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

M.Sc. /M.Com. / M.A. Programme must be completed within 2 Years (4 semesters) and maximum of 4 Years (8 semesters) from the date of acceptance to the programme. If not, the candidate must enroll in the course determined to be an equivalent by BoS in the most recent curriculum recommended for the Programme.

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 organised 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 follows,

Mark distribution for Theory Courses

Continuous Internal Assessment (CIA) : 40 Marks

End Semester Exams (ESE) : 60 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	05
4	Library Usage	05
5	Skill Enhancement *	05
	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 • Behaviour
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	05
	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	

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.

9. 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 : [1½ Hours-2.5 Units] - 25 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section – A	8 x 0.5= 04 Marks	MCQ	25 Marks	Marks secured will be converted To 5 mark
Section - B	3 x 2 = 06 Marks	Answer ALL Questions Either or Type ALL Questions Carry Equal Marks		
Section - C	3 x 05 = 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		
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	75 Marks	Marks secured will be converted To 5 mark
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	
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	75 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**

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								
232PY2A3DC		Radiological safety aspects								
232PY2A4CV	Core-XIV	Project	-	-	4	-	-	-	-	-
		Total	**18**	**4**	**8**				**700**	**22**

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	General Physics	-	-	4	4	40	60	100	2
232PY2A4CV	Core-XIV	Project	-	-	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**

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

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