award of extra credits are given in section two, these credits are not mandatory for completing the programme.

g) Advanced Learner Course (ALC): ALC is doing work of a higher standard than usual for students at that stage in their education. Research work / internships carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days.

2. STRUCTURE OF PROGRAMME

- Core Course
- Extra Departmental Course (EDC)
- Discipline Specific Elective (DSE)
- Industrial Training (IT)
- Project

3. DURATION OF THE PROGRAMME

A student is normally expected to complete the M.Sc. /M.Com. / M.A. Programme in 4 semesters. However, in any case not more than 5 consecutive semesters. Failing which the concerned BoS will identify suitable/ equivalent course.

4. REQUIREMENTS FOR COMPLETION OF A SEMESTER

Every student shall ordinarily be allowed to keep terms for the given semester in a program of his/ her enrolment, only if he/ she fulfills at least seventy five percent (75%) of the attendance taken as an average of the total number of lectures, practicals,

tutorials, etc. wherein short and/or long excursions/field visits/study tours organized by the college and supervised by the faculty as envisaged in the syllabus shall be credited to his attendance. Every student shall have a minimum of 75% as an overall attendance.

5. EXAMINATIONS

The end semester examinations shall normally be conducted after completing 90 working days for each semester. The maximum marks for each theory and practical course as follow,

Mark distribution for Theory Courses

Continuous Internal Assessment (CIA) : 25 Marks

End Semester Exams (ESE) : 75 Marks

Total : 100 Marks

i) Distribution of Internal Marks

S. No.	Particulars	Distribution of Marks
1	CIA I (2.5 Units) (On completion of 45th working day)	5
2	Model (All 5 Units) (On completion of 85th working day)	5
3	Attendance	5
4	Library Usage	5
5	Skill Enhancement *	5
	Total	**25**

Breakup for Attendance Marks:

S. No.	Attendance Range	Marks Awarded
1	95% and above	5
2	90% - 94%	4
3	85% - 89%	3
4	80% - 84%	2
5	75% - 79%	1

Note:
Special Cases such as NCC, NSS, Sports, Advanced Learner Course, Summer Fellowship and Medical Conditions etc. the attendance exemption may be given by principal and Mark may be awarded.

Break up for Library Marks:

S. No.	Attendance Range	Marks Awarded
1	10h and above	5
2	9h- less than 10h	4
3	8h - less than 9h	3
4	7h - less than 8h	2
5	6h - less than 7h	1

Note:
In exception, the utilization of e-resources of library will be considered.

***Components for "Skill Enhancement" may include the following:**

Class Participation, Case Studies Presentation/Term paper, Field Study, Field Survey, Group Discussion, Term Paper, Presentation of Papers in Conferences, Industry Visit, Book Review, Journal Review, e-content Creation, Model Preparation, Seminar and Assignment.

Components for Skill Enhancement
Any one of the following should be selected by the course coordinator

S. No.	Skill Enhancement	Description
1	Class Participation	• Engagement in class • Listening Skills • Behavior
2	Case Study Presentation/ Term Paper	• Identification of the problem • Case Analysis • Effective Solution using creativity/imagination
3	Field Study	• Selection of Topic • Demonstration of Topic • Analysis & Conclusion

4	Field Survey	• Chosen Problem • Design and quality of survey • Analysis of survey
5	Group Discussion	• Communication skills • Subject knowledge • Attitude and way of presentation • Confidence • Listening Skill
6	Presentation of Papers in Conferences	• Sponsored • International/National • Presentation • Report Submission
7	Industry Visit	• Chosen Domain • Quality of the work • Analysis of the Report • Presentation
8	Book Review	• Content • Interpretation and Inferences of the text • Supporting Details • Presentation
9	Journal Review	• Analytical Thinking • Interpretation and Inferences • Exploring the perception if chosen genre • Presentation
10	e-content Creation	• Logo/ Tagline • Purpose • Content (Writing, designing and posting in Social Media) • Presentation
11	Model Preparation	• Theme/ Topic • Depth of background Knowledge • Creativity • Presentation

12	Seminar	• Knowledge and Content • Organization • Understanding • Presentation
13	Assignment	• Content and Style • Spelling and Grammar • References

ii) Distribution of External Marks

Total : 75
Written Exam : 75

Marks Distribution for Practical course

Total : 100
Internal : 40
External : 60

i) Distribution of Internals Marks

S. No.	Particulars	Distribution of Marks
1	Experiments/Exercises	15
2	Test 1	10
3	Test 2	10
4	Observation Notebook	5
	Total	**40**

ii) Distribution of Externals Marks

S. No.	Particulars	External Marks
1	Practical	40
2	Record	10
3	Viva- voce	10
	Total	**60**

Practical examination shall be evaluated jointly by Internal and External Examiners.

A) Mark Distribution for Project

Total	**:**	**200**
Internal	**:**	**80**
External	**:**	**120**

i) Distribution of Internal Marks

S. No.	Particulars	Internal Marks
1	Review I	30
2	Review II	40
3	Attendance	10
	Total	**80**

ii) Distribution of External Marks

S. No.	Particulars	External Marks
1	Project Work & Presentation	100
2	Viva -voce	20
	Total	**120**

Evaluation of Project Work shall be done jointly by Internal and External Examiners.

6. CREDIT TRANSFER

a. Upon successful completion of 1 NPTEL Course (4 Credit Course) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of one **4 credit course** during the 3rd semester. The proposed NPTEL course should cover content/syllabus of exempted core paper in 3rd semester.

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option - 1 Paper title	4
			Option - 2 Paper title	
			Option - 3 Paper title	

b. Upon successful completion of **2 NPTEL Courses** (2 Credit each) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of **one 4 credit course** during the 3rd semester. Out of 2 NPTEL proposed courses, **at least 1 course** should cover content/syllabus of exempted core paper in 3rd semester.

Mandatory

The exempted core paper in the 3rd semester should be submitted by the students for approval before the end of 2nd semester

Credit transfer will be decided by equivalence committee

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option - 1 Paper title	2
			Option - 2 Paper title	
			Option - 3 Paper title	
2			Option - 1 Paper title	2
			Option - 2 Paper title	
			Option - 3 Paper title	

NPTEL Courses to be carried out during semester I – II.

S. No.	Student Name	Class	Proposed NPTEL Course		Proposed Course for Exemption
			Course I	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	Any one Core Paper in 3rd Semester
			Course II	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	

Class Advisor **HoD** **Dean**

7. INTERNSHIP/INDUSTRIAL TRAINING

Mark Distribution for Internship/ Industrial Training

Total : 100
Internal : 40
External : 60

i) Distribution of Internal Marks

S. No.	Particulars	Internal Marks
1	Review I	15
2	Review II	20
3	Attendance	5
	Total	**40**

ii) Distribution of External Marks

S. No.	Particulars	External Marks
1	Internship /Industrial training Presentation	40
2	Viva -voce	20
	Total	**60**

Internship/ Industrial training shall be evaluated jointly by Internal and External Examiners.

8. EXTRA CREDITS: 10

Earning extra credit is not essential for programme completion. Student is entitled to earn extra credit for achievement in Curricular/Co-Curricular/ Extracurricular activities carried out other than the regular class hours.

A student is permitted to earn a maximum of 10 extra Credits during the programme period.
A maximum of 1 credit under each category is permissible.

Category	Credit
Self-study Course	1
CA/ICSI/CMA (Foundations)	1

CA/ICSI/CMA (Inter)	1
Sports and Games	1
Publications / Conference Presentations (Oral/Poster)/Awards	1
Innovation / Incubation / Patent / Sponsored Projects / Consultancy	1
Representation in State / National level celebrations	1
Awards/Recognitions/Fellowships	1
Advanced Learner Course (ALC)*	2

Credit shall be awarded for achievements of the student during the period of study only.

GUIDELINES

Self-study Course

A pass in the self-study courses offered by the department.

The candidate should register the self-study course offered by the department only in the III semester.

CA/ICSI/CMA (Foundations)

Qualifying foundation in CA/ICSI/CMA / etc.

CA/ICSI/CMA (Inter)

Qualifying Inter in CA/ICSI/CMA / etc.

Sports and Games

The student can earn extra credit based on their Achievement in sports in University/ State / National/ International.

Publications / Conference Presentations (Oral/Poster)

Research Publications in Journals

Oral/Poster presentation in Conference

Innovation / Incubation / Patent / Sponsored Projects / Consultancy

Development of model/ Products /Prototype /Process/App/Registration of Patents/ Copyrights/Trademarks/Sponsored Projects /Consultancy

Representation in State/ National level celebrations

State / National level celebrations such as Independence Day, Republic Day Parade, National Integration camp etc.

Awards/Recognitions/Fellowships

Regional/ State / National level awards/ Recognitions/Fellowships

***Advanced Learner Course (ALC):**

ALC is doing work of a higher standard than usual for students at that stage in their education.

Research work/internships carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days will be considered as Advanced Learners Course

QUESTION PAPER PATTERN

CIA Test I : [1.5 Hours-2.5 Units] - 25 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section - A	8 x 0.5= 4 Marks	MCQ	25 Marks	Marks secured will be converted to 5 marks
Section - B	3 x 2 = 6 Marks	Answer ALL Questions Either or Type ALL Questions Carry Equal Marks		
Section - C	3 x 5 = 15 Marks			

CIA Test II/ Model: [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section - A	10 x 1 = 10 Marks	MCQ	75 Marks	Marks secured will be converted to 5 marks
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks		
Section - C	5 x 8 = 40 Marks			
Section - D	1 x 10 = 10 Marks	Compulsory Question		

End Semester Examination [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL
Section - A	10 x 1 = 10 Marks	MCQ	75 Marks
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	
Section - C	5 x 8 = 40 Marks		
Section - D	1 x 10 = 10 Marks	Compulsory Question	

PG Credit Distribution:

Part	Subjects	No. of Papers	Credit	Semester No.
III	Core	14 06	Theory: 11 x 04 =44 02 x 03 = 06 Practical: 06 x 02= 12	I-IV
	Elective	04	04 x 04 =16	I-IV
	EDC	01	01 x 04 =04	II
	Industrial Training		02	III
	Project Work	01	01 x 08 =08	IV
TOTAL CREDITS			**92**	-

M.Sc. Physics– AY 23-24

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
232PY2A1CA	Core- I	Mathematical Physics	4	1	-	3	25	75	100	4
232PY2A1CB	Core- II	Thermodynamics and Statistical Mechanics	4	1	-	3	25	75	100	4
232PY2A1CC	Core- III	Classical Mechanics	4	-	-	3	25	75	100	4
232PY2A1CD	Core- IV	Electronics	4	-	-	3	25	75	100	4
232PY2A1CP	Core Practical - I	Thermodynamics and Optics	-	-	4	4	40	60	100	2
232PY2A1CQ	Core Practical -II	Electronics -I	-	-	4	4	40	60	100	2
232PY2A1DA	DSE -I	Energy Physics	4			3	25	75	100	4
232PY2A1DB		Materials Physics and Processing Techniques								
232PY2A1DC		Laser Physics and Nonlinear Optics								
		Total	**20**	**2**	**8**	-	-	-	**700**	**24**

BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science Col...
APPROVED
BoS- 15th 12.6.23 | AC - 15th 14.7.23 | GB - 20th 5.8.23

Academic Council
CHAIRMAN
Dr.N.G.P. Arts and Science College

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
232PY2A2CA	Core - V	Spectroscopy	4	-	-	3	25	75	100	4
232PY2A2CB	Core - VI	Solid State Physics	4	1	-	3	25	75	100	4
232PY2A2CC	Core - VII	Quantum Mechanics-I	4	1	-	3	25	75	100	4
232PY2A2CP	Core Practical - III	Solid State and Spectroscopy	-	-	4	4	40	60	100	2
232PY2A2CQ	Core Practical - IV	Electronics-II	-	-	4	4	40	60	100	2
232MT2A2EA	EDC	Numerical Methods	4	-	-	3	25	75	100	4
232PY2A2DA	DSE -II	Physics of Nanomaterials	4	-	-	3	25	75	100	4
232PY2A2DB		Experimental Design								
232PY2A2DC		Medical Physics								
		Total	**20**	**2**	**8**	-	-	-	**700**	**24**

18/10/2023
BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS- 14th 18.10.23 | AC- 16th 13.12.23 | GB- 21st 05.01.24

Academic Council
CHAIRMAN
Dr.N.G.P. Arts and Science College

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
232PY2A3CA	Core -VIII	Quantum Mechanics - II	4	1	-	3	25	75	100	4
232PY2A3CB	Core - IX	Electromagnetic Theory	4	1	-	3	25	75	100	4
232PY2A3CC	Core - X	Condensed Matter Physics	3	1	-	3	25	75	100	3
232PY2A3CD	Core - XI	Microprocessors and Microcontroller	3	1	-	3	25	75	100	3
232PY2A3CP	Core Practical - V	Electronics - III	-	-	4	4	40	60	100	2
232PY2A3CT	IT	Industrial Training	-	-	-	-	40	60	100	2
232PY2A3DA	DSE -III	Crystal Growth and Thin Film Techniques	4	-	-	3	25	75	100	4
232PY2A3DB		Instrumental Methods of Analysis								
232PY2A3DC		Radiological Safety Aspects								
232PY2A4CV	Core-XIV	Project	-	-	4	-	-	-	-	-
		Total	**18**	**4**	**8**				**700**	**22**

BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS- 5.4.24. AC - 17.4.24. GB -

Dr.NGPASC
COIMBATORE | INDIA

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
232PY2A4CA	Core- XII	Molecular Physics	4	1	-	3	25	75	100	4
232PY2A4CB	Core-XIII	Nuclear and Elementary Particle Physics	4	1	-	3	25	75	100	4
232PY2A4CP	Core Practical-VI	Microprocessor	-	-	4	4	40	60	100	2
232PY2A4CV	Core-XIV	Project and Viva voce	-	-	12	-	80	120	200	8
232PY2A4DA	DSE -IV	Solar Cells	4	-	-	3	25	75	100	4
232PY2A4DB		Band gap Engineering in Semiconductors								
232PY2A4DC		Plasma Physics								
		Total	12	2	16	-	-	-	600	22
		*Grand Total							3400	92

Theory :CIA 25: ESE 75
Practical/ IT :CIA 40: ESE 60
Project :CIA 80: ESE 120

***Total Credits does not exceed 92 credits**

BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS- 18th 8/11/24
AC - 18th 26/11/24
GB -

Academic Council
CHAIRMAN
Dr.N.G.P. Arts and Science College

DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I & IV

Semester I (Elective I)
List of Elective Courses

S. No	Course Code	Course Name
1	232PY2A1DA	Energy Physics
2	232PY2A1DB	Materials Physics and Processing Techniques
3	232PY2A1DC	Laser Physics and Nonlinear Optics

