ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

Affiliated to Mahatma Gandhi University, Kottayam

CURRICULUM AND SYLLABI FOR THE PROGRAMME

B.Sc. PHYSICS

Program Code: BPHY

and

Complementary Courses

Under Choice Based Credit and Semester System
(2023 Admission Onwards)

DEPARTMENT OF PHYSICS AND CENTRE FOR RESEARCH

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Sl No.	Category	Name	Designation	Official Address
10.	Subject Expert	Dr. Pramod Gopinath	Professor	International School of Photonics, Cochin University of Science and Technology, Cochin.
11.	Subject Expert	Dr. Asha A. S	Assistant Professor	Department of Physics, Cochin University of Science and Technology.
12.	University Nominee	Dr. Deepthi Menon	Professor	Centre for Nanosciences & Molecular Medicine, Amrita Vishwa Vidyapeetham, Kochi.
13.	Representative from Industry	Er. B V Suresh Babu	Accredited Energy Auditor	Ottotractions, Valiyavila, Thiruvananthapuram
14.	Alumnus	Dr. Radhu S	Assistant Professor	Department of Physics, Nirmala College, Muvattupuzha

PREFACE

The curriculum, which encompasses the totality of student experience, should ensure a collective and dedicated effort to birth an inspiring academic culture in a campus. It is this vision of quality knowledge, its production and transmission, that has fueled the Teresian quest for essential and elemental student development. St. Teresa's College has taken meticulous care in the conception of the new well-balanced curriculum by retaining the fundamental prerequisites mentioned by the University/Higher Education Council. With the constraints of a prescribed syllabus in mind, we have created an academic sanctuary, where a deeper access to knowledge is achievable to students and teachers as well.

The Syllabus restructuring of 2022 instigates opportunities of real-world learning to equip a modern scholar with the practicality of experience. As an autonomous institution under Mahatma Gandhi University, St. Teresa's College offers a significant number of Programmes with definite placement windows to the learners. Student knowledge and training across a range of subject areas is efficiently enriched by engaging them in work-based learning, as provided by the revised and restructured curriculum.

The indefatigable effort taken by the teachers in developing Programmes and Course outcomes is commendable. The blossoming of the cognitive and intellectual skills of the scholars, the initiation of a research mentality, and pragmatic skill sets to venture out confidently into a professional space, are the core off-shoots that are anticipated. The curriculum should equip the students to be educators themselves, with a voice that echoes global effectiveness.

I congratulate the efforts taken by the Principal Dr. Alphonsa Vijaya Joseph and her team for restructuring the syllabus in keeping with the latest demands in academia. We trust that the syllabus will transform minds to embark upon higher academic summits and thereby mould learners who will make significant contributions to the world. We look forward to sharing the outcomes of our restructured curriculum and the positive changes that would reshape the academic lives of all our scholars.

Dr. Sr. Vinitha

Manager

FOREWORD

The most significant characteristic of an autonomous college is its commitment to curriculum renewal or revision. Academic autonomy has granted the college the freedom to fine tune the syllabus keeping in mind the changing needs of the new generation of students, the new educational scenario in the global context and incorporation of skill based curricula. Revision of the syllabus implies responsibility and accountability and this in turn leads to excellence in academics and proactive governance. Education in the current scenario throws up a multitude of challenges and the curricula and syllabi ought to reflect the paradigm shift that has occurred in the various disciplines.

A revision of the syllabus is implemented by modifying the curriculum after review to evaluate the effectiveness of the curriculum after it has been implemented and to reflect on what students did and did not get out of it. In line with the new Educational policy, a big educational reform can be effected by restructuring of syllabi to maintain a high level of quality in the standard of education that we impart.

The three themes under Higher Education relevant to policy initiative for restructuring of the curriculum i.e., integrating skill development in higher education, linking higher education to society and integration of new knowledge are considered with utmost importance during revision of the syllabus.

Outcome-Based Education emphasizes that the learning process is innovative, interactive and effective, where the main goal is student achievement at the end of the learning period. St. Teresa's College in its pursuit of imparting quality education has adopted Outcome Based Education (OBE) system that involves restructuring of curriculum, academic processes, teaching methodologies, assessment and evaluation systems in education to reflect the achievement of high order learning. It is a student-centric instruction model that focuses on measuring student performance through outcomes that include knowledge, skills and attitudes.

The revised syllabus and curriculum is the result of the combined efforts of the members of the Board of studies, curriculum expert committee and the syllabus committee who worked as a team to revise the syllabus and curriculum in the stipulated period. Active consultations were held with various stakeholders to elicit multiple perspectives in higher education which were incorporated in the new curriculum.

With sincere gratitude I acknowledge the instinct support and constant guidance extended by Rev. Dr. Sr. Vinitha, Provincial Superior and Manager, Rev. Sr. Emeline, Director, Dr. Sajimol

Augustine M., Senior Administrator, Smt. Betty Joseph, Vice-Principal and Dr. Beena Job, Dean of self-financed programmes. I specially thank the team headed by Dr. Betty Rani Isaac, the Heads of the Departments and all the faculty members for their diligence, commitment and exceptional contribution towards this endeavour.

Prof. Alphonsa Vijaya Joseph
Principal

ACKNOWLEDGEMENT

B.Sc Physics curriculum 2023 was updated as a result of the continuous process which began in 2015 and since has been refined and readjusted based on feedback from various stakeholders. It was done taking into consideration the fast-paced changes happening in diverse fields of Physics, in an attempt to ensure that the student community is better equipped to tackle the ever-evolving academic landscape.

There are many profound personalities whose relentless support and guidance made this syllabus restructuring a success. On behalf of department of Physics, I express our sincere gratitude to all who have contributed to make this venture a success. Our Manager Rev. Sr. Dr. Vinitha CSST, Principal Prof. Alphonsa Vijaya Joseph, Director Rev. Sr. Emeline, CSST, Senior Administrator Dr. Sajimol Augustine M and Vice-Principal Smt. Betty Joseph were the leading forces behind this new curriculum, rendering much needed motivation and support throughout the process. With great honour, I place on record my immense gratitude to them for their continued efforts. The College Curriculum Committee headed by Dr. Betty Rani Isaac along with the IQAC team under the leadership of Prof. Kala M. S has also contributed tremendously for the successful fulfillment of this endeavor. I thank them whole heartedly with much reverence. The BoS committee, both past and present has played a critical role in the process of restructuring, thoroughly studying proposals, suggesting modifications and comments aimed at ensuring the delivery of high-quality education to the students. I place on record my wholehearted appreciation to them for their continued efforts. With great honour and pride, I sincerely acknowledge and appreciate the persistent efforts made by all faculty members of the Physics Department. Their passion and drive have made this a reality and brought out the best in all regards.

The restructuring process was highly dependent on the feedback system that helped us refine and fine tune the curriculum. We are deeply indebted for the cheerful cooperation rendered to us by our alumni, students and parents. Their valuable inputs helped us optimise the changes brought to the curriculum. We wholehearted hope that our efforts will aid our students and that they will explore it to the maximum potential.

Dr. Priya Parvathi Ameena Jose
Chairperson, Board of Studies in Physics
St. Teresa's college (Autonomous), Ernakulam

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PREAMBLE

The academic system contributes to the acquisition of relevant knowledge and development of skills that learners need to apply in the context of their studies, daily life and career. Curriculum plays an important role in forging lifelong learning competencies, and social attitudes. Board of Studies in Physics has designed the curriculum for Physics with an aim to support and encourage the broad instructional goals such as basic knowledge of the discipline of Physics including phenomenology, theories and techniques, concepts and general principles. In effect, the desire to pursue learning with curiosity, integrity and intellectual rigour will be encouraged. This is to be supplemented with the ability to address the questions related to Physics with qualitative and quantitative reasoning and by experimental investigation. The thrust is also given in ensuring flexible pathways to employment, higher research degrees and many professional postgraduate programmes. With this in mind, we aim to provide a firm foundation in every aspect of Physics and to explain a broad spectrum of modern trends in Physics and to develop experimental, computational and mathematics skills of students.

Outcome based education involves assessment and evaluation practices in education reflecting the attainment of expected learning and mastery in the programme. It is a systematic way to determine if a programme has achieved its goal. This approach of learning makes the student an active learner, the teacher a good facilitator and together they lay the foundation for life-long learning. The process includes framing of specific course outcomes at various appropriate levels of taxonomy, mapping the course outcomes of each course with the Programme Specific Outcomes and finally calculating the course attainment based on the marks scored by the student in both the Internal and External assessments.

Department of Physics, St. Teresa's College, has always played a key role in designing the curriculum and syllabus of Mahatma Gandhi University and of various other Universities. The Board of studies acknowledges and appreciates the good effort put in by the faculty members of Physics Department to frame the syllabus for B. Sc. Programme in Physics for the institution which will be implemented for the admissions from 2023 onwards.

PROGRAMME OUTCOMES (PO)

On completion of an undergraduate programme from Teresa's college (Autonomous), Ernakulam students should be able to demonstrate the programme outcomes listed below:

PO 1. ***Disciplinary knowledge***

- Demonstrate a mastery of the fundamental knowledge and skills required in the discipline to function effectively as an entry-level professional in the field.

PO 2. ***Scientific Temper***

- Experiment with new approaches, challenge existing knowledge boundaries and take informed action to solve problems related to society.
- Identify, define, and deal with problems through logical, analytical and critical thinking acquired from different domains of knowledge

PO 3. ***Research and Digital Competence***

- Develop a research culture for lifelong learning and demonstrate competency in creating new knowledge.
- Analyze and choose from available data and information sources to communicate, collaborate and network through a range of digital media.

PO 4. ***Communication Skills***

- Develop language proficiency through interactions embedded in meaningful contexts.
- Demonstrate communicative competence particularly using technology in social and global environments.

PO 5. ***Leadership, Teamwork and Interpersonal Skills***

- Function effectively both as leader and/or member of a team.
- Collaborate and interact effectively with others.

PO 6. ***Moral & Ethical Awareness and Social Responsibility***

- Demonstrate social and national responsibility.
- Engage in activities that contribute to the betterment of society, with a preferential option for the economically challenged and the marginalized.

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of the B.Sc. programme in Physics, students should be able to demonstrate the programme specific outcomes listed below:

PSO1: Explain the major concepts and theoretical principles in Physics (Understand)

PSO2: Solve problems using basic understandings in Physics and mathematical and statistical tools (Apply)

PSO3: Integrate critical thinking and scientific knowledge to design, perform, record and analyse experiments (Analyse)

PSO4: Develop communication skills to decipher and transmit the basic concepts and emerging trends in Physics and foster social responsibility and environmental consciousness (Apply)

PSO5: Apply the theoretical knowledge and skills to identify, investigate and formulate new ideas and concepts (Create)

ELIGIBILITY

Students who have passed the +2 examination with Physics as an optional subject are eligible to pursue B.Sc. Physics.

PROGRAMME DESIGN

The B.Sc. programme in Physics includes (a) Common courses, (b) Core courses, (c) Complementary Courses, (d) Open Courses and (e) Project. No course shall carry more than 4 credits. The student shall select any Choice based core course offered by the department which offers the core courses, depending on the availability of teachers and infrastructure facilities, in the institution. Open course shall be offered in any subject and the student shall have the option to do courses offered by other departments.

Courses

The Bachelor's programme contains 33 courses in six semesters. The total credits of all the courses of the programme are 120. The number of Courses for the programme should contain 12 compulsory core courses, 6 core practicals and 1 choice based core course from the frontier area of the core courses and a project; 8 complementary courses, from the relevant subjects for complementing the core of study and 1 open course. There should be 10 common courses which includes the first and second language of study.

Open course and choice based core course

All students are expected to do one open course of their choice from any discipline other than their parent discipline. Departments have the freedom to change current papers /choose other papers if found relevant. But changes should not affect number of teaching hours (workload of each teacher) of each department. All students have to also do a choice-based core course.

Project

All students shall do a project related to the core course. The project can be done individually or as a group of maximum 3 students. However, the viva on this project will be conducted individually. The projects are to be identified during the V^{th} semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department by the end of VI^{th} semester and are to be produced before the external examiners.

PROGRAMME STRUCTURE

B.Sc. PHYSICS (MODEL I)

A	**Programme Duration**	**6 Semesters**
B	**Total Credits required for successful completion of the Programme**	**120**
C	**Credits required from Common Course I**	**22**
D	**Credits required from Common Course II**	**16**
E	**Credits required from Core course (including Project) and Complementary courses**	**79**
F	**Open Course**	**3**
G	**Minimum attendance required**	**75%**

COURSES

The programme (Model I) consists of common courses with 38 credits, core course, choice based core course, and complementary courses with 79 credits and open course with 3 credits.

SCHEME OF COURSES

The different types of courses and its number and credits are as follows:

Model – I		
Courses	**No. of courses**	**Credits**
Common Course 1	10	22
Common course 2	4	16
Core Courses	12	47
Core Practicals	6	
Project	1	1
Choice based core course	1	3
Complementary courses I & II	8	28
Open Course	1	3
Total	**39**	**51 (Core)**
		28 (Complementary)
		3 (Open course)
		38 (Common)
Grand Total	**39**	**120**

SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS FOR CORE COURSES

Semester	Model I	
	Theory	**Practical**
First	2	2
Second	2	2
Third	3	2
Fourth	3	2
Fifth	13	8
Sixth	17	8

COURSE CODE FORMAT

The programme is coded according to the following criteria.

A. The first letter plus second letter/any letter from the programme ie., **PH**

B. One digit to indicate the semester. i.e., **PH1 (Physics, 1st semester)**

C. One letter from the type of courses such as, **A** for common course, **B** for Complementary course, **C** for Core course, **D** for Open course, ie., **PH1C (Physics, 1st semester Core course)** **PR** for project and **I** for Internship.

D. Two digits to indicate the course number. ie., **PH1C01(Physics, 1st semester, Core course, course number is 01)**

E. The letter **B** to indicate Bachelors Programme.

F. **PH1C01B** (**Physics, 1st semester, Core course, courses number 01, and B for bachelors Programme)**

G. **23 to** indicate the year in which the syllabus is implemented**.** ie., **PH1C01B23**

H. The letter **P** denotes practical – it should come after the code letter for the course ie., **CP** (core practical- eg. **PH2CP01B23**)/**BP**(complementary practical-eg. **PH2BP01B23**)

I. The letter **PR** denotes project ie…Physics Core Project **PH6CPRB23**

J. The letter **I** denotes internship– It should come after the code letter for the course ie., **CI** (Core Intership-eg. **PH2CI01B23**)

PHYSICS CODES

Code

PH Physics

PHC Physics Core Course Theory

PH1C01B23, PH2C02B23, PH3C03B23, PH4C04B23, PH5C05B23, PH5C06B23, PH5C07B23, PH5C08B23, PH6C09B23, PH6C10B23, PH6C11B23, PH6C12B23.

Physics Core, Choice Based Theory

(**PH6C13AB23/PH6C13BB23/PH6C13CB23**)

PHCP Physics Core Practical

(**PH2CP01B23 / PH4CP02B23 / PH6CP03B23 / PH6CP04B23 / PH6CP05B23 / PH6CP06B23)**

PHD Physics Open Course Theory

(**PH5D01AB23/PH5D01BB23/PH5D01CB23**)

PHB Physics Complementary Theory

(**PH1B01B23/PH2B01B23/PH3B01B23/PH4B01B23**)

Please note:

If the department offers two different complementary courses, coding is as follows:

First course- (**PH1B01B23/PH2B01B23/PH3B01B23/PH4B01B23**)

Second course -(**PH1B02B23/PH2B02B23/PH3B02B23/PH4B02B23**)

Two digits to indicate the complementary course number. ie., **PH1B01** (Physics, 1st semester, Complementary course, course number is 01)

PHBP Physics Complementary Physics Practical 'Model I'

(PH2BP01B23/PH4BP01B23)

PHPR Physics Project

PH6PRB23

DURATION OF PROGRAMME

- The duration of U.G. Programmes shall be **6 semesters**.
- A student may be permitted to complete the programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.
- Attendance: Students having a minimum of 75% average attendance for all the courses only, can register for the examination.

DETAILED PROGRAMME STRUCTURE

B.Sc. Physics Programme – (MODEL - I)

DISTRIBUTION OF COURSES FOR BACHELOR'S PROGRAMME IN PHYSICS

Sem.	Course Type	Course Code	Title of the Course	Hours per Week	Credits	Max. Marks	
						ISA	ESA
I	Common course I	EN1A01B23	Fine-tune Your English	5	4	20	80
		EN1A02B23	Pearls from the Deep	4	3	20	80
	Common course II	HN1A01B23	Kahaani Aur Upanyas	4	4	20	80
		FR1A01B23	French Language and communicative skills -I				
		MA1A01B23	Kathasahithyam				
	Complementary course I	MT1B01B23	Differential and Integral Calculus	4	3	20	80
	Complementary course II	ST1B01B23	Descriptive Statistics	4	3	20	80
	Core Course	PH1C01B23	Methodology and Perspectives of Physics	2	2	15	60
	Core Practical	PH2CP01B23	Core Practical I Mechanics, Properties of Matter and Optics I	2	*	*	*

Total credits for Semester I = 19

Sem.	Course Type	Course Code	Title of the Course	Hours per Week	Credits	Max. Marks	
						ISA	ESA
II	Common course I	EN2A03B23	Issues that Matter	5	4	20	80
		EN2A04B23	Savouring the Classics	4	3	20	80
	Common course II	HN2A03B23	Kavita Vyakaran Aur Anuvad	4	4	20	80
		FR2A03B23	French Language and communicative skills-II				
		MA2A03B23	Kavitha				
	Complementary course I	MT2B01B23	Partial Derivatives, Multiple integrals Trigonometry and Matrices	4	3	20	80
	Complementary course II	ST2B01B23	Probability and Random Variables	4	3	20	80
	Core Course	PH2C02B23	Mechanics and Properties of Matter	2	2	15	60
	Core Practical	PH2CP01B23	Core Practical I Mechanics, Properties of Matter and Optics I	2	2	10	40

Total credits for Semester II = 21

Sem.	Course Type	Course Code	Title of the Course	Hours per Week	Credits	Max. Marks	
						ISA	ESA
III	Common course I	EN3A05B23	Literature and/as Identity	5	4	20	80
	Common course II	HN3A05B23	Naatak AurLambi Kavita	5	4	20	80
		FR3A05B23	An Advanced course in French -I				
		MA3A05B23	Drisyakalasahithyam				
	Complementary course I	MT3B01B23	Vector Calculus, Differential Equations and Analytic Geometry	5	4	20	80
	Complementary course II	ST3B01B23	Probability Distributions	5	4	20	80
	Core Course	PH3C03B23	Semiconductor Physics	3	3	15	60
	Core Practical	PH4CP02B23	Core Practical II Mechanics, Properties of Matter and Optics II	2	*	*	*

Total credits for Semester III = 19

Sem.	Course Type	Course Code	Title of the Course	Hours per Week	Credits	Max. Marks	
						ISA	ESA
IV	Common course I	EN4A06B18	Illuminations	5	4	20	80
	Common course II	HN4A06B18	Gadya Aur Ekanki	5	4	20	80
		FR4A06B18	An Advanced course in French - II				
		MA4A06B18	Malayala Gadhyarachanakal				
	Complementary course I	MT4C01B18	Fourier Series, Partial Differential Equations, Numerical Analysis and Abstract Algebra	5	4	20	80
	Complementary course II	ST4C01B18	Statistical Inference	5	4	20	80
	Core Course	PH4C04B23	Electricity and Electrodynamics	3	3	15	60
	Core Practical	PH4CP02B23	Core Practical II Mechanics, Properties of Matter and Optics II	2	2	10	40

Total credits for Semester IV = 21

Sem.	Course Type	Course Code	Title of the Course	Hours per Week	Credits	Max. Marks	
						ISA	ESA
V	Core Course	PH5C05B23	Environmental Physics Human Rights and Intellectual Property Rights	4	4	15	60
	Core Course	PH5C06B23	Classical and Quantum Mechanics	3	3	15	60
	Core Course	PH5C07B23	Physical Optics and Photonics	3	3	15	60
	Core Course	PH5C08B23	Digital Electronics and Programming in C++	3	3	15	60
	Core Practical	PH6CP03B23	Core Practical III Electricity and Magnetism	2	*	*	*
	Core Practical	PH6CP04B23	Core Practical IV Electronics and Microprocessors	2	*	*	*
	Core Practical	PH6CP05B23	Core Practical V Spectroscopy, Laser and Computer Programming	2	*	*	*
	Core Practical	PH6CP06B23	Core Practical VI Digital and Advanced Electronics	2	*	*	*
	Open Course	Offered by other depts.	Open course	4	3	20	80

Total credits for Semester V = 16

Sem.	Course Type	Course Code	Title of the Course	Hours per Week	Credits	Max. Marks	
						ISA	ESA
VI	Core Course	PH6C09B23	Thermal and Statistical Physics	3	3	15	60
	Core Course	PH6C10B23	Relativity and Spectroscopy	4	3	15	60
	Core Course	PH6C11B23	Nuclear, Particle and Astrophysics	3	3	15	60
	Core Course	PH6C12B23	Condensed Matter Physics	4	3	15	60
	Core Course	PH6C13*B23	Choice Based Core Course	3	3	20	80
	Core Practical	PH6CP03B23	Core Practical III Electricity and Magnetism	2	2	10	40
	Core Practical	PH6CP04B23	Core Practical VI Electronics and Microprocessors	2	2	10	40
	Core Practical	PH6CP05B23	Core Practical V Spectroscopy, Laser and Computer Programming	2	2	10	40
	Core Practical	PH6CP06B23	Core Practical VI Digital and Advanced Electronics	2	2	10	40
	Core Course	PH6PRB23	Project	-	1	20	80

Total credits for Semester VI = 24

Total credits for the programme = 120

Two hours will be allotted for Practical for each core course in all semesters. But the practical examination will be conducted on even semesters alone.