Semester II (Elective II)
List of Elective Courses

S. No	Course Code	Course Name
1	232PY2A2DA	Physics of Nanomaterials
2	232PY2A2DB	Experimental Design
3	232PY2A2DC	Medical Physics

Semester III (Elective III)
List of Elective Courses

S. No	Course Code	Course Name
1	232PY2A3DA	Crystal growth and thin film physics
2	232PY2A3DB	Instrumental methods of analysis
3	232PY2A3DC	Radiological safety aspects

Semester IV (Elective IV)
List of Elective Courses

S. No	Course Code	Course Name
1	232PY2A4DA	Solar Cells
2	232PY2A4DB	Band gap Engineering in Semiconductors
3	232PY2A4DC	Plasma Physics

EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S. No	Course Code	Course Name
1	232PY2ASSA	IPR, Innovation and Entrepreneurship
2	232PY2ASSB	Nanoscience

CERTIFICATE PROGRAMMES

The following are the programme offered to earn extra credits:

S. No	Programme Code and Name	Course Code	Course Name
1	2PY5A: Certificate Course in Nanomaterials Preparation Techniques	232PY5A1CA	Nanomaterials Preparation Techniques
2	2PY5B: Certificate Course in Nanomaterials Characterization	232PY5B1CA	Nanomaterials Characterization

Course Code	Course Name	Category	L	T	P	Credit
232PY2A1CA	MATHEMATICAL PHYSICS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concept of matrices, types of linear equations and complex variables
- Develop expertise in special functions and partial differential equations
- Develop expertise in special functions and partial differential equations

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of free electrons in crystals	K2
CO2	Analyze the Thermal and Optical Properties of Materials	K3
CO3	Interpret the Dielectric Properties of Materials	K3
CO4	Obtain knowledge on Magnetic Properties of Materials.	K3
CO5	Expand Knowledge on Superconductors	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2	✓	✓	✓		✓
CO3	✓	✓	✓		✓
CO4	✓	✓	✓		✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A1CA	MATHEMATICAL PHYSICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Matrices and Vectors 12 h

Rank of a matrix and some of its theorems (Normal Form, Triangular Form) - Types of linear equations - Solution to linear homogeneous and non-homogeneous equations – Vectors: Linear dependence and independence of vectors - Linearly dependence and independence of vectors by rank method - Inner product space - Orthogonal vectors - Orthonormal vectors - Gram-Schmidt orthogonalization process.

Unit II Complex Variable 12 h

Analytical functions - Cauchy-Riemann equations - Line integrals - Cauchy's theorem - Cauchy integral formula - Taylor's and Laurent's expansions - Cauchy`s residue theorem – Poles – Evaluation of residues

Unit III Special Functions 12 h

Legendre`s differential equations: Legendre polynomials - Generating functions – Recurrence relation - Bessel`s differential equation: Bessel polynomials – Generating functions – Recurrence relation - Hermite differential equation: Hermite polynomials - Generating functions – Recurrence relation

Unit IV Differential Equations and Partial Differential Equations 12 h

Differential Equations: Linear ordinary differential equations - First order and second order equations and their various solutions - Partial differential equations: Solution of Laplace equation – Solution of wave and heat equations in two dimensions - Poisson and Helmholtz equations - Diffusion and wave equations..

Unit V Tensor and Group theory 10 h

Tensors: Contravariant - Covariant - Mixed tensors – Addition and subtraction of tensors – Symmetry and Antisymmetry tensor - Quotient rule - Pseudo tensors. Group theory: Subgroups - Classes - Cyclic groups - Abelian groups – Cosets - Homomorphism and isomorphism – Reducible and irreducible representations - Character table for simple molecular types (C2v and C3v point group)..

Text Books

1. Dass H K and Rama Verma S, 2010, "Mathematical Physics", S. Chand and Company Ltd , New Delhi.
2. Gupta B D, 2009, "Mathematical Physics", 4th Edition, Vikas Publishing House Pvt Ltd, New Delhi..

References

1. George B. Arfken, Hans J. Weber, Frank E. Harris, 2012, "Mathematical Methods For Physicists: A Comprehensive Guide", Academic Press.
2. Sathya Prakash M, 2016, "Mathematical Physics with Classical Mechanics, 6th Edition, Sultan Chand & Sons, New Delhi
3. Rajput, B.S, 2008, "Mathematical Physics", 20th Edition, PragatiPrakashan.
4. E Book: Greenberg, M D. 2013," Advanced Engineering Mathematics", 2nd Edition, Person new
5. https://www.myprivatetutor.ae/prime/documents/ppts/details/199/ppton-state-transition-matrix&title=www.myprivatetutor.ae.
6. https://www.tutorialsduniya.com/notes/complex-analysis-notes./
7. https://www.tutorialsduniya.com/notes/linear-algebra-tensor-analysis-notes

Course Code	Course Name	Category	L	T	P	Credit
232PY2A1CB	THERMODYNAMICS AND STATISTICAL MECHANICS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of microstates, macrostates and ensembles
- The various statistical distributions and transport phenomenon
- The concepts of phase transitions and thermodynamic functions

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Relate the thermodynamics, microstates through thermodynamics postulates, quantities, and relations	K2
CO2	Identify the micro and macroscopic properties of the mater	K3
CO3	Explain the classical and quantum distribution laws and their relations	K2
CO4	Apply the transport properties and understand equilibrium and non-equilibrium process	K3
CO5	Classify and evaluate the heat capacities, Ising model through phase transitions	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2	✓	✓	✓		✓
CO3	✓	✓	✓		
CO4	✓	✓	✓		✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A1CB	THERMODYNAMICS AND STATISTICAL MECHANICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I **Thermodynamics, Microstates and Macrostates** 12 h

Basic postulates of thermodynamics – Fundamental relations and definition of intensive variables – Intensive variables in the entropic formulation – Equations of state – Euler relation - Densities - Gibbs-Duhem relation for entropy - Microstates and macrostates – Ideal gas – Liouville's Theorem

Unit II **Microcanonical, Canonical and Grand Canonical Ensembles** 12 h

Microcanonical distribution function – Two level system in microcanonical ensemble – Gibbs paradox – The canonical distribution function – Partition function and free energy of an ideal gas – Relation between grand canonical and canonical partition functions

Unit III **Distributions Functions and Fermi Energy** 12 h

Maxwell-Boltzmann -Bose-Einstein and Fermi-Dirac distributions – Non interacting Bose gas and thermodynamic relations – Chemical potential of bosons – Non interacting Fermi gas and thermodynamic relations – Fermi gas at zero and low temperature – Fermi energy - Fermi momentum.

Unit IV **Transport Processes** 12 h

Derivation of Boltzmann transport equation - Representation of states - Free streaming - Collision term - Equilibrium distribution – Transport phenomena - One speed and one dimension – Thermal conductivity - Brownian motion - Langevin's theory - Molecular diameter..

Unit V **Heat Capacities, Ising Model and Phase Transitions** 12 h

Heat capacities of heteronuclear diatomic gas – Heat capacities of homonuclear diatomic gas – One-dimensional Ising model and its solution by variational method

- Phase transitions and criterion for phase transitions – Classification of phase transitions by order and by symmetry – Phase diagrams for pure systems – Clausius-Clapeyron equation

Text Books

1 Palash B Pal, 2017, "An Introductory Course of Statistical Mechanics", Narosa Publishing House, New Delhi.

2 Reif, 2010, "Fundamentals of Statistical and Thermal Physics", Sarat Book Distributors..

References

1 Kittel C, 2004, "Elementary Statistical Physics", John Wiley & Sons.

2 Agarwal J P, SatyaPrakash, 2008, "Thermodynamics And Statistical Physics", Pragati Prakashan, Meerut

3 Gupta and Kumar, 2003, "Statistical Mechanics", Pragati Prakashan, Meerut.

4 E Book: SatyaPrakash, " Statistical Mechanics", Kedar Nath Ram Nath, Meerut

5 https://youtu.be/SBe7n7WpU8M

6 https://www.slideshare.net/NarendraKumar277/3d-ising-model

Course Code	Course Name	Category	L	T	P	Credit
232PY2A1CC	CLASSICAL MECHANICS	CORE	4		-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of Lagrangian and Hamiltonian mechanics
- Apply the concepts of classical mechanics to the particle systems and rigid bodies
- Emphasize the mathematical formulation in relativity problems

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Apply the Lagrangian formulation for the motion of the particles	K3
CO2	Construct the Hamilton's dynamics and experiment with variational principle	K3
CO3	Summarize the canonical transformations	K2
CO4	Analyze the dynamics of a rigid body in various aspects	K4
CO5	Make use of the central force problem and theory of relativity	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3				✓	
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A1CC	CLASSICAL MECHANICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I **Lagrangian Dynamics** 10 h

Mechanics of system of particles - Coordinate systems - Configuration space - Constraints – Principle of virtual work - D'Alembert's principle – Hamilton's principle - Lagrange's equation – Conservation laws and Symmetry properties – Applications of the Lagrangian formulation: Single particle in space - Atwood's machine.

Unit II **Hamilton's Dynamics and Variational Principle** 10 h

Cyclic coordinates - Conservation theorem - Jacobi integral equation for Hamilton's principle function - Hamilton's equations - Hamilton's equations in different coordinate systems - Examples in Hamiltonian dynamics - Calculus of variation - Principle of least action

Unit III **Classical Transformation and Poisson Brackets** 9 h

Canonical transformations - Legendre transformation - Generating functions - Procedure for application of canonical transformations - Condition for canonical transformation - Poisson brackets - Lagrange Brackets - Relation between Lagrange and Poisson brackets.

Unit IV **Dynamics of a Rigid Body** 10 h

Generalized coordinates of rigid body - Euler angle - Infinitesimal rotation as vectors - Components of angular velocity - Angular momentum - Inertia tensor - Moments of Inertia for different body systems - Euler's equations of motion - Torque free motion of a rigid body

Unit V **Central Force Problem and Theory of Relativity** 9 h

Reduction to the equivalent one body problem - Equation of motion and first integrals - Classification of orbits - Kepler problem: Motion under inverse square law - Artificial satellites - Virial theorem – Lorentz transformation - Consequences of Lorentz transformations

Text Books

1 Upadhaya J C, 2018, "Classical Mechanics", 2nd Edition, Himalaya Publishing House Pvt. Ltd, Mumbai.

2 Aruldhas G, 2015, "Classical Mechanics", PHI Learning Private Limited, New Delhi.

References

1 Gutpa S L, Kumar V, and Sharma HV, 2016, "Classical Mechanics", Pragati Prakashan, Meerut.

2 Gupta K C, 2018, "Classical Mechanics of Particles and Rigid Bodies", 3rd Edition, New Age International Publishers, New Delhi.

3 Rana N C and Joag P J, 2015, "Classical Mechanics", Tata McGraw Hill, New Delhi.

4 E-Book: Goldstein H, Poole C, and Safko J, 2002, "Classical Mechanics" , 3rd Edition, Pearson Education Asia, New Delhi

5 https://archive.nptel.ac.in/courses/115/105/115105098/

6 https://archive.nptel.ac.in/courses/115/106/115106123/

Course Code	Course Name	Category	L	T	P	Credit
232PY2A1CD	ELECTRONICS	CORE	4		-	4

PREAMBLE

This course has been designed for students to learn and understand

- The various types of diodes, transistors and their applications
- Acquire knowledge on transistors and thyristors
- The types of operational amplifiers and integrated circuits

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Outline about various semiconductor diodes	K2
CO2	Identify and construct various transistors and optoelectronic devices	K3
CO3	Examine the working of thyristors and its applications	K4
CO4	Categorize the analog electronics	K4
CO5	Experiment with the operational amplifiers and integrated chips	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A1CD	ELECTRONICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Special Diodes 9 h

V-I Characteristic of a PN junction diode - The ideal diode - Static and dynamic resistance of a diode - Parallel configuration of a diode circuits with a DC voltage source - Diode circuit with DC and AC voltage sources - Zener diode - Tunnel diode - Varactor diode - Schottky diode

Unit II Power Electronics and Optoelectronics Device 9 h

Bipolar junction transistor construction, Current gain, Input and output of BJT in CB, CE, CC configurations - Phototransistor - Operation, characteristic, drain and transfer characteristics of JFET. Circuit symbol - drain characteristics and transfer characteristics of depletion type MOSFET.

Unit III Thyristors 10 h

Types of thyristors - Silicon controlled rectifier (SCR) - SCR biasing and operation - SCR equivalent circuit – V-I characteristics of SCR – Uni-junction Transistor (UJT) - constructions and equivalent circuit of UJT - UJT operation – V-I characteristics of UJT - Silicon controlled switch (SCS) - SCS operation - applications - SUS, SBS, SAS.

Unit IV Analog Electronics 10 h

Op-Amp Parameters - Block diagram of an Op-Amp - The Op-Amps as a Voltage amplifier - Ideal operational amplifier - Virtual ground and summing point - Inverting amplifier - Non inverting amplifier - Linear amplifier - Differential amplifier - Active filters - low pass filters - high pass filters - band pass filters

Unit V Op Amp Applications and Special ICs 10 h

Comparators - The integrator - The differentiator - Log Amplifier - Antilog Amplifier - Linear integrated circuits - Digital integrated circuits - Integrated devices and circuits formation – Applications - 555 timer circuit - Functional block diagram - Characteristics and applications – Astable and monostable multivibrator

Text Books

1 Sedha R S, 2013, "Applied Electronics", S.Chand and Company, New Delhi.

2 Mehta V K, Rohit Mehta, 2014, "Principles of Electronics", S.Chand and Company, New Delhi.

References

1 Theraja B L, 2014, "Basic Electronics", S. Chand and Company, New Delhi..

2 Jacob Millman, Christos C Halkias, Chetan Parikh, 2016, "Integrated Electronics Analog and Digital Circuits and Systems", 2nd Edition, McGraw Hill Education (India) P Ltd, New Delhi.

3 David A, 2007," Electronic Devices and Circuits", 4th Edition, Prentice Hall.

4 E Book: Walter Banzhaf, 2010, "Understanding Basic Electronics", American Radio Relay League

5 https://nptel.ac.in/courses/108101091/

6 https://nptel.ac.in/courses/108102095/

232PY2A1CP	CORE PRACTICAL - I : THERMODYNAMICS AND OPTICS	SEMESTER I

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Determination of Stefan's constant.)
2	Determination of specific heat capacity of metal-Forbes Method.
3	Determination of specific heat capacity of Liquid -Ferguson Method
4	Young's Modulus- Elastic constants of the material -Elliptical fringes.
5	Determination of the wavelength of laser source – transmission grating.
6	Determine unknown resistance using a Kelvin double bridge experiment).
7	Determination of refractive index of liquid-Air wedge
8	Characteristics of LDR.
9	Determination of Planck's constant
10	Thermal conductivity of liquid and air by Lee`s disc method.
11	Young's Modulus- Elastic constants of the material-hyperbolic fringes.
12	Determination of the thickness of wire by air wedge

Note: Any 10 Experiments

References

1 Dunlap R A, 1988, "Experimental Physics: Modern methods", Oxford University Press, New Delhi..

2 Smith E V, 1970, "Manual for experiments in Applied Physics", Butterworths.

3 CMalacara D,1988, "Methods of Experiments Physics", Series of Volume, Academic Press, Inc.

4 Raghvan V, 2004, "Experiments in material science", 5th edition, PHI Learning Pvt. Ltd

232PY2A1CQ	CORE PRACTICAL-II: ELECTRONICS - I	SEMESTER I

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Build the Waveform generation by Digital Cathode ray Oscilloscope using OP-AMP.
2	Construction of Hartley oscillator using OP-AMP.
3	Construction of a frequency response by Audio frequency Oscillator using Op-Amp
4	Construction of Differentiator, Integrator circuit to verify the Output by Cathode ray Oscilloscope using OP-AMP.
5	Construction of Adder, Subtraction, Sign Changer circuit using OP-AMP.
6	Assemble the Serial and parallel sequential circuits using Shift Register.
7	Determine the shift of output voltage using Clipping and Clamping Circuits.
8	Construct the Modulus counter using IC 7490.
9	Determine the Analog to digital Converter by Digital Multimeter using Op-Amp.
10	Assemble the parameters of Op-Amp.
11	Construct the Phase Shift Oscillator.
12	Study the characteristics of FET

Note: Any 10 experiments

References

1. Jones B K, 1986, "Electronics for Experimentation and research", Prentice-Hall.
2. Zbar P B., Malvino A P and Miller M A., 1994, "Basic Electronics: A text lab manual", Tata McGraw Hill, New Delhi.
3. Malvino A.P., 1992, "Basic Electronics - A text lab manual", Tata McGraw Hill.
4. Singh S P., 2003, "Advanced Practical Physics - Vol I & II", Pragati Prakasan Meerut

Course Code	Course Name	Category	L	T	P	Credit
232PY2A1DA	ENERGY PHYSICS	DSE	4		-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concept of energy resources
- The types of renewable energy and production of biomass
- The energy storage systems

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Relate the energy source and their importance	K1
CO2	Make use of the concept of hydro-power and wind power	K3
CO3	Categorize the energy from biomass, biofuels andgeothermal	K4
CO4	Analyze the solar energy and photo synthesis.	K4
CO5	Identify the energy systems, storage and transmission	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A1DA	ENERGY PHYSICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I **Energy Source** 10 h

Energy and sustainable development - Scientific principles of renewable energy - Properties of transparent materials - Heat transfer by mass transport - Multimode transfer and circuit analysis - Extraterrestrial solar radiation - Components of radiation - Effect of earth's atmosphere - Measurement of solar radiation.

Unit II **Hydro-power and Wind power** 9 h

Assessing the resource for small installations - Reaction turbines - Hydroelectric systems - Turbine types and terms - Linear momentum and basic theory - Dynamic matching - Blade element theory- Characteristics of the wind - Power extraction by a turbine - Electricity generation - Mechanical power.

Unit III **Biomass, Biofuels and Geothermal energy** 10 h

Biofuel classification - Biomass production for energy farming - Direct combustionfor heat - Pyrolysis (destructive distillation) - Alcoholic fermentation - Anaerobic digestion for biogas - Wastes and residues - Vegetable oils and biodiesel - Geophysics - Dry rock and hot aquifer analysis - Harnessing Geothermal Resources.

Unit IV **Solar Energy and Photo synthesis** 10 h

Air heaters - Water desalination - Solar ponds - Solar concentrators - Solar thermal electric power systems - Photon absorption at the junction - Solar radiation absorption - Maximizing cell efficiency -Solar cell construction - Types and adaptations of photovoltaics - Photovoltaic circuit properties - Thermodynamic considerations - Photophysics.

Unit V **Energy systems, Storage and Transmission** 09 h

Biological storage - Chemical storage - Heat storage - Electrical storage: batteries andaccumulators - Fuel cells - Mechanical storage - Distribution of energy - Electricalpower - Socio-political factors - Some policy tools.

Text Books

1 E Book: John Twidell and Tony Weir, 2006, "Renewable Energy Resources", 2nd Edition, Taylor & Francis Group

2 Rai G D, "Solar Energy Utilisation", 2014, Khanna Publishers, New Delhi

References

1 Kothari D P, Singal K C, RakeshRanjan, 2014, "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning (P) Ltd, New Delhi.

2 Kreith and Kreider, 1978, "Principles of Solar Engineering", McGraw Hill Pub, New Delhi

3 Sukhatme S P, 1996, "Solar Energy", TMH Publishers, New Delhi.

4 Meinel A B and MeinalA P, 1976, "Applied Solar Energy", S. Chand & Co. New Delhi.

5 https://www.slideshare.net/sanjanaangel16/ biomass-energy-ppt

6 https://www.google.com/url sa=t&source=web&rct= j&url=https://th.fhi-berlin.mpg.de/th/lectures/materialscience

Course Code	Course Name	Category	L	T	P	Credit
232PY2A1DB	MATERIALS PHYSICS AND PROCESSING TECHNIQUES	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The nucleation and growth techniques of crystals, thin films and nanomaterials
- The various plasma and vacuum processing techniques
- The structural, morphology, and surface characterization techniques

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Experiment with the growth process of crystals.	K3
CO2	Explain the methods of plasma processing	K2
CO3	Make use of the important concepts of vacuum techniques.	K3
CO4	Categorize the physical and chemical growth methods.	K4
CO5	Examine the various spectroscopic and microscopic characterization methods for materials.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓		✓
CO2				✓	
CO3	✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A1DB	MATERIALS PHYSICS AND PROCESSING TECHNIQUES	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I **Crystal Growth and Nucleation** 10 h

Nucleation phenomena: Critical supersaturation - Homogeneous and heterogeneous nucleation - Nucleation on a substrate - Nucleation of a crystalline material - Surface nucleation - Vapor–Liquid–Solid mechanism of crystal growth - Gibbs's free energy- Chemical potential - Solubility curves - Bridgman–Stockbarger and related techniques - Czochralski and related techniques.

Unit II **Thermal Plasma Processing** 10 h

Advantages of plasma processing - Thermal plasmas - Principles of plasma generation - DC plasma torches - AC plasma torches - RF plasma torches - Plasma-particle interaction - Plasma processing systems - Plasma-spraying - Plasma reactors and furnaces - Plasma decomposition - Processing of ceramics - Treatment of hazardous wastes.

Unit III **Vacuum Techniques** 9 h

Artificial vacuum - Natural vacuum - Applications of vacuum techniques - Calculation of vacuum systems - Vacuum pumps - Principles of pumping - Parameters and classifications - Mechanical pumps - Vapour pumps - Ion-pumps - Classification and selection of vacuum gauges - Thermal conductivity gauges - Pirani gauge.

Unit IV **Growth Technique of Thin films and Nanomaterials** 9 h

Thermal Evaporation: RF heating - Electron bombardment heating - Cathodic sputtering: Glow discharge sputtering - Reactive sputtering - Physical Vapor Deposition - Chemical Vapor Deposition - Sol-Gel Technique - Hydrothermal growth - Combustion synthesis - Microwave synthesis.

Unit V **Characterization Tools** 10 h

Working principles and instrumentation: X-Ray Diffraction - Raman spectroscopy - UV–vis spectroscopy - Photoluminescence spectroscopy - Fourier transform infrared spectroscopy - Scanning electron microscopy - Transmission electron microscopy - Scanning probe microscopy.

Text Books

1 Bhat H L, 2015, "Introduction to crystal growth principles and practice", CRC Press, Boca Raton, USA. (Unit 1)

2 Ananthapadmanabhan P V and Venkataramani N, 1999, "Thermal plasma processing", Pergamon Materials series Vol.2. (Unit 2)

References

1 Roth A, 1990, "Vacuum Technology", 3rd Edition, North Holland. (Unit 3).

2 Rajendra Kumar Goyal, 2018, "Nanomaterials and nanocomposites, synthesis,Properties, characterization techniques and applications", CRC Press, BocaRaton, USA. (Unit 4)

3 Hartmut Frey, Hamid R Khan, 2015, "Handbook of thin film technology", Springer-Verlag, Berlin. (Unit 4, 5).

4 Chopra K L, 1969, "Thin films phenomena", 1st Edition, McGraw Hill, New York.

5 Rajendran V, 2014, "Materials Science", Tata McGraw-Hill, New Delhi

6 https://doi.org/10.1142/9789812770387_0002

7 https://nanocomposix.com/pages/nanoparticle-characterization-techniques

Course Code	Course Name	Category	L	T	P	Credit
232PY2A1DC	LASER PHYSICS AND NONLINEAR OPTICS	DSE	4		-	4

PREAMBLE

This course has been designed for students to learn and understand

- The type of lasers, and their characteristics.
- The applications of lasers in industry and medicine.
- The theory and applications of non- linear optics.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain the principle and construction of various lasers.	K2
CO2	Identify the features of lasers.	K3
CO3	Apply the characteristics of LASER in various industrialand medical applications.	K3
CO4	Make use of the concepts of nonlinear optics in higher order harmonic generations.	K3
CO5	Examine the nonlinear optical interactions and make use in various applications.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A1DC	LASER PHYSICS AND NONLINEAR OPTICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I **Lasers Fundamentals and Types** 10 h

Principle of laser - Absorption process - Emission process - Characteristics of laser - Einstein relation - Laser operation - Population inversion and derivation of threshold gain - Gain medium - Optical feedback - Active medium - Laser types - He-Ne laser - CO_2 laser - Nd:YAG laser- Semiconductor laser - Liquid dye laser.

Unit II **Laser Characteristics** 9 h

Threshold conditions - Line shape function with Doppler broadening - Population inversion and pumping threshold - High intensity laser - Laser modes and mode locking - Mode locking method - Q switching and techniques - Frequency stabilization.

Unit III **Laser Applications** 9 h

Industry - Medical application of laser - Safety aspects in laser usage - Laser Doppler velocity meter - Laser strain gauges - Holography: Operating principle - Construction and reconstruction of hologram - Simplified theory of holography - Holographic memory - Laser machining processes - Laser spectroscopy.

Unit IV **Introduction to Nonlinear Optics** 10 h

Introduction to nonlinear optics - Descriptions of nonlinear optical processes - Second harmonic generation - Optical parametric oscillation - Third-order nonlinear optical processes - Third-harmonic generation - Nonlinear susceptibility - Properties of the nonlinear susceptibility.

Unit V **Non Linear Optical Interactions** 10 h

The wave equation for nonlinear optical media - Phase matching - Quasi-phase matching - The Manley Rowe relations - Sum frequency generation - Difference frequency generation and parametric amplification - Nonlinear optical interactions with focused Gaussian beams.

Text Books

1 Nagabhushana S, Sathyanarayana N, 2013, "Laser and Optical Instrumentation", IK International Publishing House Pvt Ltd, New Delhi

2 E Book: Robert W. Boyd, 2008, "Nonliner Optics", 3rd Edition, Academic Press)

References

1 AvadhanuluM. N., Hemne P.S., 2013, " An Introduction to Lasers theory and applications", S. Chand and Co., New Delhi.

2 Richard L Sutherland, 2003, "Handbook of Nonlinear Optics", Marcel Dekker AG)

3 Laud LL, 1991, "Lasers and Nonlinear Optics", 2nd Edition, NewAge International (P) Ltd, New Delhi.

4 Skoog D A, Holler F J and Crouch S R, 2007, "Principles of Instrumental Analysis", Thomson Brooks/Cole, Belmont, CA.

5 https://www.youtube.com/watch?v=PK4yFaGHSFc&list=PLU0oJASIjGxdZMtypwhvGrnmuzNnNdcKt

6 https://www.youtube.com/watch?v=Ab1nxxkgjH8&list=PLp6ek2hDcoNC_QQA2CmW1JIHAm5aD7o

12/6/2023
BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Scie
APPROVED
SC - 15th 12.6.23
AC - 15th 14.7.23
GB - 20th 5.8.23

Academic Council
Dr.N.G.P. Arts and Science College
CHAIRMAN

Course Code	Course Name	Category	L	T	P	Credit
232PY2A2CA	SPECTROSCOPY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The different techniques of spectroscopy and their applications
- The IR, microwave, Raman spectroscopy and their instrumentation
- The nuclear magnetic resonance, electron spin resonance, nuclear quadrupole resonance and Mossbauer spectroscopy

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Apply the concepts of microwave spectroscopy to identify various chemical compounds	K3
CO2	Illustrate the modes of vibration in molecules using IR spectroscopy.	K3
CO3	Apply the theory of Raman spectroscopy for structure determination of organic and inorganic compounds.	K4
CO4	Interpret the spectra of nuclear magnetic resonance and electron spin resonance.	K2
CO5	Explain the principle of nuclear quadrupole resonance and Mossbauer spectroscopy.	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓		✓		
CO4		✓			✓
CO5		✓			✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A2CA	SPECTROSCOPY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Microwave Spectroscopy — 9 h

Rotation of molecules – Rigid rotator (diatomic molecules) - Expression for rotational constant - Intensity of spectral lines - Theory of microwave spectra of linear and symmetric top molecules – Techniques and instrumentation - Chemical analysis by microwave spectroscopy.

Unit II Infrared Spectroscopy — 9 h

Vibrational energy of a diatomic molecule- Infrared selection rules -Vibrating diatomic molecule - Normal modes of vibration in crystal - Interpretation of vibrational spectra - Group frequencies - IR spectrophotometer instrumentation - Sample handling techniques - Fourier transform infrared spectroscopy (principle and working) - Applications.

Unit III Raman Spectroscopy — 10 h

Theory of Raman scattering - Rotational Raman spectra - Vibrational Raman spectra - Mutual exclusion principle - Raman spectrometer - Sample handling techniques - Polarization of Raman scattered light - Structure determination using IR and Raman spectroscopy - Raman investigations of phase transitions - Resonance Raman scattering - Surface selection rules - SERS microprobe – Applications of SERS.