SCHEME: CORE COURSES

Course Code	Title of the Course	Category	Hours / week	Credits	Total hours /sem
Semester -I					
PH1C01B23	Methodology and Perspectives of Physics	Core	2	2	36
PH2CP01B23	Core Practical I Mechanics, Properties of Matter and Optics I	Core	2	*	36
Total Credits				**2**	
Semester -II					
PH2C02B23	Mechanics and Properties of Matter	Core	2	2	36
PH2CP01B23	Core Practical I Mechanics, Properties of Matter and Optics I	Core	2	2	36
Total Credits				**4**	
Semester -III					
PH3C03B23	Semiconductor Physics	Core	3	3	54
PH3C03B23	Core Practical II Mechanics, Properties of Matter and Optics II	Core	2	*	36
Total Credits				**3**	
Semester -IV					
PH4C04B23	Electricity and Electrodynamics	Core	3	3	54
PH3C03B23	Core Practical II Mechanics, Properties of Matter and Optics II	Core	2	2	36
Total Credits				**5**	

Course Code	Title of the Course	Category	Hours / week	Credits	Total hours /sem
Semester -V					
PH5C05B23	Environmental Physics, Human Rights and Intellectual Property Rights	Core	4	4	72
PH5C06B23	Classical and Quantum Mechanics	Core	3	3	54
PH5C07B23	Physical Optics and Photonics	Core	3	3	54
PH5C08B23	Digital Electronics and Programming in C++	Core	3	3	54
PH6CP03B23	Core Practical III Electricity and Magnetism	Core	2	*	36
PH6CP04B23	Core Practical IV Electronics and Microprocessors	Core	2	*	36
PH6CP05B23	Core Practical V Spectroscopy, Laser and Computer Programming	Core	2	*	36
PH6CP06B23	Core Practical VI Digital and Advanced Electronics	Core	2	*	36
Offered by other Depts.	Open course		4	3	72
Total Credits			**16**		

Course Code	Title of the Course	Category	Hours / week	Credits	Total hours /sem
Semester -VI					
PH6C09B23	Thermal and Statistical Physics	Core	3	3	54
PH6C10B23	Relativity and Spectroscopy	Core	4	3	72
PH6C11B23	Nuclear, Particle and Astrophysics	Core	3	3	54
PH6C12B23	Condensed Matter Physics	Core	4	3	72
PH6C13*B23	Choice based core course	Core	3	3	54
PH6CP03B23	Core Practical III Electricity & Magnetism	Core	2	2	36
PH6CP04B23	Core Practical IV Electronics and Microprocessors	Core	2	2	36
PH6CP05B23	Core Practical V Spectroscopy, Laser and Computer Programming	Core	2	2	36
PH6CP06B23	Core Practical VI Digital and Advanced Electronics	Core	2	2	36
PH6PRB23	Project	Core	*	1	*
Total Credits			**24**		

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*The practical examination will be conducted only in even semesters.

*Project evaluation will be done at the end of sixth semester.

SCHEME: OPEN COURSES

Semester	Course Code	Title of the Course	Hours / week	Credits	Total hours /sem
V	PH5D01AB23	Amateur Astronomy	4	3	72
	PH5D01BB23	Physics in Daily Life	4	3	72
	PH5D01CB23	Computer Hardware and Networking	4	3	72

SCHEME: CHOICE BASED CORE COURSES

Semester	Course Code	Title of the Course	Hours / week	Credits	Total hours /sem
VI	PH6C13AB23	Nano Science and Nano Technology	3	3	54
	PH6C13BB23	Material Science	3	3	54
	PH6C13CB23	Computational Physics	3	3	54
	PH6C13DB23	Instrumentation	3	3	54
	PH6C13EB23	Astronomy and Astrophysics	3	3	54
	PH6C13FB23	Information Technology	3	3	54

SCHEME: COMPLEMENTARY COURSES

1. Physics for Bachelor's Programme in Mathematics:

Course Code	Title of the Course	Hours / week	Credits	Total hours /sem	Max. Marks	
					ISA	ESA
Semester -I						
PH1B01B23	Properties of Matter, Error Analysis and Gravitation	2	2	36	15	60
PH2BP01B23	Practical I	2	*	36	*	*
Total Credits		**2**				
Semester -II						
PH2B01B23	Mechanics and Astrophysics	2	2	36	15	60
PH2BP01B23	Practical I	2	2	36	10	40
Total Credits		**4**				
Semester -III						
PH3B01B23	Modern Physics, Basic Electronics and Digital Electronics	3	3	54	15	60
PH4BP01B23	Practical II	2	*	36	*	*
Total Credits		**3**				
Semester -IV						
PH4B01B23	Physical Optics, Laser Physics and Magnetism	3	3	54	15	60
PH4BP01B23	Practical II	2	2	36	10	40
Total Credits		**5**				

*Two hours will be allotted for Practical for each complementary course in all semesters.

*But the practical examination will be conducted on even semesters alone.

1. Physics for Bachelor's Programme in Chemistry:

Course Code	Title of the Course	Hours / week	Credits	Total hours /sem	Max. Marks	
					ISA	ESA
Semester -I						
PH1B01B23	Properties of Matter, Thermodynamics	2	2	36	15	60
PH2BP01B23	Practical I	2	*	36	*	*
Total Credits		**2**				
Semester -II						
PH2B01B23	Mechanics and Crystallography	2	2	36	15	60
PH2BP01B23	Practical I	2	2	36	10	40
Total Credits		**4**				
Semester -III						
PH3B01B23	Modern Physics, Basic Electronics	3	3	54	15	60
PH4BP01B23	Practical II	2	*	36	*	*
Total Credits		**3**				
Semester -IV						
PH4B01B23	Physical Optics, Laser Physics, Superconductivity and Dielectrics	3	3	54	15	60
PH4BP01B23	Practical II	2	2	36	10	40
Total Credits		**5**				

*Two hours will be allotted for Practical for each complementary course in all semesters.

*But the practical examination will be conducted on even semesters alone.

EXAMINATIONS

The evaluation of each course shall contain two parts such as In-Semester Assessment and End Semester Assessment. The Internal / In-Semester (ISA) and End Semester Assessments (ESA) shall be made using Mark based Grading system based on 10 point scale. The ratio between ISA and ESA shall be 1:4.

I. MARKS DISTRIBUTION FOR EXTERNAL EXAMINATION AND INTERNAL EVALUATION

Marks distribution for external and internal assessments and the components for in semester evaluation with their marks are shown below. The in-semester evaluation is to be done by continuous assessments on the following components.

a. For courses without practical

- End–Semester Assessment (ESA): 80 marks
- In-Semester Assessment (ISA): 20 marks

ISA components - Theory	Marks
Attendance	5
*Assignment/Seminar/Viva/Internship	5
Test papers (2 x 5)	10
Total	20

Attendance

% of Attendance	Marks
90% or above	5
Between 85 and below 90	4
Between 80 and below 85	3
Above 75 and below 80	2
75 %	1
< 75	0

b. For courses with practical

- End–Semester Assessment (ESA): 60 marks
- In-Semester Assessment (ISA): 15 marks

ISA components - Theory	Marks
Attendance	5
*Assignment/Seminar/Viva/Internship	2
Test papers (2 x 5)	8
Total	15

c. For practical courses (conducted only at the end of even semesters):

- End–Semester Assessment (ESA): 40 marks
- In-Semester Assessment (ISA): 10 marks

ISA components - Practical	Marks
Attendance	2
Test paper (1 x 4)	4
Record*	4
Total	10

For practical Minimum of experiments to be done in each paper are 14. Minimum number of experiments for appearing practical examination is 8. Maximum possible number of repetitions must be done to reduce error in a measuring quantity. Percentage error must be calculated and S.I. units must be specified for all experiments.

** Bonafide reports of practical works conducted shall be submitted at the end of examination.

Division of internal marks for record (maximum 4 marks)

No. of Experiments	Marks
12 and above	4
10 & 11	3
9	2
8	1
Less than 8	0

Semester	Course Code	Course Title
1 and 2	**PH2CP01B23**	Core Practical I Mechanics, Properties of Matter and Optics I
3 and 4	**PH4CP02B23**	Core Practical II Mechanics, Properties of Matter and Optics II
5 and 6	**PH6CP03B23**	Core Practical III Electricity and Magnetism
5 and 6	**PH6CP04B23**	Core Practical IV Electronics and Microprocessors
5 and 6	**PH6CP05B23**	Core Practical V Spectroscopy, Laser and Computer Programming
5 and 6	**PH6CP06B23**	Core Practical VI Digital and Advanced Electronics Programming

d. For projects/ industrial visit and comprehensive viva-voce

All students have to begin working on the project in the area of core course in the FIFTH semester and must submit it in the SIXTH semester. The project can be done individually or in groups (not more than three students) and it should preferably be socially relevant/ industry oriented/ research oriented. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners. External project evaluation and viva / presentation are compulsory and will be conducted at the end of the programme.

An industrial visit is also included in the programme. The students must visit an industry during V or VI semester and submit a report in duplicate along with the project report. This industrial visit and the report will be evaluated internally and externally along with the project evaluation.

The ratio of In-Semester to End Semester component of the project is 1:4. The mark distribution for assessment of various components is shown below.

•Marks of End Semester Assessment (ESA): 80

Components: External Assessment	**Marks**
Dissertation of Project and Industrial Visit report	(45+5) =50
Viva-Voce on Project and Industrial Visit	(27+3) = 30
Total	**80**

•Marks of In- Semester Assessment (ISA): 20

All the four components of the internal assessment are mandatory**.**

Components: In-Semester Assessment	**Marks**
Punctuality	5
Experimentation/data collection	5
Knowledge	5
Report on Project and Industrial Visit	5
Total	**20**

**Bonafide reports of the Project work and Industrial Visit conducted shall be submitted at the time of examination.

II. ISA - TEST PAPERS

Two internal test- papers are to be attended in each semester for each paper. The evaluations of all components are to be published and are to be acknowledged by the students. All documents of internal assessments are to be kept in the college for two years and shall be made available for verification by the University. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teach the paper.

III. ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester for all papers.

(i)* Assignment (project/field work/ Industrial Visit) for Semester I & II- to be given by language teachers, report of which must be submitted and for those programmes which do not have additional language the students must undertake the assignment (project/field work/ Industrial Visit) for any one core paper.

(ii) *Assignment: for core papers (III & IV Semester), the student must undertake a Project/ Field work/ Industrial Visit/ Internship and the report of the same should be submitted for evaluation. The marks awarded to this can be considered for assignment of any one core paper.

IV. SEMINAR/VIVA

A student shall present a seminar in the 5th semester and appear for Viva- voce in the 6th semester for all papers.

END SEMESTER ASSESSMENT

The End Semester examination of all semesters shall be conducted by the institution on the close of each semester. For reappearance/ improvement, students may appear along with the next batch.

V. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, application of knowledge in life situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall

ensure that questions covering all skills are set. The student shall also submit a detailed scheme of evaluation along with the question paper.

A question paper shall be a judicious mix of short answer type, short essay type/ problem solving type and long essay type questions.

For each course the End-semester Assessment is of 3 hours duration. The question paper has 3 parts. Part A contains 12 objective type questions of which 10 are to be answered. Part B contains 9 short essay questions of which 6 are to be answered. Part C has 4 long essay questions of which 2 are to be answered.

Part	**No. of Questions**	**No. of questions to be answered**	**Marks (for courses with practical)**	**Marks (for courses without practical)**
A (Short Answer type)	12	10	10 x 1 = 10	10 x 2 = 20
B (Short Essay/Problem)	9	6	6 x 5 = 30	6 x 5 = 30
C (Long Essay)	4	2	2 x 10 =20	2 x 15 = 30

VI. EVALUATION OF PROBLEMS

Numerical problems in Physics shall be given marks in the following way:

Correct formula with correct substitution and answer	5
Correct formula with correct substitution and answer but wrong or no unit.	4
Correct formula with correct substitution and wrong answer	3
Formula alone is correct	2
Any relevant formula	1

VII. PRACTICAL EXAMINATIONS

The practical examinations for the core and complementary courses are to be conducted at the end of even semesters by the institution. The practical examinations will be evaluated by one external and one internal examiner. One external examiner will be selected from the panel of examiners

and one internal examiner will be selected by the department. The score sheet should be sent to the controller of examination soon after the evaluation. Maximum marks for End Semester assessment of practicals will be 40.

A candidate submitting a certified record with a minimum of 8 experiments alone is eligible for appearing the Practical Examination.

Evaluation of Practical Examinations

The scheme of evaluation of the practical examination will be decided by the Board of Examiners.

Student strength for practical examination

The maximum number of students in a batch shall be 15 for each laboratory session.

VIII. COMPUTATION OF CCPA

Grades

A 10 point scale based on the total percentage of marks (ISA + ESA) for all courses (theory, practical, project). Grade and Grade Point is given to each course based on the percentage of marks obtained as follows:

Percentage of Marks	Grade	Grade Point
Equal to 95 and above	S Outstanding	10
Equal to 85 and < 95	A+ Excellent	9
Equal to75 and < 85	A Very Good	8
Equal to 65 and < 75	B+ Good	7
Equal to 55 and < 65	B Above Average	6
Equal to 45 and < 55	C Satisfactory	5
Equal to 35 and < 45	D Pass	4
Below 35	F Failure	0
	Ab Absent	0

PASS CRITERIA

- A separate minimum of 30% marks each for ISA and ESA (for both theory and practical) and aggregate minimum of 35% is required for a pass in a course.
- For a pass in a programme, a separate minimum of Grade D is required for all the individual courses.
- If a candidate secures F Grade for any one of the courses in a semester / programme, only F grade will be awarded for that semester/programme until she improves this to D Grade or above within the permitted period.
- Students who complete the programme with D grade will have one betterment chance within 12 months, immediately after the publication of the result of the whole programme.

CREDIT POINT AND CREDIT POINT AVERAGE

a) Credit Point (CP) of a course is calculated:

CP = C × GP

C = Credit; GP = Grade point

b) Semester Credit Point Average (SCPA) of a semester:

SCPA = TCP/TC

TCP = Total Credit Point of that semester

TC = Total Credit of that semester

c) Cumulative Credit Point Average (CCPA) is calculated:

CCPA = TCP/TC

TCP = Total Credit Point of that programme

TC = Total Credit of that programme

CREDIT POINT AVERAGE (CPA)

CPA of different catogories of courses viz. Common courses, Complementary courses, Core courses etc. are calculated.

CPA = TCP/TC

TCP = Total Credit Point of a category of course

TC = Total Credit of thata category of course

Grades for the different semesters / programme are given based on the corresponding CPA:

CPA	Grade
Equal to 9.5 and above	S - Outstanding
Equal to 8.5 and < 9.5	A+ - Excellent
Equal to 7.5 and < 8.5	A - Very good
Equal to 6.5 and < 7.5	B+ - Good
Equal to 5.5 and < 6.5	B - Above average
Equal to 4.5 and < 5.5	C – Satisfactory
Equal to 4 and < 4.5	D – Pass
Below 4	F – Failure

- For reappearance/improvement of I, II, III & IV semesters, candidate have to appear along with the next batch.
- There shall be supplementary exams only (no improvement) for Vth Semester.
- Notionally registered candidates can also apply for the said supplementary examinations.
- A student who registers her name for the end semester assessment for a semester will be eligible for promotion to the next semester.
- A student who has completed the entire curriculum requirement, but could not register for the semester examination can register notionally, for getting eligibility for promotion to the next semester.
- A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registration along with the ESA for the same semester, subsequently.
- There shall be no improvement for internal evaluation.

All rules and regulations are subject to change as and when modified by Mahatma Gandhi University, Kottayam to which St. Teresa's college (Autonomous), Ernakulam is affiliated.

SYLLABI FOR B.Sc. PHYSICS (CORE) COURSES

CORE COURSES

SEMESTER I

PH1C01B23 - METHODOLOGY AND PERSPECTIVES OF PHYSICS

Credits- 2

Hours per week-2 **Total Lecture Hours- 36**

Course Overview & Context:

Physics is, the oldest and most basic pure science; its discoveries find applications throughout the natural sciences. This course will be an introduction to the pursuit of Physics, its history and basic footsteps. The course starts with a view on the Development of Physics in the last century and the birth of new scientific concepts with reference to the scientific contributions of various scientists and Nobel Prize winners of the last three years. It proceeds with an introduction to vector analysis and coordinate system which forms a basis for the formulation of systems. As we know, no measurement of a physical quantity can be entirely accurate and it is important to have knowledge about the deviations of measured quantity from the true value. The course also aims at emphasizing the importance of number systems and error analysis which is central to Physics and will provide a theoretical basis for doing experiments in related areas.

Another important aspect of this course is that it gives due importance to learning the contributions of women Indian scientists and establishes a gender attribute.

Course Outcomes:

CO1: Review the emergence of new scientific concepts with reference to the contributions of various scientists (Understand)

CO2: Compute line, surface and volume integrals of vectors and relate among different types of coordinate systems (Apply)

CO3: Solve number conversion problems and binary arithmetics (Apply)

CO4: Estimate and report the errors occurring in a mathematical calculation (Apply)

Syllabus Contents

Module I

Concepts and Development of Physics (12hours)

Development of physics and the birth of new scientific concepts with reference to scientific contributions of Galileo – perspectives on universe, Newton- deterministic universe, Einstein- Photoelectric effect-special theory of relativity, J J Thomson – atom model, Marie Curie- radioactivity, Max Plank-quantum hypothesis, deBroglie- matter wave, Heisenberg- uncertainty principle and Schrodinger- quantum mechanics. Contributions of Indian physicists -C V Raman, H J Babha, J C Bose, S N Bose, M N Saha, S Chandrasekhar. Women Physicists- Dr. Bibha Chowdari, Kalpana Chawla,Dr.Anna Mani. Nobel Prize winners of last three years (Topics in this part require qualitative study only).

Text Books:

1. Feynman lectures of Physics
2. Concepts of Modern Physics: Arthur Beiser,
3. Modern Physics: Kenneth Krane
4. Modern Physics: R Murugeshan
5. https://www.nobelprize.org/nobel_prizes/physics/laureates/

Module II

Introductory Vector Analysis (6 hours)

Applications of vectors in Physics. Differential and integral vector calculus: – The operator - physical significance of Gradient, Divergence and Curl, Line integral, surface integral and volume integral of vectors.

Co-ordinate systems (6 hours)

Basic Elements of coordinate system, fundamental plots and relation among coordinates and base vectors, differential elements in Cartesian, plane polar and spherical polar coordinates, cylindrical coordinates (Basic ideas with examples in physics).