Unit IV Nuclear Magnetic Resonance and Electron Spin Resonance Spectroscopy — 10 h

Theory of NMR method – Resonance condition – NMR Instrumentation – Relaxation processes - Bloch equations - Chemical shift – Spin-spin coupling –Interpretation of certain NMR spectra.

Principle of ESR - ESR spectrometer – Total Hamiltonian – Hyperfine structure – ESR spectra of free radicals in solution.

Unit V Nuclear Quadrupole Resonance and Mossbauer Spectroscopy — 10 h

Principle of nuclear quadrupole resonance – Transitions for axially and non-axially symmetric systems – NQR instrumentation – Crystallographic inequivalence - Chemical bonding – Hydrogen bonding.

The Mossbauer effect -Recoilless emission and absorption - Experimental techniques -Isomer shift – Quadrupole Interaction - Magnetic hyperfine interaction – Applications.

Text Books

1 Aruldhas G, 2017, "Molecular Structure and Spectroscopy", 2nd edition, Prentice Hall of India Pvt. Ltd & New Delhi.

2 Colin N Banwell and Elaine M McCash, 2016, "Fundamentals of Molecular Spectroscopy", 4th edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

References

1 William Kemp, 2002, "Organic Spectroscopy", 3rd edition, Palgrave Publishers Ltd, New York.

2 Jag Mohan, 2004, "Organic Spectroscopy - Principles and Applications", 2nd edition, Narosa Publishing House Pvt. Ltd, New Delhi.

3 Sharma YR, 2013, "Elementary Organic Spectroscopy – Principles and Chemical Applications", 3rd edition, S. Chand & Company Pvt. Ltd, New Delhi.

4 Straughen R P and Walker S, 1976, "Spectroscopy", Vols. I, II and III", 2nd edition Chapman & Hall, London.

5 http://www.rnlkwc.ac.in/pdf/study-material/chemistry/Spectroscopy.pdf.

6 https://microbenotes.com/infrared-ir-spectroscopy

7 NPTEL Video: www.youtube.com/watch?v=g2sqX3FkcRo&list=PLOzRYVm0a65eCqECeSQJwmKX6D4zibX84

Course Code	Course Name	Category	L	T	P	Credit
232PY2A2CB	SOLID STATE PHYSICS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamentals of crystallography.
- The crystal imperfections and atomic diffusion.
- The free electron and band theory.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain the concepts and understand the applications of crystal structure.	K2
CO2	Summarize the diffraction nature and properties of lattice.	K2
CO3	Relate the crystal imperfection and atomic diffusion.	K3
CO4	Interpret the lattice vibration and thermal properties.	K3
CO5	Analyze the free electron and band theory.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2		✓			✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	
CO5	✓		✓	✓	

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A2CB	SOLID STATE PHYSICS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I **Fundamentals of Crystallography and Bonding in solids** **12 h**

The solid state –Periodicity in crystals - Bravais lattices in three dimension –Rational features of a crystals and miller indices - Interplanar spacing - Simple and common crystal structures (SC, BCC, FCC, Diamond, NaCl,) - Forces between atoms – Ionic bonding – The Born-Haber Cycle – Covalent bonding – Metallic bonding – Hydrogen bonding – Van der Waals bonding

Unit II **Diffraction of Waves and Particles by Crystals** **12 h**

X-rays and their generation - Moseley's law - X-ray Diffraction - Bragg's law - Correction for Bragg's equation - Laue equation - Interpretation of Braggs equation - Ewald construction - Reciprocal lattice - Properties of reciprocal lattice -Reciprocal lattice to BCC & FCC lattice - X-Ray Diffraction experiment - Powder diffractometer - Electron Diffraction - Neutrons Diffraction.

Unit III **Crystal Imperfections and Atomic Diffusion** **12 h**

Crystal imperfections: Point imperfections – Concentrations of point imperfection – Line imperfections – Burgers Vector – Presence of dislocation – Surface imperfections - Ficks first and second law – Atomic diffusion: Diffusion mechanism – Random walk treatment of diffusion – Kirkendall effect - Diffusion in alkali halides.

Unit IV **Lattice Vibration and Thermal Properties** **12 h**

Lattice Vibration: Dynamics of the chain of identical atoms - Symmetry in K space - Number of modes in the first zone Low wavelength limit - Phase and group velocities - Dynamics of a diatomic linear chain - The acoustic branch - The optical branch - Anharmonicity and thermal expansion - Thermal properties: the classical model - Einstein's theory of specific heat - Density of states.

Unit V **Energy Band Theory and Fermi Surface** **12 h**

Energy Band Theory: Bloch theorem - Kronig – Penney model - Construction of Fermi surfaces - Extended, Reduced, and periodic zone schemes – Nearly free electron model - Tight binding approximation –Fermi surface: Fermi surface and

Brillouin zones - Characteristics of Fermi surfaces - Experimental study of Fermi surfaces: Anomalous skin effect - Cyclotron resonance - De Haas Van Alphen effect.

Text Books

1 Wahab M.A, 2019, "Solid State Physics", 3rd edition, Narosa Publication, New Delhi.

2 Charles Kittel, 2017, "Introduction to Solid State Physics", 8th edition, Wiley India Pvt. Ltd, New Delhi.

References

1 Pillai S O, 2018, "Solid State Physics", 8th edition, New age international Publisher.

2 Gupta S L, Kumar V, 2018, "Solid state Physics", 9th edition, K. Nath & Co., Meerut.

3 Philip Phillips, 2012, "Advanced Solid-State Physics", 2nd Edition, Cambridge University Press.

4 Patterson J D, Bailey B C, 2007, "Solid-State Physics: Introduction to the Theory", Springer Publications.

5 Puri R K, Babbar V K,2010, "Solid State Physics", S. Chand, New Delhi.

6 https://www.fzu.cz/~knizek/literatura/Ashcroft_Mermin.pdf

7 http://www.issp.ac.ru/ebooks/books/open/Introduction%20to%20Modern%20Solid%20State%20Phys.pdf

Course Code	Course Name	Category	L	T	P	Credit
232PY2A2CC	QUANTUM MECHANICS - I	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- Enable to learn Schrödinger wave equation
- Apply quantum mechanics to dimensional wave equations
- Find the solution for identical particles.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Extend the idea and applications of Schrödinger wave equation.	K2
CO2	Utilize the principle of moment of inertia for experimental verification.	K3
CO3	Apply quantum mechanics to three-dimensional wave equations.	K3
CO4	Generalize the Heisenberg and Schrödinger wave equations.	K2
CO5	Analyze the angular momentum and the system of identical particles.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2		✓	✓	✓	✓
CO3		✓			✓
CO4		✓			✓
CO5	✓		✓	✓	

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A2CC	QUANTUM MECHANICS - I	SEMESTER II

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I **Foundations of Quantum Mechanics** **12 h**

Postulates of quantum mechanics - Wave packet, Eigen values and functions – Hermitian operator - Free particle – Operator for momentum and energy – Interpretation of the wave function – Probability of interpretation, expectation value - Schrödinger equation, Ehrenfest's theorem.

Unit II **Eigen Spectrum, Identical Particles** **12 h**

Equation of motion – Schrödinger, Heisenberg and interaction representation - Square well potential with rigid walls - Square well potential with finite walls - Square well potential barrier - Alpha emission - Identical particles – Exchange operator.

Unit III **Three-Dimensional Problems and Angular Momentum** **12 h**

Particle in a spherical well - Hydrogen atom – Rigid rotator - Angular momentum operator – Eigen value and eigen function of L_2 and L_z – Eigen value of J_2 and J_z – Addition of angular momenta – Clebsh Gordan coefficients.

Unit IV **Matrix Formulation, Spin of Quantum Theory** **12 h**

Eigen values and eigen vector of matrices - Hilbert space - Dirac's Bra-Ket notation - 1D harmonic oscillator in matrix mechanics - Pauli's exclusion principle - Inclusion of spin – Spins functions for two electrons.

Unit V **Scattering Theory** **12 h**

Scattering by a perfectly rigid sphere - Scattering by a coulomb field - Green's functions – Born approximation and its validity – Scattering by a square well potential – Scattering from an exponential potential.

Text Books

1 Aruldhas G, 2016 "Quantum Mechanics", 2nd Edition, PHI Learning (P) Ltd.

2 Rajasekar Shanmuganathan, Velusamy R, 2014, "Quantum Mechanics I-The Fundamentals", CRC Press.

References

1 Leonard I Schiff, 2016, "Quantum Mechanics", 3rd Edition, McGraw- Hill International Publication.

2 Thankappan V.K, 2018, "Quantum Mechanics", 2nd Edition, New Age International (P) Ltd.

3 Satya Prakash, Kedar Nath, 2018, "Quantum Mechanics", 5th Edition, Ram Nath and Co. Publications.

4 Merzbacher E, 2011, "Quantum Mechanics", 3rd Edition, John Wiley Interscience Publications.

5 https://www.youtube.com/watch?v=oEWsimmWy5E&t=2s

6 https://library.samdu.uz/files/91637c05b4db59f81df4953d6ad54973_Foundations_of_Quantum_Mechanics_An_Exploration_of_the_Physical.pdf

232PY2A2CP	CORE PRACTICAL -III : SOLID STATE AND SPECTROSCOPY	SEMESTER II

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Determination of optical activity of specific rotation using Polarimeter.
2	Determination of viscosity of a liquid by Mayers method.
3	Determination of e /m by Thomson method.
4	Determination of susceptibility by Quinke's method.
5	Determination of e/m by Magnetron method.
6	Study of Band gap energy using Thermistor.
7	Determination of Hall coefficient using Hall Effect.
8	Determination of Refractive index of liquid by Newton's ring.
9	Determination of the bandgap of the material using four probe method.
10	Find the Young's modulus of a material by Hyperbolic fringes.
11	Determination of Planck 's constant.
12	Study the Characteristics of Solar cells.

Note: Any 10 experiments

References

1 Raghvan V, 2004, "Experiments in material science", 5th edition, PHI Learning Pvt. Ltd., New Delhi.

2 Samir Kumar Ghosh, 2008, "Textbook of Advanced Practical Physics", NCBA publishers.

3 Arora C.L, 2010, "B.Sc. Practical Physics", S. Chand.

4 Smith E V, 1970, "Manual for experiments in Applied Physics", Butterworths.

232PY2A2CQ	CORE PRACTICAL IV: ELECTRONICS - II	SEMESTER II

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Construction of Colpitt's oscillator using Op-Amp.
2	Study the Schmitt trigger using OP-Amp.
3	Study the static and drain characteristics of a JFET.
4	Construct analog to digital converter using IC 741.
5	Construct inverting, non-inverting and voltage follower using Op-Amp.
6	Study the half adder, full adder, half subtractor and full subtractor using ICs.
7	Construction of bistable multivibrator using Op-amp 741/NE 555.
8	Study the characteristics of BJT.
9	Construct the Log amplifier using Op-amp 741.
10	Construct an astable multivibrator using IC 741.
11	Construct second order low and high pass filters using IC 741.
12	Study the characteristics of MOSFET.

Note: Any 10 experiments

References

1. Ouseph C.C , 2014, "Practical Physics and Electronics", Viswanathan Publishers Ltd.
2. Bhattacharya A.B , 2011, "Advanced Electronic Practicals", New Central Book Agency (NCBA).
3. Chattopadhyay D , 2015, "Advanced Course in Practical Physics", New Central Book Agency (NCBA).
4. Samir Kumar Ghosh, 2013, "Text Book of Advanced Practical Physics", New Central Book Agency (NCBA).

Course Code	Course Name	Category	L	T	P	Credit
232MT2A2EA	NUMERICAL METHODS	EDC	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The method of solving algebraic and transcendental equations.
- The effectiveness of numerical solution over analytical solution.
- Error analysis of a method to examine its accuracy.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Discuss numerical solution of algebraic and transcendental Equation.	K2
CO2	Discuss errors in polynomial interpolation & detection of errors by difference table.	K2
CO3	Apply the concept of numerical differentiation and integration.	K4
CO4	Compute the solution of system of equations by Gauss elimination and Seidal method.	K3
CO5	Estimate the solution of ordinary differential equations.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2	✓	✓	✓		
CO3	✓	✓	✓		
CO4		✓		✓	
CO5		✓			✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232MT2A2EA	NUMERICAL METHODS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Solution of Algebraic and Transcendental Equations 9 h

Introduction - bisection method - iteration method - method of False Position - Newton-Raphson method - Ramanujan's method - Graeffe's Root-Squaring method.

Unit II Solution of Linear Systems 10 h

Direct Methods: Gaussian Elimination method - modification of the Gauss Method to compute the inverse - method of factorization - solution of tridiagonal systems - solution of linear systems: iterative methods - Householder's method.

Unit III Interpolation 9 h

Introduction - errors in polynomial interpolation - finite differences - detection of errors by difference tables - differences of a polynomial - Newton's formulae - Gauss's central difference formulae - Stirling's formula - interpolation with unevenly spaced points: Lagrange's interpolation formula - error in Lagrange's interpolation formula - Hermite's interpolation formula.

Unit IV Numerical Differentiation and Integration 10 h

Introduction - numerical differentiation - maximum and minimum values of a tabulated function - numerical integration - Trapezoidal rule - Simpson's 1/3 Rule - Simpson's 3/8 Rule - Boole's and Weddle's Rules

Unit V Numerical Solution of Ordinary Differential Equations 10 h

Introduction - solution by Taylor's series - Picard's Method - Euler's Method - Runge-Kutta Methods - Predictor Corrector Methods.

Note: Distribution of marks 80% Problems and 20% Theory.

Text Books

1 Sastry S.S., 2012, "Introductory methods of Numerical Analysis", 5th Edition, Prentice-Hall of India, New Delhi.

References

1 Venkataraman M.K, 1999, "Numerical Methods in Science and Engineering", 5th edition, National Publishing Company, Chennai.

2 Grewal B.S, 2010, "Numerical Methods in Engineering & Science: with Programs in C and C++", 10th edition, Khanna Publishers, New Delhi.

3 Jain M.K., Iyengar S.R.K. and Jain, R.K., 2012, "Numerical methods for Scientific and Engineering Computation", 6th edition, New Age International, New Delhi.

4 Curtis F.Gerald, 2007, "Applied Numerical Analysis", 7th edition, Pearson Education India Ltd., New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
232PY2A2DA	PHYSICS OF NANOMATERIALS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The classification of nanomaterials and their synthesis methods.
- The properties of special nanomaterials.
- The characterization techniques of nanomaterials.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain the classification of nanomaterials.	K2
CO2	Explain the properties of special nanomaterials.	K2
CO3	Apply to physical properties of nanomaterials.	K3
CO4	Relate the synthesis of nanoparticles using various methods	K3
CO5	Analyze the material characterization techniques.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2		✓			✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	
CO5	✓		✓	✓	

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A2DA	PHYSICS OF NANOMATERIALS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I **Classification of Nanomaterials** **10 h**

Definition of zero, one, two and three dimension nanomaterials – Surface energy – Chemical potential as a function of surface curvature – Electrostatic stabilization: Surface charge density - DLVO theory - Steric stabilization: solvent and polymer.

Unit II **Special Nanomaterials** **10 h**

Carbon fullerenes and nanotubes: Carbon fullerenes, Fullerene derived crystals, Carbon nanotubes - Micro and Mesoporous Materials: Ordered mesoporous structures - Random mesoporous structures - Crystalline microporous materials: zeolites - Organic-inorganic hybrids: Class 1 hybrids - Class 2 hybrids.

Unit III **Properties** **9 h**

Physical properties of nanomaterials: Melting points and lattice constants – Mechanical properties – Optical properties: Surface plasmon resonance – Quantum size effects – Electrical property: Surface scattering - Change of electronic structure - Quantum transport - Effect of microstructure.

Unit IV **Synthesis** **10 h**

Physical vapour deposition: Evaporation - Molecular beam epitaxy - Sputtering - Chemical vapour deposition: Typical chemical reaction - Reaction kinetics – CVD methods - Atomic layer deposition - Superlattices - Sol-Gel Films.

Unit V **Characterization** **9 h**

Structural characterization: X-Ray diffraction – Scanning electron microscopy – Transmission electron microscopy - Scanning probe microscopy – Chemical characterization: Optical spectroscopy - Electron spectroscopy - Ion spectroscopy.

Text Books

1 Guozhong Cao, 2017, "Nanostructures & amp; nanomaterials: Synthesis, properties & applications", 2nd edition, World Scientific Publishing Co. Pvt. Ltd.

2 Rajendran V, 2010, "Processes and Characterization of Advanced Nanostructured materials" 1st edition, Macmillan, India.

References

1 Chattopadhyay K K, Banerjee A A, 2009, "Introduction to Nanoscience and Nanotechnology" 2nd edition, PHI Learning private Limited.

2 Pradeep T, 2007, "Nano-The Essentials" Tata McGraw-Hill publishing company limited, New Delhi.

3 Chris Binns, 2010, "Introduction to Nanoscience and Nanotechnology" John Wiley & Sons, New Jersey.

4 Charles P. Poole Jr, Frank, Ownes, 2003 "Introduction to Nanotechnology" Sathyam Enterprise, New Delhi

5 Alain nouailhat, 2008,"An Introduction to Nanoscience andNanotechnology"2nd edition, Wiley.

6 https://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf

7 https://etp-nanomedicine.eu/wp-content/uploads/2018/10/nano-hands-on-activities_en.pdf

Course Code	Course Name	Category	L	T	P	Credit
232PY2A2DB	EXPERIMENTAL DESIGN	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The applications of various measurements instruments.
- The fundamental concepts of monitoring systems and their applications.
- The concept of optoelectronic devices.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Summarize the concepts of measurements and error	K2
CO2	Apply the tools used in electronic and digital instruments.	K3
CO3	Demonstrate the mechanisms of transducer systems.	K2
CO4	Outline the classification and applications of optical fibers.	K4
CO5	Illustrate the concept of optoelectronic devices techniques.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2	✓	✓	✓		✓
CO3		✓			✓
CO4	✓		✓	✓	
CO5	✓	✓	✓		✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A2DB	EXPERIMENTAL DESIGN	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I **Concepts of Measurements and Error** **10 h**

Measurement - Instrumentation - Classification of instruments - Factors relating to selection of instruments - Functions of instruments - Accuracy, errors and correction - Application of measurement system - Limiting errors - Types of errors - Sources of errors..

Unit II **Electronic and Digital Instruments** **10 h**

Essentials of an electronic instrument - Advantages - Electronic voltmeter - Types of electronic voltmeters - Vacuum tube voltmeters - Differential voltmeter (D.C) - Analog and digital system - Basic concepts of digital instruments - Digital voltmeter - Advantages - Characteristics - Applications.

Unit III **Transducers** **9 h**

Classification of transducers - Resistive, inductive and capacitive pressure transducer - Linear variable differential transformer (LVDT) - Piezoelectric transducer - Photoelectric transducers - Carbon microphone - Ribbon microphone - Moving coil microphone - Crystal microphone.

Unit IV **Fiber Optics** **10 h**

Structure of optical fiber - Classification of optical fiber - Propagation of light - Total internal reflection - Fiber characteristics - Splicing and connector - Fusion splices - Fiber optic communications - Advantage and disadvantage - Application of fiber optic communication.

Unit V **Optoelectronic Devices** **9 h**

Spectral response of human eye - Light emitting diode - Photoemissive devices - Photomultiplier tube - Photovoltaic devices - Type photoconductive cells - photodiodes - PN junction - PIN - Avalanche photodiode.

Text Books

1 Theraja B L, 2014, "Basic Electronics", 3rd edition, S. Chand Publisher, New Delhi.

2 Rajput R K, 2008, "Electronic measurements and Instrumentation", 2nd edition, S. Chand Publisher, New Delhi

References

1 Sawhney A K, 2013,"A Course in Electronic Measurements and instrumentation", 2nd edition, International publishing house, New Delhi

2 Alan S Morris, 2013, "Measurement and instrumentation", 3rd edition, AP publisher, New Delhi.

3 Deb A C, 2011, "Fundamentals of Biochemistry", 3rd edition, New central book agency.

4 John G. Webster, 2010, "Medical Instrumentation Application and design", 2nd edition, John Wiley & Sons publication, New Delhi

5 Fulekar M H, 2013, "Bioinstrumentation", 3rd edition, International publishing house, New Delhi.

6 https://circuitglobe.com/measurement-error.html

7 https://www.youtube.com/watch?v=8vKo_TBBX8E

Course Code	Course Name	Category	L	T	P	Credit
232PY2A2DC	MEDICAL PHYSICS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basic characteristics and production of X-rays.
- The fundamental concepts of radiation physics and its applications.
- The concept of radiation therapy techniques and radiation protection devices.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Summarize the characteristics and production of X-rays.	K2
CO2	Outline the theory of radiation and various radiation chambers.	K4
CO3	Explain the principle and function of various imaging system.	K3
CO4	Infer the basic radiation therapy techniques.	K2
CO5	Illustrate the various measures and radiation protection devices.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2	✓		✓	✓	
CO3		✓	✓		✓
CO4		✓			✓
CO5		✓	✓		✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A2DC	MEDICAL PHYSICS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I X-Rays **10 h**

Electromagnetic spectrum - Production of X-rays - X-ray spectra - Brehmsstrahlung - Characteristics of X-ray - X-ray tubes - Coolidge tube - X-ray tube design - Tube cooling - Stationary Mode - Rotating anode X-ray tubes - Quality and intensity of X-rays - X-ray generator circuits - Half wave and full wave rectification - Filament circuit - Kilo voltage circuit.

Unit II Radiation Physics **10 h**

Radiation units - Exposure - Absorbed dose - Rad gray - Kera relative biological effectiveness - Effective dose - Inverse square law - Interaction of radiation with matter - Radiation detectors - Thimble chamber - Condenser chambers - Geiger counter - Ionization chamber - Dosimeters - Survey methods - TLD and semiconductor detectors.

Unit III Medical Imaging Physics **9 h**

Radiological imaging - Radiography - Filters - Grids - Cassette - X-ray film - Film processing - Fluoroscopy - Computed tomography scanner - Generations - mammography - Ultrasound imaging - Magnetic resonance imaging - Thyroid uptake system - Gamma camera (Only Principle, function, and display).

Unit IV Radiation Therapy Physics **10 h**

Radiotherapy - Kilo voltage machines - Deep therapy machines - Tele-cobalt machines - Basics of teletherapy units - Medical linear accelerator - Radiation protection - External beam characteristics - Phantom - Dose maximum and build up - Bolus - Percentage depth dose - Tissue - Air ratio - Back scatter factor.

Unit V Radiation Protection **9 h**

Principles of radiation protection - Protective materials - Radiation effects - Somatic, genetic stochastic and deterministic effect, Personal monitoring devices - TLD film badge - Pocket dosimeter.

Text Books

1 Thayalan K, 2003, "Basic Radiological Physics", 2nd edition, Jayapee Brothers Medical Publishing Pvt. Ltd., New Delhi

2 Khan F M, 2003, "Physics of Radiation Therapy", 3rd edition, Williams and Wilkins

References

1 Bushberg, Seibert, Leidholdt, 2002, "The Essential Physics of Medical Imaging" 2nd edition, Williams and Wilkins

2 Scott, K N, Mathur A K, 2007 "Textbook of Biomedical Instrumentation" CBS publisher, New Delhi.

3 Fulekar M H, 2013, "Bioinstrumentation", 2nd edition, International publishing house, New Delhi

4 Mandeep Singh, 2014, "Introduction to Biomedical Instrumentation, PHI Publisher, New Delhi

5 John G, Webster, 2010, "Medical Instrumentation Application and Design" John Wiley & Sons publication

6 https://indico.cern.ch/event/34840/attachments/687622/944392/Silari_Summer_Students_lecture_01.08.08.pdf

7 http://ijlalhaider.pbworks.com/w/file/fetch/70354430/IP447_BIB.pdf

18/10/2023

BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and S...
APPROVED

BoS - 16th	AC - 16th	GB - 21st
18.10.2023	13.12.2023	05.01.2024

Academic Council
Dr.N.G.P. Arts and Science College
CHAIRMAN

Course Code	Course Name	Category	L	T	P	Credit
232PY2A3CA	QUANTUM MECHANICS – II	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of fundamental laws of quantum mechanics
- The basic Klein-Gordon equation and Dirac equation.
- The concepts of micro and macroscopic properties of the mater.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Outline on the approximation methods and its applications.	K2
CO2	Explain the scattering theory and partial wave analysis	K2
CO3	Recall on Time independent perturbation theory and its simple applications.	K3
CO4	Discuss the Klein-Gordon equation, Dirac equation and interpretation of negative energy states.	K3
CO5	Interpret Euler Lagrange's and Hamiltonian formulation.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	

COURSE FOCUSES ON

✓	Skill Development	-	Entrepreneurial Development
✓	Employability	✓	Innovations
-	Intellectual Property Rights	-	Gender Sensitization
✓	Social Awareness/ Environment	-	Constitutional Rights/ Human Values/ Ethics

232PY2A3CA	QUANTUM MECHANICS – II	SEMESTER III

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Approximation Methods 12 h

Time Independent Perturbation Theory – Non-Degenerate Energy Levels – First and Second Order - Degenerate Energy Levels – Variation Method: Upper Bound on Ground State Energy – Hydrogen Molecule – Exchange Interaction - WKB Approximation: One Dimensional Schrodinger Equation – Bohr Somerfield Quantum Condition – Barrier Penetration.

Unit II Scattering Theory 12 h

Partial Waves – Significant Number of Partial Waves – Partial Wave Analysis – Asymptotic Behavior of Partial Waves – Phase Shifts - Scattering Amplitudes in Terms of Phase Shifts – Differential and Total Cross Section: Optical Theorem – Phase Shifts: Relation to The Potential – Transformation from Centre of Mass to Lab Frame.

Unit III Time Dependent Perturbation Theory 12 h

Introduction – Transition probabilities – Constant and Harmonic perturbations – Transition probabilities – Fermi's golden rule – Selection rules for dipole radiation – Adiabatic approximation – Sudden approximation – Magnetic resonance – Semi-Classical treatment of an atom with electromagnetic radiation.

Unit IV Relativistic Quantum mechanics 12 h

Klein-Gordon Equation and Its Interpretation – Equation of Continuity - Dirac Equation for A Free Particle – Dirac Matrices – Covariant Form of Dirac Equation - Probability Density - Plane Wave Solutions – Interpretation of Negative Energy States – Antiparticle - Spin of Dirac Particle.

Unit V Classical Fields and Second Quantization 12 h

Classical Fields – Euler Lagrange Equations – Hamiltonian Formulation – Noether's Theorem - Quantization of Real and Complex Scalar Fields: Creation, Destruction and Number Operators - Fock States - Second Quantization of K.G. Field.

Text Books

1 Aruldhas, G.2008,"Quantum mechanics", 2nd edition, Prentice Hall of India, Pvt. Ltd, New Delhi.

2 P.M. Matthews and K. Venkatesan. 2010, "A textbook of Quantum Mechanics", 2nd edition, McGraw Hill Education (India) Private Limited, New Delhi.

References

1 J.L. Powell and B. Crasemann.,1961,"Quantum Mechanics",2nd edition Addison-Wesley Pub.

2 P.A.M. Dirac.2013,"The principles of Quantum mechanics",2nd edition, Igal Meirovich Publication.

3 L.D. Landau and E.M.Lifshitz.2013., "Quantum Mechanics", 3rd edition, Pergamon.

4 Thankappan, V.K.2012.,"Quantum Mechanics", 3rd edition, New Age International Publishers, Delhi.

5 Schiff , L.I.1968,"Quantum Mechanics",3rd edition, McGraw Hill Education (India) Private Limited, New Delhi.

6 https://www.qms.physik.uni-rostock.de/storages/uni-rostock/Alle_MNF/Physik_Qms/Lehre_Scheel/quantenoptik/Quantenoptik- Vorlesung3.pdf

7 http://www.physics.usu.edu/Wheeler/ClassicalMechanics/CMNoetherTheorem.pdf

Course Code	Course Name	Category	L	T	P	Credit
232PY2A3CB	ELECTROMAGNETIC THEORY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamental theories that explain electrostatics and magnetostatics.
- The electrodynamics principle for explaining the electromagnetic wave propagation.
- The analytical problems of relativistic systems in electrodynamics.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Summarize the fundamentals of electrostatics	K2
CO2	Outline the concepts of magnetostatics	K2
CO3	Develop the skills to solve problems of motion of charged particles in various fields	K3
CO4	Analyze the concept of electromagnetic theory in electromagnetic waves	K4
CO5	Examine the electrodynamics of radiating and relativistic systems	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	□
CO2				✓	
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A3CB	ELECTROMAGNETIC THEORY	SEMESTER III

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Electrostatics **12 h**

Coulomb's law - The electric field – Line, Flux and Gauss's Law - Divergence of E - Application of Gauss's law – Curl of E - Poisson's equation - Laplace's equation – Work and energy in electrostatics: Energy of a point charge distribution – Energy of continuous charge distribution – Induced charges – Capacitors - Laplace equation in one dimension and two dimensions – Electric Fields in matter: Dielectrics – Induced dipoles – Gauss's Law in the presence of dielectrics.