Text Books:

1. Introduction to Electrodynamics, David J. Griffiths, Prentice Hall India Pvt. Ltd.
2. Mathematical Physics: Charlie Harper
3. University Physics, Roger A Freedman, Hugh D Young 14th edition
4. Digital electronics: Albert Paul Malvino
5. Digital logic and computer design – M. Morris Mano, PHI.

Module III

Number systems (6 hours)

Decimal, hexadecimal and Binary Numbers. Conversions, Binary arithmetic addition, subtraction and multiplication. 1's and 2's complement subtraction –signed binary numbers. Signed binary arithmetic, BCD code, ASCII code, Significance of binary number system in digital electronics, microprocessors and in computers

Error analysis (6 hours)

Basic of errors, types of errors - random error, systematic error, absolute and relative errors-calibration of errors. Errors of computation- addition, subtraction, multiplication, division, error in power and roots, Propagation of errors, analysis of data, standard deviation, calculation of mean value.

Text Books:

1. Advanced course in Practical Physics by D Chattopadhyay- Chapter-1
2. Practical Physics, G L Squires, Third edn. Cambridge University Press.
3. The theory of Errors in Physical Measurements- J C Pal- New Central Book Agency-2010
4. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, John R. Taylor - Univ. Science Books
5. http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/
6. http://phys.columbia.edu/~tutorial/index.html

MODEL QUESTION PAPER

B.Sc. DEGREE (C.B.C.S) EXAMINATION, NOVEMBER 2023

SEMESTER I - CORE COURSE FOR B.Sc. PHYSICS

PH1C01B23 - METHODOLOGY AND PERSPECTIVES OF PHYSICS

Time: 3 hours **Maximum marks: 60**

Part A

Qn. No.	Questions	CO	Level of question
1.	Explain the perspectives of Galileo on Universe.	1	U
2.	State Planck's hypothesis.	1	U
3.	Define Raman effect.	1	U
4.	Briefly discuss the magnitude and direction of gradient of a scalar function.	2	U
5.	State the condition for a vector function to be conservative.	2	U
6.	Find the gradient of the function f = $e^x \sin y \log z$	2	Ap
7.	Find the equation of lines y =5x+3 into polar coordinates.	2	Ap
8.	Illustrate the fundamental plots in spherical polar coordinates.	2	U
9.	1's and 2's complement of 1001 is…. and ….	3	Ap
10.	Briefly explain ASCII code.	3	U
11.	Define standard deviation.	4	U
12.	Distinguish between random and systematic errors.	4	U
13.	Discuss briefly about scientific contributions of Einstein.	1	U

(10 x 1 = 10 marks)

Part B
(Answer any six questions. Each question carries 5 marks)

Qn. No.	Questions	CO	Level of question
14.	Define Chandrasekhar limit. Give its significance.	1	U
15.	Briefly explain line and surface integrals.	1	U
16.	Explain the concept of Nobel prize winning invention in Physics of last year.	1	U
17.	Estimate the slope of the tangent line to the three leaf rose r=sin3θ at θ=0 and θ=π/4.	2	Ap
18.	Express the basis vectors of polar coordinate system in terms of that in cartesian system	2	U

19.	State the fundamental theorems of gradient, divergence and curl	2	U
20.	Convert 12.55 to its equivalent binary, octal and hexadecimal numbers.	3	Ap
21.	A rectangular board is measured with a scale having accuracy of 0.2 cm. The length and breadth are measured as 35.4 cm and 18.5 cm respectively. Find the relative error of the area calculated.	4	Ap

(6 x 5 = 30 marks)

Part C
(Answer any two questions. Each question carries 10 marks)

Qn. No.	**Questions**	**CO**	**Level of question**
22.	Discuss major scientific contributions of any three Indian scientists.	1	U
23.	Describe the differential operators gradient, divergence and curl and give its physical significance.	2	U
24.	Explain various positional number systems. Illustrate conversion among each system with suitable example.	3	Ap
25.	Discuss the computation of errors in multiplication, division and in powers and roots. Describe the necessity of estimating errors.	4	U

(2 x 10 = 20 marks)

CO : Course Outcomes
Level : R – Remember, U – Understand, Ap- Apply, An- Analyze, E- Evaluate, C- Create

SEMESTER II

PH2C02B23 MECHANICS AND PROPERTIES OF MATTER

Credits-2

Hours per week-2 **Total Lecture Hours-36**

Course Overview & Context:

This course provides conceptual understanding of basic physics to students and thus builds a theoretical basis for doing experiments in related areas.

This course starts with oscillations and wave motion in Module I, then it proceeds to rigid body dynamics and gravitation in Module II. The last module covers elasticity, viscosity and surface tension.

The course will instill the skills required for successfully setting up and carrying out experiments falling under the topics of mechanics and properties of matter.

Course Outcomes:

CO1: Articulate various aspects of wave motion and oscillations. (Apply)

CO2: Compute the variables related to rotational motion of regular rigid bodies using basic theorems (Apply)

CO3: Apply the basic principles of elasticity to determine Rigidity modulus and Young's modulus of different materials (Apply)

CO4: Explain the basics concepts of gravitation, surface tension and viscosity. (Understand)

Syllabus Contents

Module I (12 hours)

Oscillations **(6 hours)**

Periodic motion and harmonic motion, harmonic oscillator, simple harmonic motion, energy of a harmonic oscillator, examples of harmonic oscillator – simple pendulum, loaded spring. damping, damped harmonic oscillator, forced oscillator, resonance

Wave motion **(6 hours)**

Waves- Types of waves, Characteristics of a wave and wave motion, general equation of a plane progressive harmonic wave, particle velocity differential equation of a wave motion, energy density, energy intensity, superposition of waves, beats, transverse waves in stretched strings, modes and longitudinal waves in gas

Module II (10 hours)

Dynamics of Rigid Bodies **(7 hours)**

Rigid body Translational and rotational motion - moment of inertia- Radius of gyration- analogous parameters in translational and rotational motion-General theorems of Moment of inertia- Parallel and perpendicular axes theorems - calculation of moment of inertia (uniform rod, hoop or thin circular ring, circular disc, annular disc-solid cylinder, and solid sphere) moment of inertia of flywheel

Gravitation **(3 hours)**

Newton's law of gravitation – density of earth- Mass of the earth and the sun — Gravitational Potential and Gravitational Potential energy- velocity of escape from earth- velocity of escape from solar system-equipotential surface

Module III (14 hours)

Elasticity **(8 hours)**

Basic ideas on elasticity – Young's modulus, bulk modulus, rigidity modulus, Poisson's ratio, Bending of beams, bending moment, flexural rigidity. Young's modulus – uniform and non-uniform bending, cantilever. I –section girders. Torsional rigidity-twisting couple on a cylindrical rod- Determination of rigidity modulus using Static method- static torsion and Dynamic method-torsion pendulum.

Hydrodynamics **(6 hours)**

Viscosity

Streamline and turbulent flows, coefficient of Viscosity – Determination of viscosity by Poiseuille's equation. Equation of continuity, energy possessed by a liquid, Bernoulli's theorem

Surface Tension

Surface tension, surface energy, molecular explanation of Surface tension, angle of contacts-shapes of drops-capillary rise.

Text books:

1. Mechanics - J.C. Upadhayaya, Ramprasad Pub.
2. Mechanics -D.S.Mathur, S.Chand.
3. Advanced course in Practical Physics - D Chattopadhyay, Central Book
4. Properties of Matter and Acoustics - Murugeshan and K. Sivaprasath, S. Chand

References:

1. Mechanics- Hans and Puri, TMH
2. Classical Mechanics - J.C. Upadhyaya, Himalaya Pub.
3. Classical Mechanics-Takwale and Puranik, TMH.
4. Classical mechanics- K.Sankara Rao, PHI.
5. Properties of Matter - Mathur, S. Chand,
6. Mechanics - Somnath Datta, Pearson
7. Mechanics - H.D Young and R.A Freedman, Pearson.

SEMESTER III

PH3C03B23 SEMICONDUCTOR PHYSICS

Credits- 3

Hours per week-3 **Total Lecture Hours- 54**

Course Overview & Context:

This course presumes that the students have already acquired the basic knowledge in semiconducting materials and pn junction diodes. All electronic devices depend on the use of one or other semiconducting materials and paves way for progress in several fields leading to the inventions of smart gadgets, devices for communications and computing, military systems like LIDAR and even to the latest developments for clean energy making use of light harvesting devices. Therefore, it is very much essential for a physics graduate student to be equipped with sufficient knowledge and skill in semiconductor physics. The course is designed to include applications of diodes, transistors and FET, design and construction of oscillators and amplifiers and concludes with an introduction to communication devices and their features and methods for modulation and demodulation.

Proper understanding of these topics will definitely lead to a successful continuation of the learning process to advanced levels like master programs in physics or electronics and ultimately help the learner carry out meaningful research in the field of advanced materials for optoelectronics or any other specific topic as mentioned above. In addition, the skills acquired as part of the associated lab sessions in semiconductor physics will ultimately help them perform various experiments that require the use of one or other electronic components in research field or install and trouble shoot different equipment in daily life.

Since devices like cell phones, cars, laptops etc. that are an important part of modern life, include integrated circuits on a microchip, a solid foundation in semiconductor will enable students to pursue a career in this field or to be a successful entrepreneur in a venture that makes use of integrated circuits.

Course Outcomes:

CO1: Illustrate construction of rectifiers, voltage regulators and wave shaping circuits with pn junction diode (Apply)

CO2: Compare transistor configurations, feedback amplifiers, opamp circuits and compute the circuit parameters. (Analyse)

CO3: Illustrate the characteristics of oscillators and FET and compute circuit parameters (Apply)

CO4: Explain amplitude modulation and solve power spectrum and modulation index. (Apply)

Syllabus Contents

Previous knowledge: It is expected that the student knows the basics of Intrinsic and extrinsic semiconductors, PN Junction, Depletion layer, Barrier potential, Biasing- forward and reverse, features of Ge and Si, PN Junction diode – V-I characteristics–Diode parameters like ac and dc resistance, knee voltage, breakdown voltage etc.

Module I (14 hours)

Semiconducting diodes and applications (14 hours)

Drift and diffusion in diodes-Diode current equation; Junction capacitance and diffusion capacitance; Ideal vs real diode - equivalent circuits of both; Zener diode and its reverse characteristics; Reverse breakdown- Avalanche and zener breakdown; Rectification - Half wave, Full wave, Centre tapped, Bridge rectifier circuits - Nature of rectified output, Efficiency & Ripple factor; Filter circuits – Inductor Filter, Capacitor Filter, LC Filter, π Filter; Regulated Power supplies - Zener diode voltage regulator; Voltage multipliers – Doubler & Tripler; Wave shaping circuits - Clipper-Positive, negative and biased – Clampers- Positive, negative and biased; Construction and working of LED , SOLAR cell and PN photodiode.

Module II (24 hours)

Transistors Configurations and Feedback (12 hours)

Bipolar junction transistors, Transistor biasing, CB, CC, CE configurations and their characteristics- Active, saturation and cut-off regions. Current gain α, β, γ and their relationships. Leakage currents- Thermal runaway. DC operating point and AC and DC Load line, Q-Point. Basic principles of feedback, positive & negative feedback, Advantages of negative feedback, negative feedback circuits – voltage series & shunt, current series & shunt.

Amplifiers and Oscillators (12 hours)

Need for biasing-Stabilization- Voltage divider bias. Single stage transistor Amplifiers-CE amplifier - amplification factors. Decibel system, Variations in Amplifier gain with frequency. Oscillatory Circuits, LC oscillators – Hartley Oscillator, Colpit's Oscillator, RC oscillators - Phase shift Oscillator. Astable and monostable multivibrator (basic idea only no circuits)

Module III (16 hours)

FET, Operational Amplifier & Modulation (16 hours)

FET -characteristics, FET- Parameters. Comparison between FET and BJT.MOSFET (basic idea only) OP-amp- Symbol and terminals. Characteristics of ideal OP-amp, CMRR, Applications - inverting, Non-inverting, Unity follower and Summing amplifiers. Types of modulation – AM, FM, Pulse modulation and Phase modulation (qualitative study only). Amplitude modulation-modulation index - Analysis of AM wave – Sidebands –bandwidth AM Demodulation.

Text Books:

1. Basic Electronics- B.L.Theraja 5th Edition, S Chand
2. A Text Book of Applied Electronics- R.S.Sedha, S Chand and Co.
3. Optoelectronics Wilson and Hawkes, 3rd edition, Pearson

References:

1. Principles of electronics, VK Mehta, S Chand

2. Basic Electronics, Malvino and Bates, TMH

3. Electronics Fundamentals and Applications- D. Chattopadhyay and P.G.Rakshit, New Age International Publishers.

4. Electronics: Fundamentals of Analog circuits, Thomas L. Floyd, David Buchla, PHI

5. Electronic Devices and Circuit Theory, Robert Boylestad, Louis Nashelsky, PHI

6. Basic Electronics, Debashis De, Pearson 2010

7. Basic Electronics, Santiram Kal, PHI 2010

SEMESTER IV

PH4C04B23 ELECTRICITY AND ELECTRODYNAMICS

Credits- 3

Hours per week-3 **Total Lecture Hours- 54**

Course Overview & Context:

Electricity and electrodynamics provide a unique understanding of nature and is often the starting point for advanced studies. It is applied in devices that we use on a day to day basis like motors, induction devices, etc. and extends to high profile research in phenomena involved with particle accelerators and electron tubes that are subject to high voltages and carry heavy currents. Needless to say without electric power and communication facilities, life will become difficult. It is for this reason that a course in electricity and electrodynamics is an essential part of physics education at graduate level. This course is designed to provide a strong foundation in transient currents, electrostatics and magnetostatics, electrodynamics and Maxwell's equations.

A proper understanding of these topics will help students advance to higher studies and research. It can also enable them to understand the working of various electrical equipment and even to be self-employed in assembling and repairing different household electrical equipment.

Course Outcomes:

CO1: Explain the basic types of thermo optic effects and also various aspects of transient currents in different circuits. (Understand)

CO2: Summarise the nature of magnetic field generated by electric current (Understand)

CO3: Apply Gauss's law to point charges and continuous charge distribution. (Apply)

CO4: Develop Maxwell's equations in conductors (Apply)

Syllabus Contents

Module I (18 hours)

Transient Current (4 hrs)

Growth and decay of current in LR and CR circuits-Measurement of high resistance by leakage

Charging and discharging of a capacitor through LCR circuit.

Thermo electricity (5 hrs)

Seebeck, Peltier and Thomson effects – laws of thermoelectric circuits – Peltier coefficient – Thomson coefficient – application of thermodynamics to a thermocouple and expressions for Peltier and Thomson coefficients - thermo electric power and thermo electric diagrams.

Alternating Current and Network Theorems (9hrs)

EMF induced in a coil rotating in magnetic field- AC circuit containing resistance-inductance and capacitance in series (Series resonance circuit)- Parallel resonant circuit-Power in ac circuit containing resistance- inductance and capacitance- Wattless current-Choke coil- Skin effect- Three phase ac generator- Distribution of three phase alternating current- The ac watt meter Network Theorem Ideal current source- Ideal voltage source- Superposition theorem- Thevenin's theorem- Norton's theorem, Maximum power transfer theorem.

Module II (18 hours)

Electrostatics & Magnetostatics (18 hrs)

Electric field - Continuous charge distribution - Divergence and curl of electrostatic fields - Gauss' Law and its application to obtain fields due to Spherically symmetric charge distribution, Uniformly charged spherical conductor, Line charge, Infinite plane sheet of charge & Electric field at a point between two oppositely charged parallel plates. Electric potential- Poisson's equation and Laplace's equation- The potential of a localized charge distribution- Work and Energy in electrostatics- The work done to move a charge- Energy of a point charge distribution and continuous charge distribution. Conductors: Basic properties induced charges- Surface charge and force on a conductor- Capacitors. Magnetic field of Steady currents: - Biot Savart's law - magnetic induction at a point due to a straight conductor, axis of a circular coil & at the axis of a solenoid - Force on a current carrying conductor in magnetic field - force between two parallel conductors carrying current- electron moving in a magnetic field and Lorentz force- Ampere's circuital law -

differential form - applications - to find the magnetic fields due to long solenoid & toroid - Comparison of magnetostatics and electrostatics

Module III (18 hours)

Maxwell's equations and Electromagnetic waves Maxwell's equations- Electrodynamics before Maxwell- Modification of Ampere circuital law- Magnetic Charge-Poynting's theorem The wave equation in one dimension- Boundary condition -Reflection and Transmission- Polarization- Electromagnetic waves in vacuum Monochromatic plane waves- Energy and momentum in Electromagnetic waves Electromagnetic waves in matter- Propagation in linear media- Electromagnetic waves in conductors

Text books:

1. Electricity & Magnetism – R.Murugeshan- Ninth revised edition- reprint 2013 Publications-S Chand & Company PVT-LTD, Ram Nagar, New Delhi – 110055.
2. Introduction to Electrodynamics - David J Griffiths Publications- Prentice Hall –Inc (Pearson Education- Inc)
3. Introduction to Thermo electricity – H J Goldsmid, Springer

References:

1. Electricity and Magnetism – J-H-Fewkes & JohnYarwood, University tutorial
2. Fundamentals of Magnetism and Electricity D N Vasudeva - S chand
3. Electricity and Magnetism A S Mahajan and AA Rangwala -TMH
4. Introduction to electrodynamics- David J Griffiths- PHI
5. Electromagnetics Matthew N Sadiku- Oxford 4th Edn
6. Electromagnetics with applications Kraus and Fleish 5th Edn – TMH
7. Electromagnetics J A Edminister 2nd Edn - TMH
8. Electromagnetic Fields TVS Arunmurthi – S- Chand

SEMESTER V

PH5C05B23 ENVIRONMENTAL PHYSICS, HUMAN RIGHTS AND INTELLECTUAL PROPERTY RIGHTS

Credits- 4

Hours per week-4 **Total Lecture Hours- 72 Hours**

Course Overview & Context:

The need for sustainable development is the key to the future of mankind. Continuing problems of pollution, solid waste disposal, degradation of environment, Global warming, etc. have made everyone aware of environmental issues. It is clear that no citizen of the earth can afford to be ignorant of environment issues. Recognizing this, the Hon'ble Supreme Court directed the UGC to introduce a basic course on environment in college education. Accordingly, a compulsory course in environmental studies is included in the UG curriculum.

This course encourages students to research, investigate and make their own decisions about complex environmental issues, to understand how their actions affect the environment, and how we can take action to keep our environment healthy and sustainable for the future.

The course also contains a module on Human rights and Intellectual property rights. Human Rights Education is an indispensable part of education and can be most effectively imbibed through education. The knowledge of the rights and freedoms, of oneself as much as of the others, is considered as a fundamental tool to guarantee the respect of all rights for each and every person.

Awareness of Intellectual Property Rights (IPR) is critical to shaping an environment that is conducive to fostering creativity & innovation. Hence a module is designed to provide comprehensive knowledge to the students regarding the general principles of IPR, Concept of patents, trademark and copy right, and IPR in India and abroad.

Course Outcomes:

CO1: Explain about the various natural resources and its conservation methods, and discuss the harmful effects of environmental pollution (Understand)

CO2: Discuss various aspects of waste management and ethical issues raised by environmentalism (Understand)

CO3: Distinguish between the renewable and non-renewable energy sources. (Understand)

CO4: Examine the devices and applications powered by solar energy. (Understand)

CO5: Summarize the relevance of various human rights and intellectual property rights. (Understand)

Syllabus Contents

Module I (16 hours)

Natural Resources **(8 hours)**

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problem, Water Conservation, Rain water harvesting, Watershed management

Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forest and tribal people,Case studies.

Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, Case studies.

Environmental Pollution **(8 hours)**

Definition, Causes, effects and control measures of: - a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards

Role of an individual in prevention of pollution • Pollution case studies • Disaster management: floods, earthquake, cyclone and landslides.

Module II (16hrs)

Waste management **(6 hours)**

Waste minimization and resource conservation -Solid waste Management: Causes, effects and control measures of urban and industrial wastes-Waste treatment and disposal methods.

Environment impact assessment and control **(10 hours)**

Environmental ethics: Issues and possible solutions

Environment Protection Act • Air (Prevention and Control of Pollution) Act • Water (Prevention and control of Pollution) Act • Wildlife Protection Act • Forest Conservation Act • Issues involved in enforcement of environmental legislation

Module III (10 hours)

Non-renewable and Renewable Energy Sources **(10 hours)**

Non-renewable energy sources: -Coal, Oil, Natural gas; Nuclear fission energy; Merits and demerits of non-renewable energy. Renewable energy sources: Biomass energy- Biogas plant - Fixed dome type and moving dome type; Wind energy; Wave energy; Tidal energy; Hydroelectricity; Geothermal energy conversion; Ocean thermal energy conversion; Fusion energy; Hydrogen energy- Production (electrolysis) and storage; Merits and demerits of each renewable energy sources; Storage of intermittently generated renewable energy (qualitative); Fuel cell.

Module IV (10 hours)

Solar energy **(10 hours)**

Sun as a source of energy- Solar radiation, Solar Constant, Spectral distribution; Solar pond - convective and salt gradient types; Flat plate collector; Solar water heater – Direct and indirect systems- Passive and active systems; Optical concentrator – Parabolic trough reflector - Mirror strip reflector - Fresnel lens collector; Solar desalination; Solar dryer - Direct and indirect type; Solar cooker; Solar heating of buildings; Solar green houses; Need and characteristics of photovoltaic (PV) systems; Solar cells - Principle, Equivalent circuits, V-I characteristics, fill factor, conversion efficiency; PV Sun tracking systems; Merits and demerits of solar energy**.**

Module V (20 hours)

Human Rights and Intellectual property rights (20 hours)

Human Rights (10 hours)

An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights). Human Rights and United Nations Contributions, main human rights related organs - UNESCO, UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights. Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities Environment and Human Rights Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western Ghats- mention Gadgil committee report, Kasthurirengan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

Intellectual Property Rights (10 hours)

Introduction and the need for intellectual property right (IPR)-Kinds of intellectual property rights:

Patent- Definition, Kinds of inventions protected by patent-Patentable and Non patentable inventions-Patent laws.

Trade mark-Rights of trademark-Kind of signs used as trademark-types, purpose and functions of a trademark, trademark protection, trademark registration.

Copy rights: Rights and protection covered by copyright-Law of copy rights: Fundamental of copyright law, Originality of material, Rights of reproduction.

IPR in India: Genesis and development-IPR in abroad- Major International instruments concerning Intellectual property rights.

Text & References:

1. D.P. Mittal (Taxman Publication), Indian Patents Law and Procedure
2. B.L. Wadera, Patents, trademarks, copyright, Designs and Geographical Judications.
3. P. Narayanan (Eastern Law House), Intellectual Property Law
4. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow
5. Renewable Energy Sources and Emerging Technologies: Edition 2, D.P. Kothari K. C. Singal RakeshRanjan - PHI Learning Pvt. Ltd, 2011.
6. Solar energy - M P Agarwal - S Chand and Co. Ltd.
7. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
8. Clark.R.S., Marine Pollution, Clanderson Press Oxford
9. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001 Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p
10. Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd
11. Down to Earth, Centre for Science and Environment
12. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb
13. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p
14. Mekinney, M.L & Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p
15. Rao.M.N & Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p
16. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances AndStadards, Vol I and II, Enviro Media
17. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication
18. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

SEMESTER V

PH5C06B23 CLASSICAL AND QUANTUM MECHANICS

Credits – 3

Hours per week-3 **Total Lecture Hours - 54**

Course Overview & Context:

The course gives an introduction to techniques in classical mechanics as an alternative to Newtonian mechanics. Since the branches of science at the micro level are governed by principles of quantum mechanics, this course provides a platform for better understanding of various phenomena observed in the nuclear, atomic and molecular world.

Classical and quantum mechanics remains an indispensable part of physics education. They have a two-fold role in preparing the student for the study of modern physics. The first module gives formulations of Lagrangian and Hamiltonian. The second module deals with wave mechanical formulations and the theories that demanded quantum mechanical concepts. Third module introduces the general formalism of quantum mechanics and energy eigen value problems.

Course Outcomes:

CO1: Examine the dynamical motion of classical systems using Lagrangian formalism (Apply)

CO2: Explain the Hamiltonian formalism in generating equations of motion of classical system of particles (Analyse)

CO3: Discuss the quantum mechanical concepts using wave function formalism (Understand)

CO4: Devise Schrodinger equation to one dimensional Energy Eigen value problems (Analyze)

Syllabus Contents

Module I (16 hours)

Lagrangian and Hamiltonian Formulations of Classical Mechanics (16 hours)

Constraints, degrees of freedom, generalized co-ordinates, principle of virtual work, D'Alembert's principle, Lagrange's equations (no derivation required), Application of Lagrangian (Linear

Harmonic oscillator, Planetary motion and Simple Pendulum only), Generalized momentum and cyclic coordinates, Hamilton's Canonical equations of motion, Advantages of Hamilton's method, Applications of Hamilton's method (Linear Harmonic oscillator and Simple pendulum only). Hamilton's Principle of Least Action. Derivation of Lagrange's equation from Hamilton's Principle.

Text Book:

1. Classical Mechanics, J C Upadhyaya, Himalaya Publishing house, Chapters 2,6 & 3

Module II (20 hours)

Quantum Mechanics

Historical development and Origin of Quantum theory (8 hours)

Failure of classical physics, black body radiation, Planck's quantum hypothesis, Planck's radiation law, Photoelectric effect-Einstein's explanation, Compton effect, Bohr's correspondence principle - Wave particle Dualism, Dual nature of matter - De Broglie hypothesis, De Broglie waves, Wave packet, Group and phase velocities.

General Formalism of Quantum Mechanics (12 hours)

Linear vector space- Hilbert space- Orthogonality- Linear operator - Eigen functions and eigen values - Hermitian operator - Postulates of Quantum Mechanics - wave function, Operators, Expectation value, Eigen value, Time development- Simultaneous measurability - General uncertainty relation.

Text Books:

1. Quantum Physics, Stephen Gasirowicz, Wiley –India Edition, Chapter 1
2. Quantum Mechanics, G.Aruldhas, PHI Learning Private Limited, Chapters 1, 2 & 3

Module III (18 hours)

Schrödinger equation and its applications (18 hours)

Time dependent Schrodinger equation for free particle and for particle in a field, Interpretation of wave function, probability interpretation, probability current density, expectation value, time independent Schrodinger equation, stationary states, admissibility conditions on the wave function, particle in a box - one dimensional barrier problem, square potential barrier.

Text Book:

1. Quantum Mechanics, G.Aruldhas, PHI Learning Private Limited, Chapter 4

References:

1. Classical Mechanics, Herbert Goldstein, Charles Poole and John Safk, Pearson Education, Indian Edition.

2. Mechanics, H S Hans, S P Puri, Tata McGraw Hill Education Pvt. Ltd.

3. Classical Mechanics, Rana and Joag, TMH.

4. Classical Mechanics, K. Sankara Rao, Prentice Hall of India.

5. Classical Mechanics, Greiner, Springer.

6. Concepts of Modern Physics - Arthur Beiser, Tata McGraw Hill.

7. A Text book of Quantum Mechanics, P.M. Mathews and S.Venkatesan, TMH.

8. A text book of Quantum Mechanics, Ghatak and Lokanathan.

9. Feynman lecture series –volume 3.

10. Modern Physics -G. Aruldhas, P. Rajagopal, PHI Learning Pvt. Ltd.

SEMESTER V

PH5C07B23 PHYSICAL OPTICS AND PHOTONICS

Credits- 3

Hours per week-3 **Total Lecture Hours- 54**

Course Overview & Context:

This course delivers basic ideas of wave optics and deals with different optical phenomena such as interference, diffraction and polarization in detail. A good knowledge of optics is essential for the understanding of developments of Photonics further, this course incorporates topics such as lasers, Fibre Optics and Optical Communication.

This course provides basic skills to set up optical experiments.

Course Outcomes:

CO1: Interpret the theory of interference in Fizeau and Haidinger fringe systems. (Apply)

CO2: Explain Fresnel and Fraunhoffer diffractions. (Apply)

CO3: Analyse the production and detection of different types of polarized light. (Analyse)

CO4: Analyse the mechanisms of light matter interactions that lead to laser action and explain its applications (Analyse)

Module I (22 hrs)

Interference **(11hrs)**

Review of basic ideas of interference – optical path – phase difference - coherence. superposition of waves- condition for bright and dark fringes. Interference (Analytical method) - intensity distribution. Techniques of obtaining interference- wavefront splitting Fresnel's biprism-theory-fringe width- lateral displacement of fringes. Amplitude splitting-Interference in thin films-plane parallel film (reflected system)-conditions for brightness and darkness (transmitted system-quantitative)-Fizeau and Haidinger fringes- Air wedge- theory-determination of wedge angle and thickness of spacer- colours in thin films. Newton's rings (reflected system)-determination of wavelength of light-refractive index of liquid. Michelson interferometer-principle-construction-

working (formation of fringes- qualitative ideas)- applications-determination of wavelength-thickness of thin transparent sheet-refractive index of gases.

Text Book:

1. Optics - Subramanayam, Brijlal, M. N Avadhanalu, S.Chand, Revised 24th Edition Chapter 14 (Sec.14.1 – 14.4.2, 14.8, 14.9 – 14.9.4) and Chapter 15 (Sec. 15.1 – 15.2.5, 15.4- 16.6.9, 15.7, 15.8)

Diffraction (11 hrs)

Fresnel Diffraction

Huygens- Fresnel theory –Fresnel assumptions- Fresnel half period zones-theory of rectilinear propagation- zone plate – action of zone plate for an incident spherical wavefront comparison between zone plate and convex lens. Diffraction pattern due to a straight edge – intensity at a point in the geometrical shadow.

Fraunhoffer diffraction (calculus method not required)

Fraunhoffer diffraction at a single slit, double slit- missing orders in double slit, theory of plane diffraction grating- (normal incidence, N slits)- width of principal maxima-absent spectra-overlapping of spectral lines-determination of wavelength of a spectral line- dispersive power of grating-comparison of prism & grating spectra. Comparison between interference and diffraction.

Text Book:

1. Optics - Subramanayam, Brijlal, M. N Avadhanalu, S.Chand, Revised 24thEdition Chapter 17 (Sec. 17.1 – 17.7, 17.10 -17.10.2) and Chapter 18 (18.1 – 18.2.1,18.4,18.4.2, 18.4.3, 18.7 – 18.7.2, 18. 7.4 – 18.7.8)

Module II (12 hours)

Polarization (12hrs)

Polarization- introduction to polarization- polarization by reflection- Brewster's law-Malus' Law-polarization by double refraction-calcite crystal-optic axis- principal section-Huygens explanation of double refraction-phase difference between e ray and o ray- superposition of waves linearly polarized at right angles-types of polarized light – retarders-quarter wave plates- half wave plates

– production and detection of elliptically and circularly polarized light- optical activity- Fresnels explanation of optical rotation (analytical treatment not needed)- specific rotation-application- Laurent's half shade polarimeter.

Text Book:

1. Optics - Subramanayam, Brijlal, M. N Avadhanalu, S.Chand, Revised 24th Edition, Chapter 20

Module III (20 hours)

Lasers (11hrs)

Absorption and emission of light-Absorption-spontaneous emission and stimulated emission light amplification by stimulated emission. Einstein's relations-condition for light amplification – population inversion-pumping –pumping methods –optical pumping – electrical pumping – injection pumping. Active medium-metastable states- pumping schemes (two level, three level and four level)- Characteristics of laser beam- Optical resonator (theory not required) -Threshold condition. Types of lasers-ruby laser, He-Ne laser, semiconductor laser. Applications of lasers- Holography (principle, recording and reconstruction) - materials processing-cutting, drilling and welding.

Text Books:

1. An introduction to lasers theory and applications- MN Avadhanulu. S. Chand, Chapters 1,2,3 & 5.
2. Optics - Subramanayam, Brijlal, M. N Avadhanalu, S.Chand, Revised 24th Edition, Chapter 22& 23.

Fiber Optics and Optical Communication (9hrs)

Optical fiber- Critical angle of propagation-modes of propagation (Ray theory only)- Acceptance angle -Fractional refractive index change- Numerical Aperture- Types of Optical fibers- pulse dispersion - Applications- Fiber optic communication system- Advantages of Optical fibers.

Text Book:

1. Optics - Subramanayam, Brijlal, M. N Avadhanalu, S.Chand, Revised 24th Edition, Chapter 24.

References:

1. Optics, E Hecht and AR Ganesan, Pearson
2. Optics, 3rd edition, AjoyGhatak, TMH
3. Optical Electronics, AjoyGhatak and K Thyagarajan, Cambridge
4. Optics and Atomic Physics, D P Khandelwal, Himalaya Pub. House
5. Optics, S K Srivastava, CBS Pub. N Delhi
6. A Text book of Optics, S L Kakani, K L Bhandari, S Chand.
7. Optics N.Subramanayam, Brijlal, M.N Avadhanulu S Chand.
8. Semiconductor optoelectronic devices: Pallab Bhattacharya, PHI 2009.
9. Lasers and Non linear Optics, BB Laud, New Age Int Pub. 2013
10. Laser Fundamentals, William T Silfvast, Cambridge Univ Press. 2012.
11. Optoelectronics an Introduction, J Wilson & JFB Hawkes, PHI 1999.
12. Fiber Optics and Optoelectronics, R P Khare, Oxford 2012..
13. Introduction to Optics, Frank L Pedrotti, Leno M Pedrotti& Leno S Pefrotti, Pearson 2014.
14. Optical fiber and fiber optic communication system (4th edition) Subir Kumar Sarkar, S Chand.

SEMESTER V

PH5C08B23 DIGITAL ELECTRONICS AND PROGRAMMING IN C++

Credits- 3

Hours per week- 3 **Total Lecture Hours- 54**

Course Overview and context:

This course is expected to nurture basic understanding of principles of digital electronics and to provide necessary background to the major aspects of digital logic circuits. This course discusses in detail the Boolean algebra, combinational and sequential logic circuits and the fundamentals of Programming in C++ .

This course develops skill in designing digital circuits and for executing programmes using C++. It will provide a basic step to achieve occupation related to computer programming and digital circuit designing.

Course Outcomes:

CO1: Explain the concepts and principles in Boolean algebra and digital logic circuits (Understand)

CO2: Examine various logic circuits applying sequential and combinational logic. (Apply)

CO3: Solve problems in Digital Electronics. (Apply)

CO4: Illustrate basic C++ program structure and develop programs (Apply)

Syllabus Contents

Module I

Boolean algebra and logic gates **(9 hours)**

Basic gates NOT, OR, AND. Universal Logic Gates- NOR, NAND. XOR and XNOR Gates. Rules and Laws of Boolean algebra. Duality theorem -De Morgan's Theorems. Analysis and

simplification of logic circuits- Boolean equation and truth table - SOP and POS. Minterms and Maxterms. Standard SOP and Standard POS- Conversion between Standard SOP & Standard POS. Karnaugh Map (up to four variables). K map SOP minimization.

Text Book:

1. Digital principles and applications 5thEdn. Malvino, Leach, TMH. Chapter 2, 3.

Module II (19 hours)

Combinational logic (6 hours)

Half Adder and Full Adder, Half and Full subtractor, 4-bit parallel Adder/Subtractor. Multiplexer, Demultiplexer, Encoder & Decoder.

Sequential logic (13 hours)

Flip-flops, RS, Clocked RS, Master Slave JK FF, DFF, T Flip-flop, Buffer registers- Shift register- SISO and SIPO, Counters- Binary ripple counter. D/A converters (Ladder type), A/D Converter (Counter type).

Text Books:

1. Digital principles and applications 5thEdn. Malvino, Leach, TMH. Chapter 6 (Sec. 6.7&6.8) and Chapter 4 (Sec. 4.1 - 4.6), Chapter 8(Sec. 8.1-8.7), Chapter 9 (Sec.9.1& 9.2).
2. Digital Computer Electronics, Malvino, Appendix 1 The analog interface.

Module III

Programming in C++ (26 hours)

Basic C++ program structure –comments-data types-variable types-constants operators (arithmetic, relational, logical and assignment operators)- if, if-else and else if, do while - case – loops(while, do-while, and for)-nested loops- arrays(Defining Arrays, Accessing Array Elements, Initializing Arrays)- basic ideas of functions(qualitative idea), object and classes. Programs using loops.

Text Book:

1. Object oriented programming in turbo C++, Robert Lafore (Galgotia Pub), Chapter 2,3 &7

References:

1. Digital design, M Morris Mano, PHI

2. Digital logic and computer design, M Morris Mano, PHI

3. Digital Electronics, William H Gothmann, PHI

4. Digital principles and applications 6th Edn. Malvino, Leach and Saha, TMH

5. Digital circuits and design, S Salivahanan and S Arivazhakan, PHI

6. Digital Electronics, Sedha, S Chand

7. Pulse, Digital and switching waveforms - Millam and Taub.

8. Digital computer electronics, Malvino, Brown, TMH

9. Digital electronics, Tokheim, TMH

SEMESTER VI

PH6C09B23 THERMAL AND STATISTICAL PHYSICS

Credits – 3

Hours per week-3 **Total Lecture Hours- 54 Hours**

Course Overview & Context:

The topics on thermodynamics are intended to develop a basic knowledge required to design any device involving the interchange between heat and work or the conversion of material to produce heat. The topic on statistical mechanics, is expected to provide an understanding of the behavior of these systems in a microscopic level. The first module deals with the behavior of real gases, the laws of thermodynamics and the working of heat engines. The concept of entropy, thermodynamic potentials and the various laws of thermal radiation, conductivity etc. are discussed in the second module. The third module deals with the fundamental topics of statistical mechanics and a description of the different types of statistics.

This course gives foundation for heat engine, thermodynamic relations and many more important concepts and students can understand how the microscopic world operates.

Course Outcomes:

CO1: Discuss the real and ideal behaviours of gases. (Understand)

CO2: Explain the different thermodynamics properties and efficiency of the Carnot's engine. (Analyse)

CO3: Examine the thermodynamic relations, thermodynamics potential and entropy (Apply)

CO4: Compute the value of thermodynamic probability and illustrate the concepts and applications of classical and quantum statistics. (Apply)

Syllabus Contents

Module I

Thermal Physics (18 hrs)

Behaviour of real gases **(9 Hours)**

Behaviour of real gases -Change of state, Continuity of state, Andrew's experiments on Carbon

dioxide-Critical constants- Vander Waals equation of state-Comparison with experimental PV curves-Estimation of critical constants - Constants of Vander Waals equation-Critical coefficient-Limitations of van der Waals equation.

Thermodynamics (9 Hours)

Thermodynamic system- Zeroth law(Statement and explanation)-Thermodynamic equilibrium-First law of thermodynamics- Applications of first law-Specific heats of a gas, isochoric process, isobaric process, adiabatic process, adiabatic equation of a perfect gas, cyclic process, isothermal process-Indicator diagram- Work done during isothermal and adiabatic process- slopes of adiabatics and isothermals- relation between adiabatic and isothermal elasticities

Reversible and irreversible process- Heat Engines-Carnot's ideal heat engine-Carnot's cycle Effective way to increase efficiency-Carnot's engine and refrigerator-coefficient of performance - Second law of thermodynamics-Kelvin's and Clausius's statement-Carnot's theorem

Module II

Thermodynamic relations and Thermal radiation (18 Hours)

Thermodynamic relations (9 Hours)

Entropy- change in entropy- entropy change in adiabatic process and reversible cycles Principle of increase of entropy- The T-S diagram- Physical significance of entropy- Entropy of steam-Third law of thermodynamics: Nernst's Heat theorem-Zero point energy.

Thermodynamic potentials- Significance of thermodynamic potentials- relation of thermodynamic potentials with their variables- The TdS equations- Clapeyron's Latent heat equation using Maxwell's Thermodynamical relations.

Text Book:

1. Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne, S. Chand &Co, Multicolour edition 2007, Chapters 2 and 4

Thermal Radiation (9 Hours)

Thermal radiation- Prevost's theory of heat exchanges- Black body- Fery's black body- Black

body radiation and its temperature dependence- Emissive power and absorptive power-Stefan – Boltzmann law- Conduction, thermal conductivity, thermal conductivity of bad conductor Lee's disc experiment -thermal resistance.