Unit II Magnetostatics **12 h**

Lorentz force – Magnetic fields – Magnetic forces – Currents – Biot-Savart Law – Divergence and curl of B – Ampere's Law - Comparison of magnetostatics and electrostatics – Magnetic vector potential - Effect of magnetic field on atomic orbit – Ampere's Law in magnetized materials – Ferromagnetism.

Unit III Electromotive Force **12 h**

Motional emf – Electromagnetic induction - Faraday's Law – Induced electric field – Inductance – Energy in magnetic field – Maxwell's equation in free space and linear isotropic media – Boundary conditions - Continuity equation – Poynting theorem. Waves in one dimension: Wave equation – Sinusoidal waves – Reflection and transmission – Polarization.

Unit IV Electromagnetic Waves **12 h**

The wave equation for E and B – Monochromatic Plane waves – Energy and momentum in electromagnetic waves – Electromagnetic waves in matters - TE waves in rectangular wave guides – The co-axial transmission line - Scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form.

Unit V Relativistic Electrodynamics **12 h**

Four vectors and Tensors – Transformation equations for charge and current densities - Transformation equations for the Electromagnetic Potentials – The Electromagnetic Field Tensor – Transformation Equations for Electric and Magnetic

field Vectors – Covariance of Maxwell Equations in four Vector forms and in four Tensor forms – Covariance and Transformation Law of Lorentz Force.

Text Books

1 David J. Griffiths, 2013, Introduction to Electrodynamics, 4th Edition, Pearson.

2 Chopra K. K and Agarwal G. C, 2017, Electromagnetic Theory, 6th Edition, K. Nath & Co.

References

1 John David Jackson, 1999, Classical Electrodynamics, 3rd Edition, John Wiley & Sons.

2 Gupta S.L and Kumar V, 2017, Electrodynamics, 24th Edition, Pragati Prakashan.

3 Laud B.B, 2011, Electromagnetics, 3rd Edition, New Age International Publisher.

4 Sathya Prakash, 2019, Electromagnetic Theory and Electrodynamics, Kedarnath Ramnath and Co., Meerut.

5 https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004

6 NPTEL Video: https://www.youtube.com/watch?v=G5P6dInMTFg&list=PLuv3GM6-gsE3-hVNaw-YEb7EeY5XVPZdz

7 NPTEL Video: https://www.youtube.com/watch?v=pGdr9WLto4A&list=PLl6m4jcR_DbOx6s2toprJQx1MORqPa9rG

Course Code	Course Name	Category	L	T	P	Credit
232PY2A3CC	CONDENSED MATTER PHYSICS	CORE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- The concept of free electrons in crystals.
- The thermal, and optical properties of the materials.
- The magnetic properties and superconductors.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of free electrons in crystals	K2
CO2	Analyze the thermal and optical properties of materials	K2
CO3	Interpret the dielectric properties of materials	K3
CO4	Obtain knowledge on magnetic properties of materials.	K3
CO5	Expand knowledge on superconductors	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	□
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓		✓
CO5	✓	✓	✓	✓	

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A3CC	CORE: CONDENSED MATTER PHYSICS	SEMESTER III

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I **Free Electrons in Crystal** **9 h**

Electrons Moving In 1D Potential Well - Fermi Dirac Statistics - Electrical Conductivity of Metals - Relaxation Time and Mean Free Path - Electrical Conductivity and Ohms Law - Wiedemann Franz Lorentz Law - Electrical Resistivity of Metals - The Hall Effect

Unit II **Thermal and Optical Properties of Materials** **9 h**

The Specific Heat of Solids -Debye Model -Thermal Conductivity of Solids - Thermal Conductivity Due to Electrons Thermal Conductivity Due Phonons - Thermal Resistance of Solids-Photoconductivity - Photoelectric and Photovoltaic Effect - Photoluminescence.

Unit III **Semiconducting and Dielectric Properties of Materials** **10 h**

Free Carrier Concentration in Semiconductors - Fermi Level and Carrier Concentration in Semiconductors - Mobility of Charge Carriers - Effect of Temperature on Mobility - - Dipole Moment - Local Electric Field at An Atom - Dielectric Constant and Its Measurement - Polarizability - Classical Theory of Electronic Polarizability - Dipolar Polarizability - Piezo-Pyro Ferro Electric Properties of Crystals - Ferroelectricity.

Unit IV **Magnetic Properties of Materials** **10 h**

Classification of Magnetic Materials - Atomic Theory of Magnetism – The Quantum Numbers - Origin of Permanent Magnetic Moments - Langevin's Classical Theory of Diamagnetism and Paramagnetism – Fundamental Quantum Theory of Paramagnetism - Ferromagnetism – Weiss Molecular Field - Temperature Dependence of Spontaneous Magnetization - Ferromagnetic Domain - Domain Theory - Antiferromagnetism - Ferrimagnetism and Ferrites.

Unit V **Theory of Superconductors** **10 h**

Sources of Superconductivity - Response of Magnetic Field - Meissner Effect - Thermodynamics of Superconducting Transitions - Origin of Energy Gap - Isotope Effect - London Equations - London Penetration Depth - Coherence Length -

Elements of BCS Theory - Normal Tunneling and DC and AC Josephson Effect - High Temperature Superconductivity.

Text Books

1 Wahab. M.A, 2022, "Solid State Physics: Structure And Properties of Materials" 22nd reprint, Narosa publications.

2 Charles Kittel, 2006 "Introduction to Solid State Physics", 7th edition John Wiley & sons.

References

1 J. O. Pillai, 2020 Solid State Physics, 9th Edition, New Age International Publishers.

2 Dekker A.J. 2000 Solid State Physics the Macmillan Press LTD.

3 P. Srivastava, Elements of Solid-State Physics, 2nd Edition, Prentice Hall of India PVT LTD, New Delhi, 2008.

4 Gupta Kumar, 2011, Solid State Physics, K Nath and co Meerut.

5 K. Ilangovan ,2021, Solid State Physics, MJP publications, Chennai

6 Puri R.K., Babbar V.K., 2010 Solid State Physics And Electronics , S. Chand & Company Ltd, New Delhi

7 https://youtu.be/Ofzd2ZqFvjo

Course Code	Course Name	Category	L	T	P	Credit
232PY2A3CD	MICROPROCESSORS AND MICROCONTROLLER	CORE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- The architecture and assembly language of 8085 and 8086 microprocessor.
- The interfacing of 8085 microprocessor.
- The architecture, programming & Interfacing of 8051 microcontroller.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Outline the architecture of microprocessor 8085 and write assemble language program.	K2
CO2	Demonstrate the interfacing in 8085 microprocessor.	K3
CO3	Experiment with the architecture and programming of 8086 microprocessor.	K3
CO4	Contrast microprocessor and microcontroller and perform basic arithmetic programs.	K2
CO5	Interfacing of microcontroller with ADC, DAC and Sensor.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2	✓		✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓		✓		
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A3CD	MICROPROCESSORS AND MICROCONTROLLER	SEMESTER III

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Microprocessors 8085 Architecture and Programming 10 h

Intel 8085 microprocessor - Architecture of 8085 - 8085 Microprocessor Unit - Data transfer operations - Arithmetic operations - Logical operations – Branching and machine control operations - Addressing modes - Writing assembly language programs: Looping, counting and indexing - Counters and time delays - Stack - Subroutine.

Unit II Interfacing of Microprocessor 8085 10 h

General purpose programmable Peripheral device: 8255A Programmable Peripheral Interface(PPI) – Block diagram – Mode 0 – BSR mode – A/D converter – 8257 DMA controller – Interfacing – Programming and Execution – Basic concept in serial I/O – Interfacing requirements – Transmission format - Synchronous Vs Asynchronous Transmission.

Unit III 8086 Microprocessor 09 h

Features of 8086 - Architecture – Pins and signals – Minimum mode and maximum mode signals – External memory addressing - 8 bit data transfer – 16 bit data transfer – Interrupt processing – Response to interrupt – Classification of interrupt – Interrupt priority. Addition, subtraction and multiplication programs.

Unit IV Microcontroller 8051Architecture and Programming 10 h

Features of microcontroller and 8051 - Difference between microprocessor and microcontroller – 8051 Architecture - Pins and signals 8051- Memory organization – Special function register (SFR) – 8051 Interrupts - Execution – Sources – Enabling and disability – Priority- Timing- Level of Interrupts - Data types and directives Instruction set - Addition, subtraction and multiplication programs.

Unit V Interfacing of Microcontroller 8051 09 h

LCD Interfacing: LCD operation - LCD pin descriptions - LCD Addressing- Keyboard Interfacing - ADC Interfacing: ADC devices - ADC 0804 Chip - Programming ADC 0804 in Assembly - DAC Interfacing: DAC 0808 - Current to voltage in DAC0808 - Sensor Interfacing: Temperature sensor - Signal conditioning and interfacing the LM35 to 8051.

Text Books

1. Gaonkar Ramesh S, 2013, "Microprocessor Architecture, Programming and Applications with 8085/8080", 6th Edition, New Age International. [Unit I to III

2. Latha C, Murugeshwari B, 2015, "Microprocessors and Microcontrollers, 1st Edition, Scitech Publications. [Unit IV]

References

1. Mazidi M A, 2023, "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson & Uttar Pradesh.[Unit V]

2. Nagoor Kani A, 2015, "Microprocessors and Microcontrollers", McGraw Hill Education & New Delhi.

3. Badri R, 2001, "Advanced Microprocessors and Interfacing", Tata McGraw Hill& New Delhi..

4. Yadav D S, 2008, "Microcontrollers Features and Applications",2nd Edition, New age international publisher Pvt. Ltd & New Delhi.

5. https://myethiolectures.files.wordpress.com/2015/06/programming-8085.pdf

6. https://www.onlinenotesnepal.com/assembly-language-programming-with-8085-microprocessor/

232PY2A3CP	CORE PRACTICAL: ELECTRONICS - III	SEMESTER III

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Construct the Wien Bridge Oscillator using OP-AMP and verify the output performance by digital cathode ray oscilloscope.
2	Construct Binary added weighted resistor - using OP-AMP.
3	Construct Binary adder and Subtractor using IC 7483 and IC 7486.
4	Verify the characteristics of Photodetector using digital multimeter
5	Study the characteristics of voltage doubler using digital voltmeter
6	Design of Saw tooth wave generators using OPAMP
7	Study the characteristics of SCR.
8	Construct monostable multivibrator using Op-AMP/NE 555.
9	Characteristics of Tunnel Diode 1N3716.
10	Construct half-adder and full-adder circuits using NAND gates and study their performance.
11	Construct voltage regulated power supply using Zener diode.
12	Construct the amplifier using JFET.

Note: Any 10 Experiments

References

1. Ouseph. C C, 2014, Practical Physics and Electronics, Viswanathan Publishers Ltd.
2. Bhattacharya. AB, 2011, Advanced Electronic Practical's, New Central Book Agency (NCBA)
3. Chattopadhyay. D, 2015, Advanced Course In Practical Physics, New Central Book Agency (NCBA)
4. https://www.youtube.com/watch?v=2gF_nfaBV_0

Course Code	Course Name	Category	L	T	P	Credit
232PY2A3DA	CRYSTAL GROWTH AND THIN FILM TECHNIQUES	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The various experimental techniques for crystal growth.
- Choose various growth techniques for thin film deposition.
- Summarize various characterization techniques like XRD, SEM, TEM, AFM.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Develop the concepts of crystal growth technique through Nucleation.	K3
CO2	Relate the various experimental techniques for crystal growth.	K2
CO3	Identify various preparation methods like gel, melt and vapor growth techniques of crystal.	K3
CO4	Construct the thin films deposition in various techniques.	K3
CO5	Analyze the various characterization techniques for both crystal and thin film samples.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓		✓
CO2	✓		✓		
CO3	✓		✓		
CO4	✓		✓		
CO5	✓		✓		✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A3DA	CRYSTAL GROWTH AND THIN FILM TECHNIQUES	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I **Basic Concepts and Nucleation Phenomenon** **10 h**

Crystals - Classes of crystal system – Crystal symmetry - Single crystal - Growth of crystal -Historical perspective. Nucleation Phenomena: Critical Supersaturation - Homogeneous Nucleation -Heterogeneous Nucleation - Nucleation on a Substrate - Nucleation of a Crystalline Material - Equilibrium Shape of Anisotropic Nuclei.

Unit II **Crystallization Principles and Growth Techniques** **10 h**

Solvents and solutions – Solubility diagram – Metastable zone and induction period – Miers TC diagram – Solution growth – Low and high temperatures solution growth – Slow cooling and solvent evaporation methods - Two-Dimensional Layer Growth Mechanism.

Unit III **Gel, Melt and Vapor Growth Techniques** **10 h**

Principle of gel technique – Various types of gel - Structure and importance of gel Methods of gel growth and advantages - Melt technique – Czochralski growth– Bridgeman method – Horizontal gradient freeze – Hydrothermal growth – Vapor phase growth – Physical vapor deposition – Chemical vapor deposition.

Unit IV **Thin Film Deposition Techniques** **9 h**

Vacuum evaporation - Hertz-Knudsen equation - Evaporation from a source and film thickness uniformity - E-beam, pulsed laser and ion beam evaporations - Mechanisms and yield of sputtering processes – DC, magnetically enhanced, reactive sputtering – Spray pyrolysis – Electro deposition – Sol-gel technique.

Unit V **Characterization Techniques** **9 h**

X–ray diffraction – Powder and single crystal – Fourier transform infrared analysis – Elemental dispersive X-ray analysis – Transmission and scanning electron microscopy – UV-Vis-NIR spectrometer – Vickers micro hardness – Basic principles and operations of AFM and STM - X-ray photoelectron spectroscopy for chemical analysis – Photoluminescence.

Text Books

1. Markov I V, 2004, "Crystal Growth for Beginners: Fundamentals of Nucleation, Crystal growth and Epitaxy", 2nd edition, World Scientific Publishing Company Private Limited & Singapore.
2. Bhat H L, 2015, "Introduction to Crystal Growth Principles and Practice", Taylor & Francis & London.