Text Book:

1. Thermodynamics and Statistical physics Brij Lal, N.Subrahmanyam and P S Hemne, (S. Chand &Co, Multi colour edition 2007, Chapters 5,6 and 8

Module III

Statistical Mechanics (18hrs)

Probability – Principle of equal a priori probability – Micro and macro state – Thermodynamic probability Position space, Momentum space, phase space, mu – space and gamma space (qualitative ideas only) Minimum size in classical and quantum mechanics – entropy and thermodynamic probability - Boltzmann's entropy relation – Ensembles – Kinds of ensembles Three kinds of statistics – Classical statistics – Maxwell – Boltzmann Distribution law – Need of quantum statistics – indistinguishability of particles – partition function, average energy of particle, equipartition theorem.

Text Book:

1. Brij Lal, N.Subrahmanyam and P S Hemne, Multi colour edition 2007, Chapters 9,10,11,12.

References:

1. Heat and Thermodynamics, Mark W Zemaskay and Richard H Dittman, TataMcGrawHill Publishing Co. (Special Indian Edition)
2. Thermodynamics and Statistical Mechanics, Greiner, Springer
3. Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif. McGraw Hill.
4. A Treatise on Heat; Saha and Srivastava, The Indian Press, Allahabad.
5. Statistical Mechanics, R.K. Pathria, Pergamon press, Oxford

SEMESTER VI

PH6C10B23 RELATIVITY AND SPECTROSCOPY

Credits – 3

Hours per week-4 **Total Lecture Hours - 72**

Course Overview & Context:

The course is meant to enable the student to understand the laws of physics in the context of relativistic speed and to know how the spectral lines from various atoms and molecules are originated. This course discusses in detail the relativistic variations of mass, energy, length and time and introductory concepts in general theory of relativity. Further, the details of atomic, molecular, Nuclear Magnetic Resonance and Electron Spin Resonance Spectroscopy are included

This course establishes skill development in real time applications of various spectroscopic techniques.

Course Outcomes:

CO1: Compute the relativistic variation of parameters on the basis of Special theory of Relativity and (Apply)

CO2: Articulate the concepts of Vector atom model and explain various atomic spectroscopic properties (Apply)

CO3: Illustrate the various kinds of spectroscopic methods (Apply)

CO4: Explain the basics of general theory of relativity (Understand)

Syllabus Contents

Module I (23 hours)

Special and General Theories of Relativity **(23 hours)**

Inertial and non-inertial frames of reference- Galilean transformation, Significance of Michelson-Morley experiment, Postulates of Special Theory of Relativity, Lorentz transformation, Spatial

contraction, Time dilation, composition of velocities, mass of moving particle, Equivalence of mass and energy.

Introductory concept of general theory of relativity - the equivalence principle, clocks in a gravitational field, global positioning system (Qualitative ideas only)

Text Books:

1. Modern Physics, G. Aruldhas, P. Rajagopal, PHI Learning Pvt. Ltd. Chapter 1
2. Concepts of Modern Physics, Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd.
3. Gravity - An Introduction to Einstein's relativity, James B. Hartle, Addison Wesley Publishers

Module II (21 hours)

Atomic Spectroscopy (21 hours)

Early atom models – Bohr model, Vector Atom model, Quantum numbers associated with vector atom model, Coupling Schemes- L-S coupling, j-j coupling, Pauli Exclusion principle, Magnetic dipole moment due to orbital and spin motion of electron, Spin-Orbit coupling. Optical spectra, spectral terms and notations, selection rules, intensity rule and interval rule, fine structure of sodium D line, Zeeman Effect, Larmor's theorem, quantum mechanical explanation of the normal Zeeman Effect, Anomalous Zeeman effect and Paschen Back Effect.

Text Books:

1. Modern Physics, R Murugeshan & Kiruthiga Sivaprasath , S Chand, Chapter 6
2. Concepts of modern Physics, Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd.
3. Modern Physics, G Aruldhas & P Rajagopal, PHI Learning Pvt. Ltd.

Module III (28 hours)

Molecular spectroscopy (22 hours)

Electromagnetic spectrum, Molecular energies, Classification of molecules, Rotational Spectra of diatomic molecules, Diatomic vibrational spectra, Explanation with simple harmonic oscillator. Electronic Spectra of molecules, Phosphorescence and Fluorescence, Raman Scattering, Classical

description of Raman scattering and its failure, Quantum theory of Raman Scattering, Raman Spectrometer. IR and Microwave spectroscopes.

Text books:

1. Fundamentals of molecular spectroscopy, Colin N. Banwell and Elanine M McCash,Tata McGraw Hill
2. Modern Physics,G Aruldhas & P Rajagopal - PHI Learning Pvt. Ltd,
3. Concepts of Modern Physics, Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd.

NMR and ESR Spectroscopy (6 hours)

NMR Spectroscopy- Basic principles - Applications of NMR. ESR Spectroscopy- Basic principles, Applications of ESR.

Text Book:

1. Molecular Structure & Spectroscopy, G Aruldas, Prentice Hall of India , Chapters 10 & 11

References:

1. Modern Physics, Kenneth S Krane.
2. Mechanics, H S Hans, S P Puri, Tata McGraw Hill Education Pvt. Ltd.
3. Classical Mechanics, K. Sankara Rao, Prentice Hall of India
4. Modern Physics, R Murugeshan & Kiruthiga Sivaprasath , S Chand
5. Carroll, Sean M. Spacetime and Geometry: An Introduction to General Relativity. Cambridge University Press, 2019. ISBN: 9781108488396.
6. A First Course in General Relativity - Bernard F. Schutz, Cambridge University Press

SEMESTER VI

PH6C11B23 NUCLEAR, PARTICLE AND ASTROPHYSICS

Credits-3

Hours per week-3 **Total Lecture Hours-54**

Course Overview & Context:

Nuclear physics is a science dealing with structures, elements and forces of the nuclei and its applications in the modern world are enormous. This course is intended to explore the interior of the nucleus and to understand the paramount importance of the nucleus in the grand scheme of things. The course starts with the basic topics such as classification and static properties of nuclei, nuclear forces. Then it gives an introductory note on nuclear models and detectors of nuclear radiations. The principal aspects of radioactivity, nuclear reactions and particle physics are further included in this course. Introductory notes on Astrophysics and cosmic rays are also part of this course.

This course gives the foundation for understanding various nuclear reactions occurring in the nucleus and equips the students with necessary skills to make them understand the realm of nuclear physics.

Course Outcomes:

CO1: Explain the structure, properties and models of atomic nucleus to interpret nuclear reactions and their applications (Apply)

CO2: Discuss the process of radioactivity and the laws governing a radioactive process (Understand)

CO3: Discuss the classification of stars and the stellar evolution (Understand)

CO4: Illustrate the classification and properties of elementary particles and cosmic rays (Apply)

Syllabus Contents

Module I (16 hours)

Nuclear structure **(13 hours)**

Nuclear composition – Nuclear electrons, Classification of nuclei – isotopes, isobars, isomers,

mirror nuclei. Nuclear properties: nuclear radii – spin and magnetic moment - Stable nuclei - Binding energy- binding energy curve, Liquid drop model - Semi empirical binding energy formula with correction factors - Shell model - Nuclear forces- Meson theory of nuclear forces – Discovery of pion– Virtual Photons

Detectors of nuclear radiations **(3 hours)**

Interactions between energetic particles and matter (basic concepts only) – Ionization chamber - Proportional counter - Geiger-Muller counter

Module II (22 hours)

Nuclear Transformations **(15 hours)**

Radioactive decay – Radiation hazards – Half life – Radiometric dating – Radioactive series - Alpha decay, tunnel theory of alpha decay - Beta decay, positron emission, electron capture, inverse beta decay – Gamma decay - The concept of interaction cross section – Nuclear reactions, Resonance, Center of mass coordinate system, Q value of nuclear reaction – Nuclear fission – Nuclear reactors – Breeder reactors – Fusion reactors – Confinement methods

Astrophysics **(7 hours)**

Classification of stars – Hertzsprung - Russel diagram – Luminosity of a star – Stellar evolution - White Dwarfs - Chandrasekhar limit - Neutron stars - Black holes - Supernova explosion – Photon diffusion time.

Module III (16 hours)

Particle Physics (12 hours)

Interactions and Particles – Leptons - neutrinos and antineutrinos, other leptons –Hadrons – Resonance particles – Elementary particle quantum numbers – Basic concepts of symmetries and conservation principles – Basic concepts of Quarks – color, flavor, Quark confinement –Higgs boson

Cosmic rays (4 hours)

Latitude effect – Azimuth effect – Altitude effect - Primary cosmic rays – Secondary cosmic rays – Cosmic ray showers – Discovery of Positron – Mesons, Van Allen belts –Origin of cosmic rays

Text Books:

1. Concepts of Modern Physics, Arthur Beiser, 6th Edition, Tata McGraw-Hill publishing company

2. Modern Physics, R Murugeshan and K. Sivaprasath, 15th Edition (Revised) (2010), S.Chand

References:

1. Atomic and Nuclear Physics, S N Ghoshal, S.Chand.

2. Nuclear and Particle Physics S L Kakani and Subhra Kakani -Viva Books 2008

3. Elements of Nuclear Physics, M L Pandya and R P S Yadav, Kedar Nath Ram Nath

4. Modern Physics, Kennth Krane, 2nd Edition, Wiley India (Pvt) Ltd.

5. Modern Physics , G. Aruldhas and P. Rajagopal, Prentice-Hall India

6. An Introduction to Astrophysics, Baidyanath Basu, 2nd Edition, Prentice-Hall India

SEMESTER VI

PH6C12B23 CONDENSED MATTER PHYSICS

Credits – 3

Hours per week-4 **Total Lecture Hours - 72**

Course Overview & Context:

Condensed matter physics deals with the physical properties of condensed phases of matter which try to understand their behavior by using physical laws. In particular, these include the laws of quantum mechanics, electromagnetism and statistical mechanics. This course provides basic knowledge about the structure of crystals, theories that discuss the distribution and motion of electrons in materials and the properties thereof. It also explores new materials like superconductors, polymers, nanomaterials, liquid crystals which have high prospects of application.

This course introduces students to the physical properties of solids and to equip the students with such skills as to make them understand the mysteries of nature at different scales. It also enables the students to develop problem solving skills, analyze problems starting from first principles, evaluate and validate experimental results, and draw logical conclusions thereof.

Course Outcomes:

CO1: Discuss the fundamental aspects and bonding of crystal structures and explain the phenomenon of X- ray diffraction for the characterisation of crystal structures (Understand)

CO2: Explain the evolution and origin of energy bands to describe the electrical properties of solids (Understand)

CO3: Discuss about the different types of materials and their properties such as semiconducting, superconducting, magnetic and dielectric. (Understand)

CO4: Apply the theoretical concepts to address the problems and challenges in condensed matter physics (Apply)

Syllabus Contents

Module I (26 hours)

Crystal Structure (14 hours)

Crystal lattice – Unit cell - Basis – Symmetry Operations – Point groups and Space groups – Types of lattices – Lattice directions and Planes – Miller Indices - Interplanar spacing – Crystal structures – simple cubic, fcc, bcc and hcp – structure of diamond, Zinc Blende and sodium chloride.

X Ray Diffraction (5 hours)

Bragg's Law – Experimental methods of X ray Diffraction –Laue's Method – Rotating crystal method - Powder Method – Reciprocal Lattice – Reciprocal lattice vectors – Elementary ideas only

Bonding in solids (7 hours)

Inter-atomic forces, ionic bonding, bond dissociation and cohesive energy, madelung energy, covalent bonding, metallic bonding, hydrogen bonding, van der waals bonding (basic ideas only).

Text Book*:*

1. Solid State Physics, R. K. Puri and V. K. Babbar, Chapter 1 and 2

Module II (24 hours)

Free Electron Theory and Band theory of Solids (12 hours)

Drude – Lorentz's classical theory – Sommerfeld's quantum theory – Free electron gas in one dimension – Fermi energy – Total energy - Density of states – Filling of energy levels – Application of free electron gas model Band theory – Bloch theorem (statement only) – Kronig – Penney model (Qualitative ideas only) – Velocity and effective mass of electron – Distinction between metals, insulators and semiconductors.

Semiconducting Properties of materials (12 hrs)

Semiconductors – Intrinsic and Extrinsic – Drift velocity – mobility and conductivity of Intrinsic semiconductors - Carrier concentration, Fermi level and conductivity for intrinsic and extrinsic semiconductors (Expression only), Hall Effect.

Direct and Indirect band gap, Principles of LED and Photodiodes.

Text Book:

1. Solid State Physics, R. K. Puri and V. K. Babbar - Chapter 5, 6 and 7

Module III (22 hours)

Magnetic and Dielectric properties of Solids (13 hours)

Types of Magnetism – Langevin's classical theory of Dia and Paramagenetism – Ferromagnetism – Weiss theory - Domains and hysteresis – Antiferromagnetism and ferrimagnetism (Qualitative ideas only)

Dielectric properties – Local field – dielectric constant and polarisability – Clausius Mossotti relation – Sources of polarisability – Frequency dependence – Ferro and Piezo electricity (Qualitative ideas only)

Text Book*:*

1. Solid State Physics, R. K. Puri and V. K. Babbar, Chapters 8 and 9

Superconductivity (9 hrs)

Superconducting phenomenon – Meissner effect –Critical field – Penetration depth - Type I and Type II superconductors – Entropy, specific heat, energy gap – Isotope Effect –Josephson Effect and Tunneling – SQUIDs – BCS theory (qualitative ideas only) – Cooper Pairs – High temperature Superconductors – Applications.

Text Book:

1. Solid State Physics, R. K. Puri and V. K. Babbar - Chapter 10

References:

1. Introduction to Solid State Physics- Kittel, C. Wiley -8th edition
2. Elementary Solid-State Physics - Ali Omar - Pearson
3. Solid State Physics, P.K. Palanisamy, Scitech publications
4. Solid State Physics -Ashcroft, N.W. &Mermin, N.D., TMH
5. Solid State Physics - Blakemore, J.S., Cambridge, 2nd edition

6. Solid State Physics - C.L. Arora,. S Chand.
7. Solid State Physics - S.O. Pillai,. New Age International
8. Superconductivity, Superfluids and Condensate - James F Annett - Oxford

CORE PRACTICAL

Core Practical I

PH2CP01B23 Mechanics, Properties of matter and Optics I

Credits- 2

Hours per week-2 **Total Lecture Hours- 72**

Course Overview & Context:

The experiments for the lab session are so chosen as to enable the students validate each theory that they have learned in various courses and also to understand the working of several electrical, electronic, mechanical and thermal devices that they have learned in the program. The first year practical focuses on mechanics, properties of matter and preliminary optics that they have already learned.

The lab sessions complement the theory modules and impart hands-on training that will further lead to the strengthening of their knowledge which is essential for progression in academic and research frontiers.

Course Outcomes:

CO1: Illustrate and record basic experiments in Mechanics & Properties of matter. (Apply)

CO2: Practice basic experiments in Optics and analyse the optical constants (Analyse)

Syllabus Contents

1. Cantilever – Young's modulus of material of bar- Scale & Telescope
2. Uniform bending – Pin and Microscope – Determination of Young's modulus
3. The Torsion Pendulum – Rigidity modulus of material of wire.
4. Symmetric Compound Pendulum-Determination of radius of gyration (K) and Acceleration due to gravity (g)
5. Static torsion- Rigidity modulus

6. Measurement of density of a solid – Sensibility method to find mass using beam balance and screw gauge / vernier calipers for dimension measurements

7. Viscosity of a liquid -Variable pressure head

8. Viscosity- Stoke's method

9. Sonometer – Verification of laws, Measurement of density of solid.

10. Lee's Disc – Thermal Conductivity.

11. Surface tension - Capillary rise method

12. Quincke's method – Determination of surface tension

13. Liquid Lens- Refractive index of Liquid

14. Spectrometer- Refractive Index of material of Prism

15. Air wedge-Diameter of wire

16. Spectrometer- Small angled prism-Refractive index of material of prism (Supplementary angle method)

17. Vertical oscillations of a spring – Determination of Young's modulus

18. One dimensional elastic collision – Hanging sphere method – Law of conservation of energy and momentum

Core Practical II

PH2CP02B23 Mechanics, Properties of matter and Optics II

Credits-2

Hours per week-2 **Total Lecture Hours-72**

Course Overview & Context:

This course acts as a continuation of the set of experiments chosen for the previous year. More experiments are included to verify and understand different principles and theorems in optics and mechanical properties of materials.

All the experiments in this course also complement the theory modules and impart hands-on training that is expected to strengthen subject knowledge which is essential for further studies and research.

Course Outcomes:

CO1: Estimate elastic constants of materials using basic experiments in Mechanics & Properties of matter. (Apply)

CO2: Practice basic experiments in Optics and analyse the optical constants (Analyse)

Syllabus Contents

1. Fly Wheel – Moment of Inertia
2. Cantilever- pin & microscope –Determination of Young's modulus
3. Torsion pendulum- n and I - using two identical masses
4. Uniform bending – Young's Modulus-Optic lever method.
5. Non Uniform Bending - Young's modulus of material of bar.
6. Non Uniform bending – Optic Lever – Determination of Young's modulus
7. Young's Modulus –Koenig's method

8. Asymmetric Compound Pendulum – Acceleration due to gravity, radius of gyration & moment of inertia.

9. Viscosity-constant pressure head- coefficient of viscosity (η) of the liquid

10. Viscosity- Searle's rotation viscometer method

11. Liquid lens- Optical constants of a convex lens

12. Kater's pendulum-g

13. Spectrometer – Refractive index of liquid.

14. Spectrometer – i-d curve

15. Thermal conductivity of rubber

16. Kundt's tube- Velocity of sound

17. Specific heat of liquid –Newton's law of cooling

18. Newton's rings-Determination of wavelength.

Core Practical III

PH6CP03B23 Electricity and Magnetism

Credits-2

Hours per week-2 **Total Lecture Hours-72**

Course Overview & Context:

This course is designed to enable the students apply and verify different theorems they have learned in electricity and magnetism in their theory courses.

All the experiments in this course also complement the theory modules and impart hands-on training that is expected to strengthen subject knowledge which is essential for further studies and research.

Course Outcomes

CO1: Apply the concepts of electricity and magnetism to construct circuits and perform basic experiments in the topic (Analyse)

CO2: Analyse the experimental results through mathematical calculations and arrive at a conclusion. (Analyse)

Syllabus Content

1. Melde's String – Measurement frequency

2. A.C Sonometer- Frequency of a.c.

3. Field along the axis of circular coil-Moment of magnet (null method)

4. Field along the axis of a coil-Variation of magnetic field along the axis of a circular coil

5. Searle's Vibration Magnetometer – Moment of magnet.

6. Electro chemical equivalent of copper.

7. Potentiometer – Resistivity of the given wire.

8. Potentiometer – Calibration of low range voltmeter.

9. Potentiometer-Calibration of low range ammeter

10. Potentiometer-Calibration of high range voltmeter.

11. Carey Foster's Bridge-Measurement of resistivity

12. Carey Foster's Bridge – Temperature coefficient of Resistance.

13. Conversion of Galvanometer in to ammeter

14. Conversion of Galvanometer into voltmeter

15. LCR circuit analysis-Series, parallel and Q-factor

16. Mirror Galvanometer-Figure of merit

17. B.G-charge sensitivity–Standard capacitor method

18. B.G.–Measurement of high resistance by leakage method

19. Verification of Thevenin's and Norton'stheorem

20. Deflection and Vibration Magnetometer-m &Bh

21. e/m–Thomson's apparatus-Bar magnet/magnetic focusing

22. B.G-Measurement of capacitance

Core Practical IV

PH6CP04B23 Electronics and Microprocessors

Credits-2

Hours per week-2 **Total Lecture Hours-72**

Course Overview & Context:

This is an advanced course in electronics and also includes microprocessors. Microprocessors are a section for the students which they have not learned previously. The experiments are introduced with a view to help them appreciate the role of these electronic components in various devices and to learn the basics of machine level programming. All the experiments in this course also complement the theory modules and impart hands-on training that is expected to strengthen subject knowledge which is essential for further studies and research.