References

1. Brice J C, 1986, "Crystal Growth Process", John Wiley & New York.
2. Ohring M, 2002, "Materials Science of Thin Films", 2nd Edition, Academic Press & Boston.
3. Kaufmann E N, 2012, "Characterization of Materials, Volume-I", John Wiley & New Jersey.
4. Goswami A, 2017, "Thin Film Fundamentals", New Age Publications & New Delhi.
5. https://books.google.com.jm/books?id=K0e8Nh9zSYC&printsec=frontcover&source=gbs_book_other_versions_r&cad=2#v=onepage&q&f=false.
6. http://www.pas.rochester.edu/~stte/phy415F20/units/unit_1-3.pdf
7. https://www.taylorfrancis.com/books/mono/10.1201/9781420042955/materials-characterization-techniques-sam-zhang-lin-li-ashok-kumar

Course Code	Course Name	Category	L	T	P	Credit
232PY2A3DB	INSTRUMENTAL METHODS OF ANALYSIS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The principle of analytical experimental methods.
- The concepts and applications of various instrumentation methods.
- The qualitative and quantitative instrumental analysis.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Summarize the types of instrumental methods, measurements, signals and data evaluation.	K2
CO2	Explain the instrumentation and analysis of TGA, DTA and DSC.	K3
CO3	Develop the skills to analyze XRD and XRF spectroscopic techniques.	K3
CO4	Analyze the concept of optical method and electron microscopes.	K2
CO5	Examine the electrochemical techniques.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2			✓	✓	
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
✓	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A3DB	INSTRUMENTAL METHODS OF ANALYSIS	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Instrumental Methods and Measurements 10 h

Classification of instrumental techniques - Basic functions of instrumentation – Sensitivity and detection limit – Hardware techniques for signal-to-noise enhancement – Software techniques for signal-to-noise enhancement – Evaluation of results – Accuracy and instrument calibration.

Unit II Thermal Analysis 10 h

Thermo gravimetric analysis: Instrumentation – Applications – Differential Thermal analysis: Instrumentation – General Principles – Applications – Differential Scanning Calorimetry: Instrumentation – Applications – Microthermal analysis – Dynamic Mechanical Analysis.

Unit III X-ray Analysis 9 h

Production of X-rays and X-ray spectra – Instrumentation – X-ray Absorption methods – X-ray Fluorescence method - X-ray Diffraction: Reciprocal lattice concept – Diffraction patterns – Automatic Diffractometers – Choice of X-radiation – X-ray powder data file – Quantitative analysis – Structural applications – Crystal topography.

Unit IV Optical and Microscopic Analysis 9 h

Ultraviolet-Visible Molecular Absorption spectrometry: Measurement of Transmittance and Absorbance – Beer's law – Instrumentation: Instrument components – Single beam instruments – Double beam instruments – Qualitative applications of U-V Absorption spectroscopy: Solvents – Detection of functional groups - Electron spectroscopy: X-ray photoelectron spectroscopy: Principle – Instrumentation – Applications – Scanning Tunneling Microscope: Principle – Instrumentation – Atomic Force microscope: Principle – Instrumentation.

Unit V Electrical Methods 10 h

Electrochemical cells – Potentiometry: General principles – Reference electrodes – Ion-selective Field-Effect-Transistors – Molecular selective electrode systems – Instruments for selecting cell potentials – Coulometry: CV relationships during an electrolysis – Coulometric methods of analysis – Voltammetry: Voltametric Instrumentation: Cyclic voltammetry - Applications of voltammetry.

Text Books

1. Skoog, Holler and Crouch, 2014, Principles of Instrumental Analysis, 6th Edition, Cengage Learning India Private Limited.
2. Willard M and Steve D, 1986. Instrumental Methods of Analysis, 7th Edition, CBS Publishers, New Delhi.

References

1. Skoog D.A and West M, 2004, Fundamentals of Analytical Chemistry, 8th Edition, Saunders-College Publishing.
2. P.S. Kalsi, "Spectroscopy of Organic Compounds", 6th Edition, New Age International Publication, New Delhi.
3. Stradling R.A, 1979, Electron Microscopy and Microanalysis of Crystalline Materials, Applied Science Publishers, London.
4. Philips V.A, 1971, Modern Metallographic Techniques and their Applications, Wiley Interscience.

Course Code	Course Name	Category	L	T	P	Credit
232PY2A3DC	RADIOLOGICAL SAFETY ASPECTS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of nuclear radiation towards biological effect and protection.
- The principles of optimization and detection of radiation.
- The safety aspects of nuclear radiation.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Interpret the structure of atomic nucleus.	K2
CO2	Make use of the principles of radioactivity into handling radio-isotopes.	K2
CO3	Identify various radiations interacting with matter.	K3
CO4	Classify various types of detector principles for nuclear radiation.	K3
CO5	Take part in implementing the safety aspects principles.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1				✓	
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
✓	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A3DC	RADIOLOGICAL SAFETY ASPECTS	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I General Properties of Atomic Nucleus 10 h

Scattering of Alpha-particles - Nuclear size and Determination : Nuclear Force Methods, Electromagnetic Methods - Mass spectroscopy - Basic Components of Mass Spectroscopes - Double Focussing Mass spectrograph - Double Focussing Mass spectrometer - Doublet Method of mass spectroscopy - Mass Synchrometer - Theories of Nuclear Compositions

Unit II Radioactivity and Isotopes 9 h

Law of radioactive Disintegration - Displacement laws of Soddy Russell and Fajans - Law of successive Transformation - Radioactive Equilibrium - Radioactive Branching - Dosimetry - Induced Radioactivity by Nuclear Bombardment - Mixture of Activities - Radio-isotope Therapy - Measurements of Decay Constants - Isotopes (Separation and Uses).

Unit III Interactions Nuclear Radiations with Matter 10 h

Interaction of Charged Particles with Matter - Stopping Power of Heavy Charged Particles - Range and Straggling - Stopping Power and Range of Electrons - Cerenkov Radiation - Synchrotron Radiation - Absorption of Gamma Rays (Thomson, Rayleigh and Delbruck Scattering) - Photoelectric effect - Compton effect - Pair Production

Unit IV Detection and Measurement of Nuclear Radiations 10 h

Ionization chamber - Semiconductor Detectors -Diffused Junction detector - Surface Barrier detector - Lithium drifted Junction detector - Regions of multiplicative operation - Proportional Counter - Geiger Muller Counter (Quenching of Discharge) - Scintillation Counters (Photomultiplier tube, Scintillators, Pulse Formation, Resolving Power)

Unit V Safety Concepts 9 h

Radiation units- Equivalent dose - Effective dose-Committed dose- Collective dose - Genetically significant dose - Detriment - Annual limit on intake- ALARA - Sources of Radiation - Interaction of radiation with tissue - Radiation risk - Sources of exposure - Leakage limits - Personnel monitoring - Film badgeThermoluminescent dosimeter- Pocket dosimeter.

Text Books

1 Tayal D. C, 2018, "Nuclear Physics", Himalaya Publishing House, Mumbai (Unit I to IV).

2 E book: Kuppuswamy Thayalan, 2017, "Basic Radiological Physics", Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi. (Unit -V).

References

1 AERB Radiation Production Rules 2004

2 Muraleedhara varier K , "Nuclear radiation detection, measurements and analysis"- Narosa Publications, New Delhi.

3 S. S. Kapoor and V.S. Ramamurthy- "Nuclear Radiation Detectors", Wiley Eastern Ltd.

4 Training course material on "Safety Aspects in Ionizing Radiation" by Indian Association for Radiation Protection

5 https://www.youtube.com/watch?v=ww5xpqv0yHs

6 https://www.youtube.com/watch?v=67PfCRGGY8c

7 https://www.uth.edu/dotAsset/7f418bea-3f2e-428a-92ee-0f529a7a2eba.ppt

232PY2ASSA	SELF STUDY: IPR, INNOVATION AND ENTREPRENEURSHIP	SEMESTER III

Total Credit: 1

Syllabus

Unit I Introduction to IPR

Introduction to intellectual property right (IPR), Physical and Intellectual Property, Tangible and Intangible property, Traditional Knowledge, Different types of intellectual property rights (IPR), Patents, Trade mark, Trade secret, Copyright, Design and Geographical Indications.

Unit II International Instruments of IPR

World Trade and IPR-General Agreement on Trade and Tariff (GATT), World Intellectual Property Organization (WIPO), World Trade Organizations (WTO), Trade-Related Aspects of Intellectual Property Rights (TRIPS), Establishment, functions and guidelines of GATT, WIPO, WTO and TRIPS.

Unit III Indian Patent Act

Patent Act 1970-amendments of 1999, 2000, 2002 and 2005, Patentable subject matter, Patentability criteria, non-patentable inventions, Compulsory licenses.

Unit IV IPR Infringement

Infringement-direct, contributory and induced, Infringer, Defences to infringement, Remedies for infringement (civil and criminal) and penalties, Appellate Board.

Unit V Current Scenario

India's New National IP Policy, 2016-Govt. of India, Step towards promoting IPR, Govt. Schemes in IPR, Career Opportunities in IP, IPR in current scenario with case studies, Advantages and disadvantages of IPR.

Text Books

1 Nithyananda K.V, 2019, "Intellectual Property Rights: Protection and Management", Cengage Learning India Private Limited & Delhi.

2 Neeraj P, Khusdeep D, 2014, "Intellectual Property Rights", PHI Learning Private Limited & Delhi.

References

1 Ahuja, V K, 2017, "Law relating to Intellectual Property Rights", 3rd Edition, Lexis Nexis, Gurgaon, India.

2 Subramanian N, Sundararaman M, 2018, "Intellectual Property Rights-An Overview" Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-engebook.pdf.

3 World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

232PY2ASSB	SELF STUDY: NANOSCIENCE	SEMESTER III

Total Credit: 1

Syllabus

Unit I Introduction

Definition of nanoscience– Importance of nanoscience – Physical and chemical properties - Electronic - Structural - Mechanical - Optical - Magnetic properties – Applications.

Unit II Conduction in confined geometries

Nanomaterials - 2D, 1D, 0D - size and dimensionality effects - Partial confinement - Properties dependent on density of states - Quantum dots

Unit III Preparation of Nanomaterials

Top down and bottom up approach - Plasma arcing – Hydrothermal- Sol gel process - Ball milling - Sputtering – Electro deposition.

Unit IV Characterization Techniques

X-ray Diffraction (XRD) - Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Absorption spectroscopy - FTIR spectroscopy - Photoluminescence (PL).

Unit V Significant Nanomaterials and Applications

Nano electronics - Nanobots - Biological applications of nanoparticles – Carbon nanotubes (CNTs) - Nano mechanics.

Text Books

1 Shanmugam S, 2011, "Nanotechnology", MJP Publishers, (2011).

2 SubbiahBalaji, 2010, "Nanobiotechnology", MJP Publishers (2010).

References

1 Guozhong Cao, 2011, "Nanostructures and Nanomaterials Synthesis, Properties and Applications" - World Scientific.

2 Pradeep T, 2012, "Nano: The Essentials", Tata McGraw-Hill Publishing Co.

3 Brecket A G, 2008, "Hand book on Nanotechnology", 1st Edition, Dominant publishers and distributors &New Delhi.

4 Guozhong Gao, 2004, " Nanostructures &Nanomaterials: Synthesis, Properties & Applications", Imperial College Press .

5 Narendra Kumar, Sunita Kumbghat, 2016, "Essentials in Nanoscience and Nanotechnology" , John Wiley & Sons.

6 https://www.sciencedirect.com/book/9780080523606/encyclopedia-of-materials-characterization

BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS- 5-4-24 AC- 17-4-24 GB -

Academic Council
CHAIRMAN
Dr.N.G.P. Arts and Science College

Course Code	Course Name	Category	L	T	P	Credit
232PY2A4CA	MOLECULAR PHYSICS	Core	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamental knowledge on the structure and dynamics of the molecules through various theories
- The relation between molecular interactions and properties
- The phenomenological theories on reaction dynamics and transport properties

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Outline the molecular structure and bonding	K1
CO2	Interpret the molecular symmetry	K2
CO3	Illustrate with the molecular interaction and mechanics	K2
CO4	Identify the molecular reaction dynamics	K3
CO5	Examine quantum theory to electron transfer, electronic structure and spectra	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	
CO3			✓		✓
CO4	✓	✓		✓	✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill **Development**		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A4CA	MOLECULAR PHYSICS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Molecular Structure and Bonding **12 h**

Chemical bonding - The VSEPR model - Valence bond theory – The hydrogen molecule - Polyatomic molecules - Molecular orbital theory – Bond properties - Polyatomic molecules - Molecular shape in terms of molecular orbitals - Molecular structure, properties and conformations.

Unit II Molecular Symmetry **12 h**

Symmetry elements and operations – The symmetry classification of molecules – Applications to molecular orbital theory – Character tables and symmetry labels – Vanishing integrals and orbital overlap - Vanishing integrals and selection rule.

Unit III Molecular Interactions and Mechanics **12 h**

Electric properties of molecules - Electric dipole moments - Polarizabilities - Relative permittivity's - Interactions between dipoles - Repulsive and total interactions - Molecular interactions in gases - Potential energy (force field) in molecular mechanics.

Unit IV Molecular Reaction Dynamics **12 h**

Potential energy surfaces – Transition state theory – The Eyring equation – Thermodynamic aspects – Microscopic – Macroscopic connection - Zero-point vibrational energy - Molecular electronic, rotational, vibrational and translational partition functions .

Unit V Electron Transfer, Electronic Structure and Spectra **12 h**

The rates of electron transfer processes - Theory of electron transfer processes - Crystal-field theory - Ligand-field theory - Electronic spectra of atoms - Electronic spectra of complexes - Charge-transfer bands.

Text Books

1 Atkins.P and Depaula.J, 2009, "Physical Chemistry", Oxford University Press.

2 P. Atkins, Overton.T, Rourke. J and Weller. M, 2009, "Inorganic Chemistry", Oxford University Press.

References

1 Christopher, Cramer. J, 2004, "Essential of Computational Chemistry - Theories and Models", Oxford University Press.

2 Gerhard Herzberg, 2003, "Molecular Spectra and Molecular Structure", Krieger Pub Co.

3 Robert Eisberg and Robert Resnick, 2006, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Wiley.

4 W. Demtroder, "Molecular Physics", 2003, Springer, Berlin, Heidelberg (doi.org/10.1007/978-3-662-55523-1)

Course Code	Course Name	Category	L	T	P	Credit
232PY2A4CB	NUCLEAR AND ELEMENTARY PARTICLE PHYSICS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The principles and concepts governing nuclear and particle physics.
- The forces and reactions involved in nuclear particles.
- The concepts of radioactivity decay and elementary particles.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Interpret the various properties of nuclei and nuclear forces.	K2
CO2	Identify the type of nuclear decay and their measurements.	K3
CO3	Examine the radioactive elements and its disintegration.	K3
CO4	Analyze the nuclear reaction dynamics.	K4
CO5	Explain the concepts of elementary particles.	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2	✓	✓	✓		✓
CO3		✓	✓		✓
CO4	✓	✓		✓	
CO5	✓		✓	✓	

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A4CB	NUCLEAR AND ELEMENTARY PARTICLE PHYSICS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I **Properties of Nucleus and Nuclear forces** **12 h**

Nuclear constituents – Nuclear size - Nuclear mass – Nuclear binding energy curve and stability of nuclei – Nuclear magnetic dipole moment - Electric quadrupole moment – Nuclear spin – Parity – Deuteron – Theory of ground state of deuteron - Nucleon-nucleon scattering – Scattering cross section – Spin dependence of nuclear forces

Unit II **Nuclear Decay** **12 h**

Determination of energy of alpha particles - Alpha ray spectra and nuclear energy levels – Gamow's theory – Beta decay process – Measurement of beta ray energies – Beta ray spectra – Selection rules in beta decay – Fermi theory of beta decay – Absorption of gamma ray by matter – Measurement of gamma ray energies – Internal conversion

Unit III **Radio Activity** **12 h**

Properties of alpha, beta and gamma rays - Mean life of a radioactive element - Half-life period - Determination of decay constant and half-life - Soddy's displacement law - Radioactive series - Law of successive disintegration and radioactive equilibrium – Properties of radioactive rays - Radioactive decay – Radioactive dating

Unit IV **Nuclear Reactions** **12 h**

Conservation laws in nuclear reactions - Q value - Threshold energy - Nuclear Transmutation - Nuclear reaction cross section - Types of nuclear reactions - Compound nucleus theory - Breit Wigner dispersion formula - Direct reaction - Nuclear fission - Energy released in fission - Nuclear chain reaction - Four factor formula - Nuclear fusion - Stellar energy.

Unit V **Particle Physics** **12 h**

Production of new particles in high energy reaction - Classification of elementary particle – Fundamental interaction - Quantum numbers - Law in production and decay process - Symmetry and conservation laws - Special symmetric groups - Gelman-Neumann theory - Quark model

Text Books

1 Satya Prakash, 2014, "Nuclear Physics and Particle Physics", Sultan Chand & Sons, New Delhi.

2 Kakani. S.L., Shubhra Kakani, "Nuclear and Particle Physics", Vivo Books

References

1 Tayal. D.C, 2017, "Nuclear Physics", Himalaya Publishing House, Mumbai.

2 Patel. S. B, 2010, "Nuclear Physics-An Introduction", 2nd Edition, New Age International, Mumbai.

3 David Griffiths, 2008, "Introduction to Elementary Particles", 2nd Edition, Wiley Publication, New Delhi.

4 Ghoshal S. N, 2014, "Nuclear Physics", S. Chand & Company Limited, New Delhi.

5 Swayam https://swayam.gov.in/nd1_noc20_ph19/preview

6 PGPathshala Paper No.: Nuclear and Particle Physics Module: Introduction to Nuclear Physics, Sanjay Kumar Chamoli

7 MIT Open Courseware https://ocw.mit.edu/courses/physics/8-701-introduction-tonuclear-and-particle-physics-spring-2004/

232PY2A4CP	CORE PRACTICAL VI: MICROPROCESSOR	SEMESTER IV

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Content
1	Write 8085 ALP for 8 bit addition and subtraction
2	To perform 8 Bit multiplication and division using 8085 instruction set
3	To find the biggest and smallest number element in the array using 8085
4	Write 8085 ALP for LED interfacing
5	To perform for sorting the element in an array in ascending and descending order using 8085
6	To generate triangular and square wave by using 8085 ALP
7	Masking off most significant four bits and setting bits using two different instructions using 8085
8	Write 8085 ALP for Stepper motor controller
9	Write 8085 ALP for Elevator controller
10	Write Microprocessor 8085 ALP for interface IV (Waveform generation)
11	Write Microprocessor 8085 ALP for Traffic control system
12	Write Microprocessor 8085 ALP for subroutines (display results)

Note: Any 10 experiments

1 Praod Borole, 2014, "8085 Microprocessor Architecture and Programming", ANE Books Pvt Ltd

2 Doughlas V. Hall, 1990, "Microprocessor Interfacing Programming and Hardware", 2nd Revised Edn, McGraw-Hill Inc, New Delhi.

3 Nagoor Kani, 2015, "Microprocessors and Micro Controllers", McGraw-Hill Inc, New Delhi.

4 Aditya P. Mathur, 2016, "Introduction to Microprocessors", McGraw-Hill Inc, New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
232PY2A4DA	SOLAR CELLS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The technology behind different generations of solar cells
- The characteristics and properties of solar cells
- The construction and working of CdTe, DSSC and Perovskite solar cells

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain the properties of semiconductors	K1
CO2	Understand the properties and characteristics of solar cells	K2
CO3	Analyze the amorphous silicon solar cell	K2
CO4	Construct the CdTe solar cells by thin film fabrication methods	K3
CO5	Evaluate the construction of dye sensitized solar cells and perovskite solar cells	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓		✓
CO2		✓		✓	✓
CO3	✓		✓		
CO4		✓		✓	✓
CO5	✓		✓	✓	

COURSE FOCUSES ON

✓	Skill **Development**	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
✓	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A4DA	SOLAR CELLS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Fundamentals of Semiconductors 09 h

Semiconductor as solar cell material - Formation of energy bands - Charge carriers in semiconductors - Carrier concentration and distribution - Carrier motion in semiconductors - Drift-Motion due to Electric field - Generation of carriers - Recombination of carriers.

Unit II Solar Cells 11 h

Solar cell parameters - Open circuit voltage - Short circuit current - Fill Factor - Efficiency of solar cells - Effect of series and shunt resistance on efficiency - Effect of solar radiation on efficiency - Requirements for high short circuit current - Minimization of optical losses and recombination - Requirement for high open circuit voltage - Design for high FF - Solar simulator: I-V Measurement - Quantum efficiency measurement.

Unit III First Generation Solar Cells 09 h

Amorphous silicon: The first bipolar amorphous semiconductor – Designs for amorphous silicon solar cells – Staebler Wronski effect – Atomic and electronic structure of hydrogenated amorphous silicon: Deposition techniques – RF glow discharge deposition - Glow discharge deposition at different frequencies – Hot wire chemical vapor deposition.

Unit IV Second Generation Solar Cells 09 h

CdTe properties and thin films - Fabrication methods – Condensation, Reaction of Cd and Te vapors on a surface – Galvanic reduction of Cd and Te ions at a surface - Precursor reaction at a surface - Window Layers – CdTe absorber layer and cadmium chloride treatment - CdS/CdTe intermixing - Back contact - Solar cell characterization – CdTe modules.

Unit V Third Generation Solar Cells 10 h

Operating mechanism of dye-sensitized solar cell – Materials – Performance of highly efficient DSSCs – Electron transfer processes and charge recombination in DSSC - Organic-Inorganic perovskites for photovoltaics - Deposition methods –Electronic properties - Device operation - Ongoing challenges - Lead-free alternatives.

Text Books

1. Chetan Singh Solanki, 2013, "Solar Photovoltaics: Fundamental Technologies and Applications", 2nd Edition, PHI Learning Private Limited, New Delhi.
2. Antonio Luque, Steven Hegedus, 2012,"Handbook of Photovoltaic Science and Engineering", 2nd Edition. Wiley, New York.

References

1. Angele Reinders, Pierre Verlinden, WilfriedVansark, 2017, "Photovoltaic Solar Energy", 3rd Edition, Wiley, New York
2. Brabec C, Scherf U, Dyakonov V, 2008, "Organic Photovoltaics", 1st Edition, Wiley, New York
3. Kothari D P, Singhal K C, Rakesh Ranjan, 2014,"Renewable Energy Source and Emerging Technologies",2nd Edition, PHI Learning Private Limited, New Delhi
4. John T, Tony W, 2005, "Renewable Energy Resources", 2nd Edition, Taylor &Francis, London
5. https://www.energy.gov/eere/solar/solar-photovoltaic-cell-basics
6. https://onlinecourses.nptel.ac.in/noc21_ph25/preview/

Course Code	Course Name	Category	L	T	P	Credit
232PY2A4DB	BAND GAP ENGINEERING IN SEMICONDUCTORS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The band structure of semiconductors.
- The study on semiconductor carrier properties.
- The applications of semiconductors in various fields

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Outline about band structure of semiconductors.	K2
CO2	Identify the physical characteristics of semiconductors	K2
CO3	Analyze the concept of band gap engineering	K4
CO4	Examine the excess carriers in semiconductors	K3
CO5	Explain the optical device in semiconductors	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2		✓			✓
CO3	✓	✓	✓	✓	✓
CO4		✓			✓
CO5	✓	✓	✓	✓	✓

COURSE FOCUSES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A4DB	BAND GAP ENGINEERING IN SEMICONDUCTORS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Conduction in Metals — 09 h

Electron volt - Unit of energy - Current density - Motion in a magnetic field - Nature of the atom - Energy band theory of crystals - Insulators - Semiconductors - Conductors - Conduction in metals - Potential energy field in a metal - Bound and free electrons - Energy density - Fermi level - Density of states.

Unit II Theory of Semiconductors — 11 h

Electrons and holes in an intrinsic semiconductor - Conductivity of a semiconductor - Carrier concentrations in an intrinsic semiconductor - Donor and acceptor impurities - Fermi level in a semiconductor having impurities – Diffusion - Carrier lifetime - The continuity equation.

Unit III Semiconductor Diode Characteristics — 09 h

Qualitative theory of the p-n junction– The p-n junction as a diode – Band structure of an open - Circuited p-n junction – The current components in a p-n diode – Ohmic contacts - Open circuited p-n junction - Theory of p-n diode forward and reverse currents - The schottky barrier diode - The schottky effect

Unit IV Excess Carriers in Semiconductors — 09 h

Optical absorption - Luminescence – Photoluminescence – Electroluminescence - Carrier lifetime and Photoconductivity – Direct recombination of electrons and holes – Indirect recombination of electrons and holes - Steady state carrier generation - Photoconductive devices - Diffusion of carriers - Diffusion processes - The Haynes–Shockley experiment.

Unit V Optoelectronic Devices — 10 h

Photo diodes - Current and voltage in an illuminated junction - Solar cells - Photodetectors - Gain, Bandwidth, and Signal-to-Noise ratio of photodetectors – Light-Emitting diodes - Light-Emitting materials – Lasers - The basic semiconductor laser - Heterojunction lasers.

Text Books

1 Late Jacob Millman, Christos C Halkias, Satyabrata Jit, 2007, "Electronic Devices and Circuits", 3rd Ed, Tata McGraw Hill Education Private Limited, New Delhi.

2 Ben G. Streetman, Sanjay Kumar Banerjee., 2003, " Solid State Electronic Devices", 7th Ed., Pearson, Boston.

References

1 Ali Omar, M., 2000, "Elementary Solid-State Physics: Principles and Applications", 2nd Ed., Addison- Wesley.

2 Rita John, 2014, "Solid State Physics", 4th Ed, Tata McGraw Hill Publications, New Delhi.

3 Kittel, C., 2010, "Introduction to Solid State Physics", 7th Ed., Wiley.

4 Donald, A., 2003, "Semiconductor physics and devices", 3rd Ed., Mc Graw Hill, New Delhi.

5 https://www.electronicshub.org/types-of-semiconductor-devices.

6 https://nptel.ac.in/courses/108108122/

Course Code	Course Name	Category	L	T	P	Credit
232PY2A4DC	PLASMA PHYSICS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of plasma physics.
- The theoretical aspects in the production of plasma and its confinement.
- The working principle behind the applications of Plasma.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Summarize the basic concepts of plasma.	K2
CO2	Infer the characteristics of plasma.	K2
CO3	Analyze the confinements in plasma.	K4
CO4	Classify the different waves of plasma.	K2
CO5	Identify the different applications of plasma waves.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓			✓
CO2		✓			✓
CO3	✓		✓	✓	
CO4		✓			✓
CO5		✓			✓

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability	✓	Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

232PY2A4DC	PLASMA PHYSICS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I **Plasma Concepts** **9 h**

Plasma as state of matter - Debye shielding - Criteria for plasma - Magnetic pressure - Particle drifts – Plasma frequency - Landau damping - Collisions - Bohm diffusion - Plasma radiation.

Unit II **Characteristics of Different Plasma** **10 h**

Production of plasma: Low pressure cold cathode discharge - Thermionic arc discharge - Plasma guns - Q machines - RF produced plasma - Current and voltage measurement in plasmas - Plasma probes: Electrostatic probe - Magnetic probe - Measurement types - Photography and atomic spectroscopy - Radiation measurements - Single particle measurements - Neutrons measurement - Light scattering measurement.

Unit III **Plasma Confinement** **10 h**

Motion in a magnetic field - Motion in finite electric and magnetic field - Motion in inhomogeneous and curved magnetic fields - Magnetic mirrors - Motion in non-uniform electric field - Motion in time varying electric and magnetic field.

Unit IV **Waves in Plasma** **10 h**

Wave representation - Group velocity - Phase velocity - Plasma oscillations - Electromagnetic waves in the absence of magnetic field - Electromagnetic waves perpendicular to magnetic field - Electromagnetic waves parallel to magnetic field - Electron plasma wave in cold and warm plasma - Ion acoustic wave.

Unit V **Applications of Plasma** **09 h**

Gas discharges - Thermonuclear fusion - Laser driven fusion - Magnetic fusion - Magnetohydrodynamic generator (MHD) – Basic theory of MHD – Principle of working – Plasma diode.

Text Books

1 Chen F.F, 2016, "Introduction to Plasma Physics and Controlled Fusion, 3rd Edition", Springer International Publishing, Switzerland.

2 Ghosh B, 2014, "Basic Plasma Physics", 1st Edition, Narosa Publishing House, New Delhi.

References

1 Krall N.A and Trivelpiece A.W, 1973, "Principles of Plasma Physics", 1st Edition, McGraw Hill, US.

2 Stix T.H, 1962, "The Theory of Plasma Waves", 1st Edition, Mc Graw Hill, New York.

3 Bittencourt J.A, 2004, "Fundamentals of Plasma Physics", 3rd Edition, Springer, New York.

4 Choudhuri A.R, 2015, "The Physics of Fluids and Plasmas", 5th Edition, Cambridge, India.

5 E-Book: I. H. Hutchinson, 2022, Introduction to Plasma Physics, 2nd Edition, MIT press, Cambridge.

6 Website Link: https://www.youtube.com/watch?v=E8Fqdg4eI00

7 Website Link: https://www.mpg.de/plasma-physics

BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS- 8/1/24 AC - 26/1/24 GB -

Academic Council * Dr.N.G.P. Arts and Science College * CHAIRMAN