Course Outcomes

CO1: **A**nalyse the basic experiments in electronics. (Analyse)

CO2: Employ programming of 8085 microprocessors to perform binary arithmetics and logical operations (Apply)

Syllabus content

1. Diode Characteristics – Knee voltage, dynamic & static resistances.
2. Zener characteristics – forward and reverse – Study of dynamic and static properties
3. Transistor characteristics – Common Emitter Configuration
4. Half wave rectifier – Study of ripple factor and load regulation with and without filter circuit
5. Full wave rectifier – (center tap) – Study of ripple factor and load regulation with and without filter circuit

6. Full wave rectifier – (bridge) – Study of ripple factor and load regulation with and without filter circuit

7. FET – characteristics – Determination of parameters

8. Voltage regulator using zener diode – Study of line and load regulations

9. Regulated power supply–Transistor and Zener diode

10. Clippers – positive, negative and biased – Study of output waveforms

11. Clampers – positive, negative and biased – Study of output waveforms

12. Voltage multiplier-Doubler and Tripler.

13. OPAMP characteristics – Study of CMRR and open loop gain

14. OPAMP – inverter, non inverter and buffer – Study of gain

15. Op-Amp-Adder and Subtractor

16. LC Oscillator – Colpitt's /Hartley – using transistor

17. Phase shift oscillator – using transistor

18. 8085 Microprocessor- addition and subtraction of 8 bit numbers

19. 8085 Microprocessor–multiplication of two eight bit numbers with result 16 bit.

20. 8085 Microprocessor–sorting in ascending and descending order.

Core Practical V

PH6CP05B23 Spectroscopy, Laser and Computer Programming

Credits-2

Hours per week-2 **Total Lecture Hours-72**

Course Overview & Context:

This is an advanced level set of experiments incorporating spectroscopy and lasers and also introduces an important programming language C++.

All the experiments in this course will equip the students to master the techniques in the relevant topics.

Course Outcomes:

CO1: Illustrate the experiments in Laser and spectroscopy (Apply)

CO2: Employ programming in CPP to solve numerical problems in Physics (Apply)

Syllabus Content

1. Spectrometer–Grating-wavelength

2. Spectrometer-prism-Dispersive power

3. Spectrometer-prism-Resolving Power

4. Spectrometer-Grating Resolving Power

5. Spectrometer- Grating – Dispersive power

6. Spectrometer–Cauchy's constants

7. Laser-Determination of wavelength

8. Ultrasonic-Determination of velocity of ultrasonic waves

9. Single slit– Diffraction using Laser

10. Optical fiber – Determination of numerical aperture

11. Laser – Determination of spot size and divergence

12. Computer programming – Simple Pendulum –Calculation of 'g' from experimental data.

13. Computer programming – Solving differential equation – Runge kutta method – II order.

14. Computer programming – Multiplication of any two matrices- (m x n) and (n x q)

15. Computer programming–Conversion of temperature scale

16. Computer programming–sorting the numbers in ascending and Descending order C++

17. Computer programming–Solving a quadratic equation

18. Computer programming–Solving a linear equation-Bisection method.

19. Computer programming–Solving an equation by Newton–Raphson method

20. Computer programming-Generation of Fibonacci series

Core Practical VI

PH6CP06B23 Digital and Advanced Electronics

Credits-2

Hours per week-2 **Total Lecture Hours-72**

Course Overview & Context:

This course introduces digital electronics experiments that are necessary for a physics student.

The chosen experiments in this course shall facilitate a better understanding of working of advanced electronic components and to appreciate their significance in integrated circuit devices.

Course Outcomes:

CO1: Illustrate the experiments in digital electronics (Apply)

CO2: Design logic circuits based on registers (Apply)

Syllabus content

1. Gates – AND, OR & NOT – Truth table verification.

2. Sweep Generators – ON & OFF state.

3. Universal gates IC–NAND,NOR-Realize basic gates from universal gates.

4. BCDto7segmentdecoder(IC)

5. Astable multivibrator –using transistor

6. Monostable multivibrator- using transistor

7. Monostable multivibrator–IC555

8. Regulated power supplyusingIC741

9. Wave shaping RC circuits-Integrator and differentiator

10. Regulated power supply-UsingIC's-LM7805,7905,7809,7909,7812,7912

11. Construction and measurement of a dual Regulated power supply with filter.

12. R.C. Coupled amplifier-Gain

13. Amplitude modulation

14. Pulse width modulation

15. Ring counter using74194and74151

16. Astable multivibrator–IC555

17. D/A Converter using IC

18. 4bitShiftregister

19. Flip-Flop–R.S

20. J.K Flip-Flop

21. Schmitttrigger using7414

SEMESTER VI

PH6PRB23 PROJECT

Credits – 1

Hours per week-0 **Total Lecture Hours - 0**

Course Overview & Context:

This course enables students to identify relevant research problems and equips them to find the solution through design, analysis and interpretation of the results.

Course Outcomes:

CO1: Validate the principles of Physics in a research based / industry oriented/ skill based problems. (Create)

OPEN COURSES

SEMESTER V

OPEN COURSE

PH5D01AB23 AMATEUR ASTRONOMY

Credits- 3

Hours per week-4 **Total Lecture Hours- 72**

Course Overview & Context:

Astronomy is the study of the stars, planets, and other celestial objects that populate the sky. It is an endlessly fascinating field, the oldest of the natural sciences, and one of the few areas of science that amateurs can directly assist the professionals. This course is intended for students of other disciplines. This course is expected to provide basic ideas and resources to a student who is interested in getting started with astronomy and give answers to many intriguing astronomical puzzles. The course gives an overview of observational astronomy, tools of astronomy, solar system, evolution of stars and universe.

The main objective is to introduce the student to the fascinating world of Astronomy and develop skill sets in observational astronomy at the amateur level.

Course Outcomes:

CO1: Illustrate the celestial coordinate system, apparent daily and annual motions of stars and differentiate various types of telescopes. (Apply)

CO2: Summarise the stellar - galactic classifications and represent different stages in stellar evolution (Understand)

CO3: Discuss about the different constituents of Solar System (Understand)

CO4: Compare the different models of the Universe (Understand)

Syllabus Contents

Module I

Observation of sky **(18 hours)**

Constellations –Types of constellation- Examples-Orion,Ursa Major, Crux. Cardinal Points, Celestial coordinates – Location on the celestial sphere – equatorial co-ordinate system- right

ascension and declination – Horizontal coordinate system- azimuth and altitude. Apparent daily and annual motion of the stars – The ecliptic - Earth's seasons – Equinoxes and solstices – The solar and sidereal day.

Text Books:

1. Architecture of the Universe -Necia H. Apfel& Allen Hynek-
2. The Benjamin Cummings publishing company, Inc.,

The tools of Astronomy- Optical Telescope - refracting telescope, reflecting telescope – Resolving power – Magnification – Telescope aberration –Hubble Space telescope –James Webb Telescope– Radio Telescope – GMRT.

Text Book:

1. Astronomy: A Self-Teaching Guide – Dinah L. Moche, Wiley,6th edn., Chapters 1&2

Module II

Stars and Galaxies **(18 hours)**

Astronomical distance scales – AU, Parsec and light year. Distance to stars, Parallax method – Spectra of stars – Spectral classes –temperature – Luminosity – apparent and absolute magnitudes – H – R Diagram -Galaxy –Hubble's classification of galaxies-Milky Way - Cluster of galaxies.

Stellar Evolution – Life cycle of stars – birth, lifetimes, Shining stars, Oldage – Red giants – synthesis of heavier elements — Death –Mass Loss – White dwarfs – Exploding stars – Supernova – Neutron stars –Black holes

Text Book:

1. Astronomy: A Self-Teaching Guide – Dinah L. Moche, Wiley,6th edn.,

Module III

The Solar system **(18 hours)**

The sun- distance and size – structure – Rotation - surface – sunspots –Activity cycles – Magnetism – Flares and coronal mass ejections – Solar wind -Planets – Brief history and Origin – Laws of

planetary motion – Comparison of Planets - Mercury – Venus – Earth – Mars – Jupiter – Saturn – Uranus –Neptune (Structure, atmosphere, Surface features – Moons of all planets) - Moon- rotation, size, density – Surface features – Craters, Mountains – Structure - Lunar and solar eclipse - Minor members of the solar system- Asteroids, comets and meteors

Text Book:

1. Astronomy: A Self-Teaching Guide – Dinah L. Moche, Wiley,6th edn.,

Module IV

Our universe **(18 hours)**

Early models of universe- Earth at the centre- Aristotle- Ptolemy- a spinning earth- Sun at the centre- Copernican model. Planetary paths- Beyond the eye- Galileo and his observations - Starry messenger- force of gravity.

Text Book:

1. Architecture of the Universe -Necia H. Apfel & Allen Hynek-The Benjamin Cummings publishing company, Inc., (ch- 3, 4, 8& 9)

The expanding universe- Hubble's law -Red Shift-Cosmic Microwave background. Big bang theory – Steady state theory - age and size of universe. Extraterrestrial Life, SETI (Search for extra-terrestrial intelligence) – Space Travel

Text Book:

1. Astronomy : A Self-Teaching Guide – Dinah L. Moche, Wiley,6th edn.,

References:

1. Concepts of Contemporary Astronomy – Paul W. Hodge, McGraw _ Hill
2. Astronomy: A Beginners Guide To The Universe - Steve Mcmillan andEric Chaisson, Pearson Education
3. Understanding the Universe, James B. Seaborn, Springer
4. Elements of Cosmology, Jayant V. Narlikar, Universities Press
5. Introduction to Astrophysics. BaidyanathBasu:,Prentice-Hall of IndiaPvt. Ltd

6. Astrophysics of the Solar System, K. D. Abhyankar, Universities Press
7. Chandrasekhar and his limit – G Venkataraman, University Press

SEMESTER V

OPEN COURSE

PH5D01BB23 PHYSICS IN DAILY LIFE

Credits: 3

Hours per week-4 **Total Lecture Hours: 72**

Course Overview & Context:

Physics is one of the oldest of the academic disciplines and is a fascinating field which shapes our everyday life. Physics is there everywhere and we use the principles of Physics in everyday life without really understanding it. Physics account for all the phenomena such as heat, light, electricity, magnetism etc and it also includes astronomy which deals with celestial bodies and our universe. This course is intended for students of other disciplines. The main objective of this course is to help the students to understand the basic principles in Physics and to view the objects around them with the view of a physicist. The course is expected to provide basic ideas and resources to a student who is interested in Physics and to unveil the fascinating world of Physics around him ranging from the concave and convex mirrors to the twinkling stars and the universe.

Course Outcomes:

CO1: Interpret the theory of Physics behind various phenomena of light and electricity (Apply)

CO2: Express the equations of motion in linear and rotational motions and their applications in daily life (Understand)

CO3: Explain the relevance of Physics in the realm of matter and energy (Understand)

Syllabus Contents

Module I (20 hours)

Unit 1 (8 hours)

Fundamental and derived quantities. Units and dimensions, dimensional analysis, order of magnitude, significant figures, errors.

Unit 2 Light **(12 Hours)**

Reflection, refraction, diffraction, interference, scattering (elementary ideas only) – examples from daily life – apparent depth, blue color of sky, twinkling of stars.

Total internal reflection, mirage, sparkling of diamond, primary and secondary rainbow – optical fibers. Concave and convex mirrors, lenses – focal length, power of a lens, refractive index, prism, dispersion. Human eye, defects of the eye – myopia, hypermetropia, presbyopia and astigmatism and their correction by lens.

Module II (22 hours)

Unit 3 Motion (12 Hours)

Velocity, acceleration, momentum, Idea of inertia, force - laws of motion. Newton's law of gravitation, acceleration due to gravity, mass and weight, apparent weight, weightlessness. Rotational motion, Moment of inertia, torque, centripetal and centrifugal acceleration examples- banking of curves, centrifugal pump, roller coasters.

Unit 4 Electricity **(10 Hours)**

Voltage and current, ohms law. Electric energy, electric power, calculation of energy - requirement of electric appliances – transformer, generator, hydroelectric power generation – wind power – solar power – nuclear power

Module III (30 hours)

Unit 5 Matter and energy **(18 Hours)**

Different phases of matter, fluids - surface tension, viscosity- capillary rise, Bernoulli's theorem and applications -Heat energy, temperature, different temperature scales – degree Celsius, Fahrenheit and Kelvin.

Waves – transverse and longitudinal waves, sound waves, Doppler Effect.

Lasers, fluorescence, phosphorescence, electromagnetic waves – applications – microwave oven, radar, super conductivity.

Unit 6 Universe **(12 hours)**

Different types of stars, Galaxies, black hole. Satellites, Artificial satellites, Global positioning system. Geo stationary satellite.

Texts Books:

1. Fundamentals of Physics with Applications by Arthur Beiser
2. Conceptual Physics by Paul G Hewitt

SEMESTER V

OPEN COURSE

PH5D01CB23 COMPUTER HARDWARE AND NETWORKING

Credits: 3

Hours per week-3 **Total Lecture Hours: 72**

Course Overview & Context:

Computer Hardware and networking sector is expanding tremendously in the last two decades, as computers, laptops and internet has become an inevitable part of our life. Computer hardware is the combination of different physical parts of a computer such as hard disks, printers, keyboards etc. Networking involves linking a group of two or more computer systems for the purpose of sharing information and data. This course covers the topics like microprocessor, data storage devices, installation of softwares and also installation of Pascal, C, Oracle, Visual Basic etc.

The course enables the students to develop skills in installation and configuration of software tools and operating systems.

Course Outcomes:

CO1: Explain the basic architecture of microprocessors (Understand)

CO2: Discuss about the features of primary and secondary devices (Understand)

CO3: Illustrate the installation and administration of operating systems and software tools. (Apply)

Syllabus Content

Module I (24 hours)

Microprocessors – Basic concepts of Intel 80186, 80286, 80386, 80486 and Pentium processors. Motherboard, Expansion buses, Memory, upgrading / adding memory, BIOS Motherboard – removing, installing / configuring motherboards, BIOS set up, troubleshooting memory.

Module II (24 hours)

Data storage devices, IDE and SCSI controllers, hard disk, installing / upgrading CD ROM drives, DVD, Optical storage, Tape back – ups. Printers, Keyboards, pointing and positioning devices, digital camera, Scanners, Monitors, Hard disks- installing / upgrading, troubleshooting, formatting, Error codes, BIOS disk routines

Module III (24 hours)

Multimedia, Graphical accelerators, audio, modems, I/E add on, Networks, Power supplies, UPS Printer installation, Software installation – DOS, Windows 95, 98, Linux, WindowsNT installation, Administration, Installing PASCAL, C, ORACLE, VISUAL BASIC, Software diagnostics – PC tools, Norton utilities, XT/AT diagnostics, Viruses and anti-viruses.

Text Books:

1. IBM PC and CLONES- Hardware, troubleshooting and maintenance – B Govindarajalu
2. PC Hardware, a beginner's guide – Ron Gilster
3. All about Motherboard: - Manahar Lotia, Pradeep Nair

CHOICE BASED CORE COURSES

SEMESTER VI

CHOICE BASED CORE COURSE

PH6C13AB23 NANOSCIENCE AND NANOTECHNOLOGY

Credits-3

Hours per week: 3 **Total Lecture Hours-54**

Course Overview & Context:

Nanoscience is the best example of a truly interdisciplinary research field where contributions from Physics, Chemistry, Engineering, Mathematics and Biotechnology design the developmental pattern of relatively new branch of science. This, in turn, nurture many other high-tech ventures like optics, photonics, medicine, computers and automobiles besides providing luxuries like self-cleaning windows, smart surfaces, cosmetics and so on. In fact, there is nearly nothing that nanoscience has not influenced. To enable them to understand the science of small things, synthesis and analysis techniques and then to probe much more, Nanoscience and Nanotechnology is the right beginning. The course summarises the fundamentals and technical approaches in the synthesis, fabrication and processing of nanostructures and nanomaterials so as to provide a systematic and coherent picture of the field. Also some important nanostructures and nanodevices are introduced.

The course equips the students with skills and knowledge in the synthesis and characterisation of nanomaterials.

Course Outcomes:

CO1: Explain the properties of materials in nano-regime and distinguish the different types of quantum structures (Understand)

CO2: Distinguish between different types of synthesis and characterization methods (Apply)

CO3: Explain the structure, properties and applications of carbon nanotube and bulk nanostructured materials (Understand**)**

Syllabus Contents

Module I (18 hours)

Introduction to Nanoscience (5 hrs)

Introduction to nanoscience- Bulk to nano transition- magic numbers-formation of 13 atom nanoparticles- mass spectroscopy, Size Dependence of Properties- surface to volume ratio, basics of changes in colour of a material in the nano regime, examples for changes in electrical and magnetic properties at the nanoscale citing GMR and CMR (basic ideas).

Applications of Nanotechnology (2 hrs)

Nanomedicines, smart surfaces-smart window, self cleaning surfaces, smart paint, applications in automobile. MEMS, NEMS.

Quantum Confined Structures (11 hrs)

Quantum confined structures-Quantum Wells, Wires, and Dots - Fermi gas model - Comparison of density of states and energy dispersion curve in bulk, Quantum well, Quantum wire and Quantum dots. Equation representing energy of electrons and holes in the quantum confined structures and the concept of Blue shift in band gap - properties dependent on density of states - absorption, emission. Applications – quantum confined structures as lasing media.

Module II (16 hours)

Synthesis techniques (10 hrs)

Overview of Top down and Bottom Up methods. Top - down methods: a) ball milling b) laser ablation c) arc discharge method d)Lithography-basic steps in lithographic process - electron beam lithography, nanoimprint lithography, two photon lithography. Bottom - up methods: a) homogenous nucleation, b) sol gel method, c)MBE, d) chemical vapour deposition, e) hydrothermal synthesis.

Methods of Characterization (6 hrs)

Scanning Electron Microscope, Transmission electron microscope, Scanning Electron Microscope, Atomic Force microscope, X-ray diffraction, Raman Spectroscopy.

Module III (20 hours)

Carbon nanostructures (8 hrs)

Carbon nanostructures: Carbon molecules, Buckminister fullerene, Carbon nanotube- structure, Properties-Electrical properties, Vibrational Properties, Mechanical Properties. Applications of Carbon Nanotubes –Computers, Fuel Cells, Chemical Sensors, Catalysis, Mechanical Reinforcement, Field Emission and Shielding. (Elementary ideas).

Bulk Nanostructured Materials (12hrs)

Solid Disordered Nanostructures -Failure Mechanisms of Conventional Grain-Sized Materials, Mechanical Properties, Optical properties-Porous Silicon - Metal Nanocluster Composite Glasses. Magnetic Properties- GMR, CMR materials, Ferrofluids, Spintronics, Spin Valve transistors.

Ordered Nanostructures-Natural Crystals-Zeolites-Photonic crystals:1D, 2D, 3D photonic crystals, comparison of photonic and electronic crystals(elementary ideas), features-presence of band gap, defect and defect modes- point defect, line defect and surface defect.

Text Books:

1. Nanoscope – Santhi A, MedTech (Scientific International)
2. Introduction to Nanotechnology, Charles. P. Poole , Jr. and Frank J Owens, Wiley, 2003
3. Nanophotonics, Paras N Prasad, Wiley Interscience
4. Photonic crystals , Moulding the flow of light – John D Joannopoulos, Princeton University Press.
5. Nanostructures and Nanomaterials- Synthesis, Properties & Applications, Guozhong Cao, Imperial College Press
6. Nanotechnology –The Science of Small- M. A Shah, K A Shah Wiley
7. Ball milling basic ideas from Preparation of Lithium Niobate Nanoparticles by High Energy Ball Milling and their Characterization, SujanKar et al., Universal Journal of Materials Science 1(2): 18-24, 2013
8. Introduction to Nanoscience and Nanotechnology, K.K. Chattopadhyay and A. N Banerjee, PHI Learning and Pvt. Ltd

SEMESTER VI

CHOICE BASED CORE COURSE

PH6C1BB23 MATERIAL SCIENCE

Credits-3

Hours per week: 3 **Total Lecture Hours-54**

Course Overview & Context:

Material Science gives the students an insight into the properties and mechanisms in micro and macrostructures. It also establishes the significance of evolving nature of materials into Novel Engineering materials and Nanomaterials. The students are also introduced into the analytical tools.

The course equips the students with skills and knowledge in the synthesis and characterisation of nanomaterials and modern engineered materials.

Course Outcomes:

CO1: Discuss the various properties of micro and macrostructures (Understand)

CO2: Explain the properties of materials in the nanoregime (Understand)

CO3: Illustrate the significance of modern engineering materials (Understand)

Syllabus Contents

Module I (18 hours)

Structure and Properties of Materials Classification of engineering materials-Engineering requirement of materials- Level of structures, Microstructure and Macrostructure, Structure-Property relationships, Physical properties of materials, Mechanical Properties-Stress strain relationship, creep, impact strength- Thermal properties, Thermal cracking- Electrical properties-Dielectric strength and dielectric constant- Chemical and Optical properties- Identification of metals and alloys- Identification tests.

Text Book:

1. Material Science-GBS Narang, Chapter 1 and 9

Module II (18 hours)

Optical Properties of Materials

Absorption processes- Fundamental absorption-Exciton absorption- Free –carrier absorption- Photoconductivity- Photoelectric effect- Photovoltaic effect- Photoluminescence-colour centres- Generation of colourcentres

Text Book:

1. Solid State Physics, M.A. Wahab, Chapter-15

Nanoscience

Materials at nanoscale- Quantum confinement - Size effect on shape- Magic numbers- Different types of nanostructures- Quantum dots- Fullerenes- Graphene- Carbon nanotubes- Structure, properties and applications

Text Books:

1. Nanotechnology-The science of small, MA Shah and KA Shah, Chapter 1 and 2
2. Nanoscience and Nanotechnology- Fundamentals to frontiers- MS Ramachandra Rao and Shubra Singh, Chaper 5.

Modern Engineering Materials

Display devices- active and passive-Liquid crystals- Types of Liquid crystals- Nematic liquid crystals-Cholesteric liquid crystals- Smectic liquid crystals-General features of liquid crystals- Numeric display using LCD- Metallic glasses - Thermodynamic, Mechanical, Electronic and magnetic properties- Applications Shape memory alloy-structural change- general characteristic- Thermomechanical behavior

Text Book:

1. Semiconductor Physics and Optoelectronics, V.Rajendran et al. Unit-II

Module III (18 hours)

Nanoscience

Metal nanoclusters-magic numbers, theoretical modelling, geometric and electronic structure, magnetic clusters; Semiconducting nanoparticles- Rare gas and molecular clusters- carbon nanostructures- Carbon clusters, CNT preparation, properties and applications; Quantum wells, wires and dots – preparation, Size and dimensionality effects, applications .

Text Book:

1. Modern Physics by Murugeshan

Material Characterization Techniques

Qualitative study of Powder XRD, SEM, TEM, STM, AFM and Raman spectroscopy.

Text Book:

1. Nanotechnology-The science of small- MA Shah and KA Shah, Chapter 5

References:

1. Material Science-GBS Narang, Khanna Publishers
2. Solid State Physics (2nd ed.), M.A. Wahab, Narosa pub.
3. Nanotechnology-The science of small, MA Shah and KA Shah, Wiley.
4. Nanoscience and Nanotechnology- Fundamentals to frontiers- MS Ramachandrarao and Shubra Singh, Wiley.
5. Semiconductor Physics and Optoelectronics, V.Rajendran et al., Vikas Publishing House.

SEMESTER VI

CHOICE BASED CORE COURSE

PH6C13CB23 COMPUTATIONAL PHYSICS

Credits-3

Hours per week: 3 **Total Lecture Hours-54**

Course Overview & Context:

The course gives the students an overview of solutions of linear and nonlinear equations. The students will be introduced to curve fitting techniques and differentiation and integration.

The course equips students with comuptational techniques for solving numerical problems in integration and differentiation.

Course Outcomes:

CO1: Illustrate the solutions of linear and nonlinear equations (Apply)

CO2: Illustrate the methods of curve fitting (Apply)

CO3: Solve the problems in numerical integration and differentiation (Apply)

Syllabus Contents

Module I (18 hours)

Solutions of Nonlinear Equations

Bisection Method - Newton Raphson method (two equation solution) – Regula-Falsi Method, Secant method - Fixed point iteration method - Rate of convergence and comparisons of these Methods.

Solution of system of linear algebraic equations

Gauss elimination method with pivoting strategies-Gauss-Jordan method-LU Factorization, Iterative methods (Jacobi method, Gauss-Seidel method)

Module II (18 hours)

Curve fitting: Regression and interpolation

Least squares Regression- fitting a straight line, parabola, polynomial and exponential. Curve Finite difference operators-forward differences, divided difference; shift, average and differential operators- Newton's forward difference interpolation formulae- Lagrange interpolation polynomial- Newton's divided difference interpolation polynomial.

Module III (18 hours)

Numerical Differentiation and Integration

Numerical Differentiation formulae - Maxima and minima of a tabulated function- Newton- Cote general quadrature formula - Trapezoidal, Simpson's 1/3, 3/8 rule

Solution of ordinary differential equations

Taylor Series Method, Picard's method-Euler's and modified Euler's method –Heun's method-RungeKutta methods for 1st and 2nd order.

Text Books:

1. Numerical Methods, Balagurusamy, TMH
2. Numerical Methods for Scientists and Engineers- K Sankara Rao- PHI
3. Introductory Numerical Methods, S SSastry, PHI.

SEMESTER VI

CHOICE BASED CORE COURSE

PH6C13DB23 INSTRUMENTATION

Credits-3

Hours per week: 3 **Total Lecture Hours-54**

Course Overview & Context:

The course familiarizes the students with various measuring systems and their applications. Students will be introduced with different types of transducers, their characteristics and applications.

Course Outcomes:

CO1: Explain the different types of measurements and instruments (Understand)

CO2: Distinguish between different types of transducers (Understand)

CO3: Discuss about Resistive, Inductive and Capacitive Transducers (Understand)

Syllabus Contents

Module I (18 hours)

Measurements and Measurement Systems

Measurements-Method of measurement-Instruments and measurement systems- Mechanical, Electrical and Electronic instruments-Classification of Instruments- Applications of Measurement Systems - Elements of generalized measurement systems.

Text book:

1. A Course in Electrical and Electronics Measurements and Instrumentation, Sawhney. A.K- Chapter 1

Module II (18 hours)

Primary Sensing Elements and Transducers

Mechanical Devices as Primary Detectors – Mechanical Spring Devices – PressureSensitive Primary Devices – Flow Rate Sensing Elements - Transducers-Classification–Characteristics (Static and Dynamic) and Choice of Transducers – Characterization

Text books:

1. Sensors and Transducers, Patranabis D., Chapter 1
2. A Course in Electrical and Electronics Measurements and Instrumentation, Sawhney. A.K-Chapter 25

Module III (18 hours)

Resistive, Inductive and Capacitive Transducers

Potentiometers –Strain gauges (Theory, types) - Rosettes – Resistance thermometer – Thermistors (materials, Constructions, Characteristics) – Thermocouples-Self inductivetransducer – Mutual inductive transducers – Linear Variable Differential Transformer –LVDT Accelerometer – RVDT – Synchros – Capacitive transducer – Variable Area Type– Variable Air Gap type – Variable Permittivity type – Capacitor microphone.

Miscellaneous Transducers (8 hours)

Light transducers (photo-conductive, photo emissive, photo-voltaic, semiconductor, LDR)– Piezoelectric transducer – Hall Effect transducers – Digital Encoding transducers

Text book:

1. A Course in Electrical and Electronics Measurements and Instrumentation, Sawhney. A.K-Chapter 1 and 25
2. Sensors and Transducers, Patranabis D., 2nd edition, PHI, 2015.

References:

1. Measurement Systems-Applications and Design, Doebelin. E.A, Tata McGraw Hill
2. Principles of Measurement Systems John. P, Bentley,, III Edition, Pearson
3. Transducers and Instrumentation, Murthy.D.V.S,, Prentice Hall of India
4. Instrumentation- Devices and Systems, Rangan, Sarma, and Mani, Tata-McGrawHill

5. Electronic Instrumentation by H.S Kalsi, McGrawHill
6. Instrumentation measurements and analysis, Nakra&Choudhary, Tata-McGrawHill
7. Mechanical and industrial measurement by R.K. Jain, Khanna Publishers, NewDelhi

SEMESTER VI

CHOICE BASED CORE COURSE

PH6C13EB23 ASTRONOMY AND ASTROPHYSICS

Credits-3

Hours per week: 3 **Total Lecture Hours-54**

Course Overview & Context:

The course gives an overview of the techniques and tools in the Observational astronomy. The students are introduced to the large scale structure of universe and its components. It also envisages a glimpse of Astrophysics and evolution of universe.

Course Outcomes:

CO1: Discuss the elements and tools of observational astronomy. (Understand)

CO2: Illustrate the concepts of celestial coordinate system and time (Apply)

CO3: Explain the structure of Sun, different types of galaxies and concepts of Astrophysics and cosmology (Understand)

Syllabus Contents

Module I (12 hours)

Observational astronomy **(12 Hours)**

Astronomical distance scales – AU, Parsec and light year. Stellar Parallax and distance to stars from parallax. Magnitude scale - Apparent and absolute magnitudes. Variable stars as distance indicators. Cepheid variables. Astronomy in different bands of electromagnetic radiation- Optical, radio and X-ray astronomies, Radiation Laws.

Optical Telescopes. Types of telescopes-refracting and reflecting – Newtonian and Cassegrain telescopes. Magnification and f number. Resolving Power, Telescope mounts – alt-azimuth and equatorial mounts.

Text Books :

1. Astrophysics: Stars and Galaxies K D Abhyankar Section 3.1 & 4.3,
2. Introduction to Astronomy and Cosmology, Ian Morison, John Wiley & Sons, Inc. Chapter 5
3. ASTRONOMY, A Self-Teaching Guide, Dinah L. Moché, John Wiley &Sons, Inc. Chapter 2 & 3.

Module II (16 hours)

Celestial sphere (8 Hours)

Concept of celestial sphere - cardinal points, celestial equator, ecliptic, equinoxes.Diurnal motion of sun - summer solstice and winter solstice. Celestial co-ordinatesystems: – Horizon system – Azimuth & Altitude, Equatorial system-Right ascension &declination, Ecliptic coordinate system.

Time - apparent and mean solar time, sidereal time. Twilight, Seasons- causesofseasons (qualitative ideas). International Date Line.

Text Books:

1. Astrophysics: Stars and GalaxiesK D Abhyankar, Chapter 2
2. ASTRONOMY, A Self-Teaching Guide, Dinah L. Moché, Chapter 1

Sun (5 Hours)

Sun - solar atmosphere and internal structure – Photosphere, chromosphere and corona. Radiation zone & Convection Zone. Sun spots, Activity Cycles, flares, prominences, coronal holes, Solar wind.

Text Books:

1. ASTRONOMY, A Self-Teaching Guide, Dinah L. Moché, Chapter 4,
2. Introduction to Astronomy and Cosmology, Ian Morison, Chapter 2

Galaxies (3 hours)

Galaxies - our galaxy, galaxy types & turning fork diagram. Structure on the largest scaleclusters,super clusters and voids.

Text Book:

1. ASTRONOMY, A Self-Teaching Guide, Dinah L. Moché, Chapter 6

Module III (26 hours)

Astrophysics (14 hours)

Gravitational contraction - Virial theorem, Jeans mass. Energy production inside stars.Thermonuclear fusion. Hydrogen burning. p-p chain. CNO cycle. Evolution of stars – birth–protostar, hydrostatic equilibrium, red giant, late stages of evolution - white dwarfs &Chandrasekhar limit, Neutron stars, Supernovae, Pulsars, Black holes. StellarClassification, H-R diagram - Main sequence stars.

Text Books:

1. Astrophysics: Stars and Galaxies K D Abhyankar, Chapter 10,
2. ASTRONOMY, A Self-Teaching Guide, Dinah L. Moché , Chapter 5

Cosmology (12 hours)

Large scale structure of the universe – isotropy and homogeneity. Cosmological principle.

Standard big bang model - GUT, Planck Epoch, Inflation, Nucleosynthesis, Recombination& CMBR. Expanding universe - red shift. Hubble's law and Hubble parameter. Age of universe and its determination. Dark energy and Dark Matter (qualitative idea).

Text Books:

1. ASTRONOMY, A Self-Teaching Guide, Dinah L. Moché, Chapter 7
2. Introduction to Astronomy and Cosmology, Ian Morison, Chapter 9

References:

1. A short history of the Universe – Joseph Silk
2. Introduction to Astronomy and Cosmology, Ian Morison, John Wiley &Sons,Inc.
3. Introduction to cosmology- J V Narlikar
4. http://www.astro.cornell.edu/academics/courses/astro201/topics.html
5. http://www.ualberta.ca/~pogosyan/teaching/ASTRO_122/lectures/lectures.html
6. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

SEMESTER VI

CHOICE BASED CORE COURSE

PH6C13FB23 INFORMATION TECHNOLOGY

Credits-3

Hours per week: 3 **Total Lecture Hours-54**

Course Overview & Context:

The course enables to learn about the fascinating world of information technology and to use the tools available in Internet and the World Wide Web for a deep study of the subjects related to physics in better way by the students themselves. Prerequisites: Awareness of basic computer operations.

Course Outcomes:

CO1: Explain the basics of Information technology, computer networks and internet (Understand)

CO2: Design HTML webpage (Apply)

CO3: Discuss the basic ideas of DBMS and MS/OPEN Office (Understand)

Syllabus Contents

Module I (20 hours)

Information and its Use: Information Technology – Quality of information – Message transmission – Electronic Office – E mail – Document storage – Computers in Industry –Different types – Graphical user interface

Text book:

1. Information Technology – The Breaking Wave", D.Curtin, K.Sen and K.Morin,Tata McGraw Hill, 1999. Chapter – 1, 2

Computer Networks:

Importance of Networks. Components of Networks. Classificationof Networks: Broad cast networks-Switched networks. Switching Techniques. TypesofNetworks – LAN – MAN – WAN. Networking Models – OSI reference model – TCP/IPreference model-Comparison between the OSI and TCP/IP models. Network Topology –Bus- Star-Ring-Tree-Mesh- Cellular.

Text Books:

1. Computer Networks, A.S. Tanenbaum - Prentice Hall of India, Chapter – 1
2. Computer Fundamentals, P.K. Sinha 3rd Edn. BPB Publications, Chapter – 17

THE INTERNET:

Internet Protocols – Internet Protocol (IP)-Transmission Control Protocol (TCP) -Internet Address – Structure of Internet Servers Address-Address Space- Services on Internet- Domain Name System-SMTP and Electronic mail – Http and World Wide Web-Usenet and News groups-FTP-Telnet-Network Security-Digital Signature-E-mail Privacy-Internet Tools – Search Engines-Web browsers-Internet explorer, Netscape Navigator, Mozilla Firefox (Working Knowledge)

Text Books:

1. Computer Networks, A.S.Tanenbaum - Prentice Hall of India, Chapter –5, 6,7
2. Computer Fundamentals, P.K. Sinha 3rd Edn. BPB Publications, Chapter – 18

Module – II (20 hours)

THE HTML:

What is HTML? Basic Tags of HTML – HTML-TITLE-BODY - Starting an HTML document

– The <!DOCTYPE>declaration-setting boundaries with <HTML>-theHEAD element-the BODY element-the STYLE element and the SCRIPT element. -Formatting of text– Headers- Formatting Tags-PRE tag-FONT tag-Special Characters. Working with Images- META tag - Links – Anchor Tag -Lists – Unordered Lists-Ordered Lists-Definition Lists -Tables –TABLE, TR and TD Tags-Cell Spacing and Cell Padding-Colspan and Row span -Frames –Frameset- FRAME Tag-NOFRAMES Tag - Forms –FORM and INPUT Tag-Text Box-Radio Button- Checkbox-SELECT Tag and Pull Down Lists-Hidden-Submit and Reset

Text book:

1. HTML4 – 2nd Edn. Rick Darnell, Techmedia, Chapter – 1, 2,3,4,5

Module – III (14 hours)

Basic Idea of DBMS:

Need for Data Base – Database Systems versus File systems -View of Data - Data Abstraction-Instances and Schemas - Data Models – ER Model-Relational Model- Network Model-Hierarchical Model (general ideas) -Basic ideas aboutStructured Query Language.

Text book:

1. Fundaments of Database System – Elmasri, Ramez and NavatheShamkantB. 4th Edn.Person Education, India, 2004. Chapter – 1

MS – OFFICE/OPEN OFFICE (Working Knowledge):

Word processors – PowerPoint -Spreadsheets – Databases (No specific text book is preferred. MS office (97, 98, 2000, /Open Office which isinstalled in the lab can be used. Working practice must be given)

References

1. "Information Technology – The Breaking Wave", D.Curtin, K.Sen and K. Morin,Tata McGraw Hill, 1999.
2. Computer Networks – A.S. Tanenbaum - Prentice Hall of India
3. Computer Fundamentals – P.K. Sinha 3rd Edn. BPB Publications
1. Internet and World Wide Web – Deitel
2. HTML4 – 2nd Edn. Rick Darnell, Techmedia
3. Database System Concepts – Silberschatz-Korth-Sudarshan 4th Edn – Tata MacGraw Hill
4. Information Technology and systems", Green, B.C., Longman Scientific&Technical
5. Publishers, England, 1994.
6. Networks – Tirothy S. Ramteke – 2nd Edn. Pearson Edn – New Delhi, 2004

9. Data and Computer Communucation, William Stalling, PHI, New Delhi
10. Mastering HTML4 – Ray D.S. and Ray E.J. – BPB
11. HTML – The Complete Reference – Tata McGraw Hill
12. Fundaments of Database System – Elmasri, Ramez and NavatheShamkant B.4thEdn.v Pearson Education, India, 2004.

COMPLEMENTARY COURSES

COMPLEMENTARY PHYSICS FOR MATHEMATICS

SEMESTER I

PH1B01B23 PROPERTIES OF MATTER, ERROR ANALYSIS & GRAVITATION

(Complementary Course for B.Sc. Mathematics)

Credits: 2

Hours per week-2 **Total lecture hours -36**

Course Overview & Context:

This course will try to provide conceptual understanding of basic physics to students and will provide a theoretical basis for doing experiments in related areas. This course exposes students to basic physics.

This course provides information on basic phenomena in Physics such as elasticity, surface tension, hydrodynamics and gravitation. As we know, no measurement of a physical quantity can be entirely accurate and it is important to have knowledge about the deviations of measured quantity from true value. Brief discussions about how errors are reported, how to estimate random errors, and how to carry error estimates into calculated results are included as a part of this course. Module I deals with elasticity and its applications. Module II explains hydrodynamics and surface tension with their applications in day today life. Module III handles error analysis and gravitation.

Course Outcomes:

CO1: Apply static and dynamic methods to determine rigidity modulus and bending of beams to Young's modulus (Apply)

CO2: Explain the factors affecting surface tension and viscosity (Understand)

CO3: Solve the problems related to errors occurring in a mathematical calculation (Apply)

CO4: Discuss the theory and application of gravitation in planetary system (Understand)

Syllabus content

Module I

Elasticity **(13 hours)**

Stress- strain- Hooke's law- Elastic moduli- Poisson's ratio- twisting couple determination of rigidity modulus- static and dynamic methods- static torsion- torsion pendulum, bending of beams- cantilever, uniform and non-uniform bending, I section girder.

Text Book:

1. Mechanics - D. S. Mathur- Revised by P. S. Hemne, S. Chand &Co., Chapters 13 & 14.

Module II (9 hours)

Viscosity **(6 hours)**

Streamline and turbulent flow - critical velocity - Coefficient of viscosity - Derivation of Poiseuille's equation, Stokes equation -Determination of viscosity by Poiseuille's method. Bernoulli's theorem.

Surface tension **(3 hours)**

Molecular theory of surface tension - surface energy - excess pressure in a liquid drop - factors affecting surface tension – applications.

Text Book:

1. Mechanics– Prof. D.S Mathur Revised by: Dr. P.S Hemne. , SChand & Company Pvt. Ltd, chapter 15

Module III (14 hours)

Error Analysis **(7 hours)**

Basic ideas – uncertainties of measurement – importance of estimating errors – dominant errors – random errors – systematic errors - absolute and relative errors –Propagation of errors – sum and differences – products and quotients – multiplying by constants – powers.

Text book*:*

1. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, John R. Taylor - Univ. Science Books

Gravitation **(7 hours)**

Newton's law of gravitation – G by Boy's method – Mass and density of earth – Acceleration due to gravity –rotation of earth – Escape velocity - Gravitational Potential and field due to a solid sphere- Equipotential surface.

Text book:

1. Mechanics– Prof. D.S Mathur Revised by: Dr. P.S Hemne. , SChand & Company Pvt. Ltd, chapter 15

References:

1. Elements of properties of matter, D S Mathur
2. Advanced course in Practical Physics by D Chattopadhyay
3. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
4. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
5. Modern Physics- G. Aruldas and P. Rajagopal (PHI Pub)
6. Physics- Resnick and Halliday
7. http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/
8. http://phys.columbia.edu/~tutorial/index.html

MODEL QUESTION PAPER

B.Sc. DEGREE (C.B.C.S) EXAMINATION, NOVEMBER 2023

SEMESTER I – COMPLEMENTARY PHYSICS COURSE FOR B.Sc. MATHEMATICS

PH1B01B23 PROPERTIES OF MATTER, ERROR ANALYSIS & GRAVITATION

Time: 3 hours **Maximum marks: 60**

Part A

(Answer any ten questions. Each question carries 1 mark)

Qn.No.	Questions	CO	Level of question
1.	State Hooke's law in elasticity.	1	R
2.	Explain the significance of Poisson's ratio.	1	U
3.	Write a note on I section Girder	1	R
4.	Define neutral surface	1	R
5.	Distinguish between stream line and turbulent flow.	2	R
6.	Mention some applications of surface tension.	2	R
7.	Explain the dependence of temperature on surface tension.	2	U
8.	Explain the method to determine the error of digital instrument with an example	3	R
9.	Determine the number of significant digit of following numbers (i) 15.83 (ii) 0.000375 (iii) 50.00 and (iv) 2030	3	Ap

10.	Determine the dimension of gravitational potential by dimension method.	4	Ap
11.	Define the term equipotential surface.	4	R
12.	State gravitational law	4	R

(10 x 1 = 10 marks)

Part B
(Answer any six questions. Each question carries 5 marks)

Qn.No.	Questions	CO	Level of questions
13.	What couple must be applied to a wire of 1 meter long and 1mm diameter, in order to twist one end of it through 90 degree and the other end remaining fixed? Rigidity modulus = 2.8×10^{11} dynes/ cm^2	1	Ap
14.	Establish the relation between elastic moduli.	1	U
15.	Explain the motion of spherical bead through a viscous liquid.	2	R
16.	Discuss the method to determine the coefficient of viscosity by constant pressure head method.	2	R
17.	Derive the expression for work done in blowing a soap bubble.	2	Ap
18.	A student measured the acceleration due to gravity by measuring the time period and length of simple pendulum. Derive the expression for uncertainty in the measurement of acceleration due to gravity.	3	Ap
19.	Find the uncertainty in measurement of q if	3	Ap

20.	Explain Boy's method to determine Gravitational constant in detail.	4	R
21.	Calculate the magnitude of the gravitational force between the objects described below. (i) two protons separated by a distance of 5.0×10^{-14} m (mass of a proton = 1.7×10^{-27} kg) (ii) Two binary stars, each of mass 5.0×10^{28} kg, with a separation of 8.0×10^{12} m and (iii) Two 1500 kg elephants separated by a distance of 5.0 m	4	Ap

(6 x 5 = 30 marks)

Part C
(Answer any two questions. Each question carries 10 marks)

Qn.No.	Questions	CO	Level of questions
22.	With necessary theory, explain an experiment to determine the rigidity modulus of the material of the wire using torsion pendulum.	1	Ap
23.	Explain the method to determine the Young's modulus of material of the bar using it as a cantilever.	1	Ap
24.	Derive Poiseuille's equation.	2	C
25.	Derive the expression for gravitational potential and field at a point due to a solid sphere.	4	Ap

(2 x 10 = 20 marks)

CO : Course Outcomes
Level : R – Remember, U – Understand, Ap- Apply, An- Analyze, E- Evaluate, C- Create

COMPLEMENTARY PHYSICS FOR MATHEMATICS

SEMESTER II

PH2B01B23 MECHANICS AND ASTROPHYSICS

(Complementary Course for B.Sc. Mathematics)

Credits: 2

Hours per week-2 **Total lecture hours - 36**

Course Overview & Context:

This course will try to provide conceptual understanding of basic mechanics and astrophysics to students and will reveal a theoretical basis for doing experiments in related areas.

This course exposes students to basic physics of rotational dynamics, oscillations, waves, ultrasonics and astrophysics. The session rotational dynamics differentiates the translational and rotatory dynamics and application of rotatory motion in industry. The chapter ultrasonic deals with the production and applications of ultrasonic waves. Module II explains the various aspects of simple harmonic motion and wave motion. Module III reveals the interesting phenomena in galaxies.

Course Outcomes:

CO1: Apply relevant theorems and strategies to determine the physical parameters related to rotational motion of bodies (Apply)

CO2: Discuss the production and applications of ultra-sonic wave (Understand)

CO3: Represent and solve equations of oscillatory motion of particles (Apply)

CO4: Discuss the evolution of different kinds of stars (Understand)

Syllabus content

Module I (14 hours)

Rotational Dynamics (10 hours)

Angular velocity- angular momentum- torque- conservation of angular momentum, angular acceleration- moment of inertia- parallel and perpendicular axes theorems moment of inertia of rod, ring, disc, cylinder and sphere - flywheel

Text book:

1. Mechanics- D S Mathur, (revised edition 2012), Chapter 11

Ultrasonic (4 hours)

Piezo electric effect – Production of ultrasonic waves- Piezo electric crystal method – Magnetostriction method – Applications.

Text book:

1. Mechanics- D S Mathur, (revised edition 2012), Chapter 10

Module II (14 Hours)

Oscillations (9 hours)

Periodic and oscillatory motion- simple harmonic motion- differential equation, expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion - damped oscillation- forced oscillation and resonance.

Text book:

1. Mechanics- D S Mathur, (revised edition 2012), Chapter 7,8.

Waves (5 hours)

Waves- characteristics of waves- classifications- progressive wave- energy of progressive wave- superposition of waves- theory of beats- Doppler Effect.

Text book:

1. Mechanics- D S Mathur, (revised edition 2012), Chapter 10.

Module III

Astrophysics **(8 hours)**

Temperature and color of a star- Magnitude system- stellar classification - mass of star life time of a star- main sequence stars-HR diagram- evolution of stars- white dwarf -supernova explosion- neutron star- black hole- (all topics to be treated qualitatively)

Text books:

1. An Introduction to Astrophysics - Baidyanath Basu, Chapter 2,3,4.

References:

1. Elements of properties of matter, D S Mathur Mechanics- H.S.Hans and S.P.Puri. (TMH)
2. Mechanics, D S Mathur
3. Modern Physics- R. Murugeshan, Er. Kirthiga Sivaprasad
4. A text book on oscillations waves and acoustics, M.Ghosh , D Bhattacharya
5. Introduction to Astrophysics-Baidyanath Basu.
6. Mechanics by D.S. Mathur and P.S. Hemne, S. Chand.
7. Waves, Mechanics & Oscillations- S B Puri
8. Astronomy: A self-teaching Guide- Dinah L Moche, Wiley 6th Edition, Chapter 7,12.

COMPLEMENTARY PHYSICS FOR MATHEMATICS

SEMESTER III

PH3B01B23 MODERN PHYSICS, BASIC ELECTRONICS AND DIGITAL ELECTRONICS

(Complementary Course for B.Sc. Mathematics)

Credits: 3

Hours per week-3 **Total lecture hours - 54**

Course Overview & Context:

The aim of the course is to make the students aware of the basic principles in science leading to latest emerging technologies. Electronics industry is an evolving field based upon the advancements in the Semiconductor Physics. Spectroscopy and Radioactivity are another major field to obtain finer details of the materials.

The first module of the course introduces the students to basic structure of matter and its interaction with radiation. The second module an introductory idea about Quantum Mechanics and Nuclear Physics. The course also covers the basics of Semiconductor physics and the Digital Electronics.

Course Outcomes:

CO1: Discuss different atom models used to study spectroscopy and estimate the spectral characteristics (Apply)

CO2: Discuss emergence of quantum mechanics and solve photoelectric equation, energy and uncertainties in position/momentum of a particle in a box (Apply)

CO3: Explain the ground state properties of the nucleus for the study of the nuclear structure behavior (Analyze)

CO4: Construct rectifiers, voltage regulators, transistors and express different number systems and Boolean algebra in digital circuitry design (Apply)

Syllabus content

Module I (12 hours)

Atom models & Spectroscopy (12hours)

Thomson's model - Rutherford's nuclear atom model (qualitative) - Bohr atom model – Bohr radius – total energy of the electron – Bohr's interpretation of Hydrogen atom- Sommerfeld's relativistic atom model – elliptical orbits of Hydrogen (qualitative) – Sommerfeld's relativistic theory – fine structure of H_α line - Vector atom model – quantum numbers associated with vector atom model – coupling scheme (qualitative) - optical spectra – spectral terms – spectral notation – selection rules. - Raman effect – quantum theory of Raman effect.

Text Book:

1. Modern Physics, R. Murugeshan, S. Chand and Co. 18thEdn, Chapter 6,19

Module II (20 hours)

Quantum mechanics (12 hours)

Introduction – breakdown of classical physics – black body radiation and Planck's quantum hypothesis (qualitative) – photoelectric effect – Einstein's explanation of photoelectric effect – de Broglie hypothesis – matter wave – Davisson Germer experiment – uncertainty principle(derivation and application not required) - wave packet – wave function – properties of wave function – probabilistic interpretation of wave function – normalisation condition – timeindependent Schrödinger equation – particle in a box problem.

Text Books:

1. Modern Physics, G. Aruldhas and P. Rajagopal, Tata McGraw-Hill, 5thedn.
2. Quantum Mechanics, Aruldhas, PHI Pub.
3. Modern Physics , Arthur Beiser, Tata McGraw-Hill

Nuclear Physics (8 hours)

Classification of nuclei - general properties of nucleus - binding energy - nuclear stability -theories of nuclear composition - nuclear forces - magic numbers - natural radioactivity -alpha- beta & gamma rays - properties of alpha rays - properties of beta rays - properties of gamma rays- fundamental laws of radioactivity – Soddy Fajan's displacement law - law of radioactive disintegration – half life - mean life - units of radioactivity - law of successive disintegration - radioactive dating.

Text Book:

1. Modern Physics , R Murugeshan, KiruthigaSivaprasath, S. Chand and Co., Chapter 27- sections:27.1 to 27.7 & 27.10, Chapter 31- sections:31.1 to 31.5, 31.29 to 31.31 & 31.33 to 31.35.

Module III (11hours)

Basic Electronics (11 hours)

Energy bands in solids - conduction in solids – semiconductors - majority and minority charge carriers - intrinsic conduction. PN junction diodes – biasing - diode equation (derivation not required), diode parameters, diode ratings - diode characteristics - junction break down. Rectifiers - half wave, full wave and bridge rectifiers. Zener diode characteristics – voltage regulation. Bipolar junction transistors – biasing - transistor currents- transistor circuit configurations - common emitter configurations.

Text Book:

1. Basic Electronics, B. L. Theraja - Chapter12 (12.17, 12.20, 12.22, 12.23-26, 12.30), Chapter 13, Chapter14, Chapter15(15.1-2), Chapter 18 (18.1-18.8).

Module IV (11 hours)

Digital electronics (11 hours)

Different number systems – decimal - binary – octal - hexa decimal number systems –conversion between different number systems – binary mathematics – addition and subtraction –

complementary scheme - arithmetic basic theorems of Boolean algebra – de Morgan's theorems – AND, OR, NOT, NAND, NOR, XOR gates – truth tables – half adder and full adder – subtractor.

Text Book:

1. Digital principles and applications, A. P. Malvino and P.Leach

References:

1. Concepts of Modern Physics- A. Beiser , Tata McGraw-Hill, 5th Edn.
2. Modern Physics, G. Aruldas and P.Rajagopal , PHI Pub.
3. Quantum Physics- S. Gasiorowicz (John Wiley & Sons)
4. Electricity and Magnetism - D C Tayal

COMPLEMENTARY PHYSICS FOR MATHEMATICS

SEMESTER IV

PH4B01B23 PHYSICAL OPTICS, LASER PHYSICS AND MAGNETISM

(Complementary course for B.Sc. Mathematics)

Credits: 3

Hours per week-3 **Total lecture hours - 54**

Course Overview & Context:

The syllabus is expected to provide a comprehensive knowledge and understanding of physics that will cater to the basic requirements for his/her higher studies. It also aims to make the learner to have knowledge about various phenomena in optics interference, diffraction, polarization of light, lasers, fiber optics, holography and also covers a topic on magnetism. It inculcates an appreciation of the physical world and the discipline of physics.

The course begins with revision of fundamentals in optics and extends into some important applications. A good knowledge of optics is essential for the understanding of photonics in further and hence the topic is extended to the principle and applications of laser, Fiber optics and holography. This course also provides a basic knowledge about the magnetic phenomena.

Course Outcomes:

CO1: Interpret interference of light in thin film, diffraction at straight edge and in grating (Apply)

CO2: Explain different types of polarised light and compute thickness of retardation plates. (Apply)

CO3: Examine basic principles of lasers, holography and Fiber Optic communication (Apply)

CO4: Examine the behaviour of magnetic material in a magnetic field (Apply)

Syllabus content

Module I (20 hours)

Interference (12 hours)

Interference of light - Principle of superposition - conditions for maximum and minimum intensities - coherent sources - Interference by division of wave front and division of amplitude - Young's double slit experiment (division of wave front) – Expression for fringe width - Newton's rings by reflected light (division of amplitude) - measurement of wavelength of sodium light by Newton's rings - interference in thin films.

Diffraction (8 hours)

Introduction – Difference between Interference and diffraction - Fresnel and Fraunhoferdiffraction - Fresnel Diffraction at a straight edge - Theory of plane transmission grating -Determination of wavelength (normal incidence) – resolving power - dispersive power.

Text Book:

1. A Text book of Optics- N. Subrahmanyam, Brijlal and M.N. Avadhanulu (S. Chand and Co.)

Module II (12 hours)

Polarization (12 hours)

Polarization - preferential direction in a wave - polarized light - natural light - production of linearly polarized light – polarization by reflection – Brewster's law - polarization by double refraction – calcite crystal – optic axis – principal section – positive and negative crystals – Huygen's explanation of double refraction - phase difference between O and E rays – supposition of linearly polarized lights - types of polarization – retardation plates (only half wave plate and quarter wave – Nicol prism –Malus's law.

Text Book:

1. Modern Physics, R Murugeshan, Kiruthiga Sivaprasath, S. Chand and Co.

Module III (14 hours)

Lasers (10 hours)

Interaction of light and matter - quantum behaviour of light - energy levels – population - thermal equilibrium - absorption and emission of light - the three processes - Einstein relation- condition for large stimulated emissions - condition for light amplification – population inversion – pumping - active medium - metastable state - pumping schemes - solid state lasers – ruby laser & yag laser - gas laser – helium-neon laser - applications (basic ideas).

Holography (1 hour)

Holography –introduction – principle- method-advantages and applications

Text book:

1. An Introduction to LASER – theory and applications, M.N. Avadhanulu., SChand & Company, First edition, Chapter 1- sections: 1.3 to 1.13-1.15 to 1.16 & 1.18 to1.20- Chapter 2- sections:2.2- 2.2.1 & 2.2.2 - 2.3 & 2.3.1. & Chapter 5.

Fibre optics (3 hours)

Introduction-optical fibre-critical angle of propagation -acceptance angle-types of optical fibres-single mode –multimode-graded index fibre-fibre optic communication system.

Text book:

1. A Text book of Optics- N. Subrahmanyam, Brijlal and M.N. Avadhanulu (S. Chand and Co.)

Module IV (8 hours)

Magnetism (8 hours)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism- paramagnetism-ferromagnetism antiferromagnetism. Electron theory of magnetism- explanation of

ferromagnetism (Qualitative idea)- hysteresis- Experimental method.

Text book:

1. Electricity and Magnetism – R.Murugeshan, S.Chand & Co Ltd.

References:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)
2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
3. Optics- Satyaprakash (RatanprakashMandir)
4. Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)
5. Optics- A. Ghatak (Tata McGraw-Hill)

COMPLEMENTARY PHYSICS FOR CHEMISTRY

SEMESTER I

PH1B02B23 PROPERTIES OF MATTER AND THERMODYNAMICS

(Complementary Course for B.Sc. Chemistry)

Credits: 2

Hours per week-2 **Total lecture hours -36**

Course Overview & Context:

This course will try to provide conceptual understanding of basic physics to students and will provide a theoretical basis for doing experiments in related areas.

This course exposes students to basic physics. It helps to understand basic phenomena in Physics such as Elasticity, Surface tension and hydrodynamics. This course also covers the fundamental laws in thermodynamics and their applications in modern life. Module I deals with elasticity. Module II is divided into hydrodynamics and surface tension. Module III deals with thermodynamics.

Course Outcomes:

CO1: Apply static and dynamic methods to determine rigidity modulus and bending of beams to Young's modulus (Apply)

CO2: Discuss the theory for the dynamics of fluid systems (Understand)

CO3: Examine Carnot engine and refrigerator by applying second law of thermodynamics (Apply)

CO4: Deduce Maxwell's thermodynamic relations from thermodynamic potentials (Apply)

Syllabus content

Module I

Elasticity **(13 hours)**

Stress- strain- Hooke's law- Elastic moduli- Poisson's ratio- twisting couple determination of rigidity modulus- static and dynamic methods- static torsion- torsion pendulum, bending of beams- cantilever, uniform and non-uniform bending, I section girder.

Text Book:

1. Mechanics - D. S. Mathur- Revised by P. S. Hemne, S. Chand &Co., Chapters 13 & 14.

Module II (10 Hours)

Viscosity **(7 hours)**

Streamline and turbulent flow - critical velocity - Coefficient of viscosity - Derivation of

Poiseuille's equation, Stokes equation-Determination of viscosity by Poiseuille's method- Brownian motion – Viscosity of gases Bernoulli's theorem.

Surface tension **(3 hours)**

Molecular theory of surface tension - surface energy - excess pressure in a liquid drop - factors affecting surface tension – applications.

Text Book:

1. Mechanics– Prof. D.S Mathur Revised by: Dr. P.S Hemne. , SChand & Company Pvt. Ltd, chapter 15

Module III (13 hours)

Thermodynamics **(13 hours)**

Thermodynamic systems- thermodynamic equilibrium- thermodynamic processes isothermal process- adiabatic process- zeroth law of thermodynamics, first law of thermodynamics- heat

engine- the Carnot engine- refrigerator, concept of entropy second law of thermodynamics- third law of thermodynamics- Maxwell's thermodynamic relations.

Text Book:

1. Heat and Thermodynamics, Brijlal and Subrahmanyam and P. S. Hemne, S. Chand & Co., Chapter 5 & 6Text Book***:***

References:

1. Elements of properties of matter, D S Mathur
2. Advanced course in Practical Physics by D Chattopadhyay
3. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
4. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)
5. Modern Physics- G. Aruldas and P. Rajagopal (PHI Pub)
6. Physics- Resnick and Halliday
7. Heat and Thermodynamics – Mark W Zemanski (Tata McGraw-Hill)

MODEL QUESTION PAPER

B.Sc. DEGREE (C.B.C.S) EXAMINATION, NOVEMBER 2023

SEMESTER I - COMPLEMETARY PHYSICS COURSE FOR B.Sc. CHEMISTRY

PH1B02B23 PROPERTIES OF MATTER & THERMODYNAMICS

Time: 3 hours **Maximum marks: 60**

Part A

(Answer any ten questions. Each question carries 1 mark)

Qn.No.	Questions	CO	Level of question
1.	Differentiate between stress and strain.	1	U
2.	State Hooke's law of elasticity.	1	U
3.	Distinguish between angle of twist and angle of shear.	1	U
4.	Describe a cantilever.	1	U
5.	Briefly explain cohesive and adhesive forces.	2	U
6.	State Bernoulli's theorem.	2	R
7.	Distinguish between streamline and turbulent flow.	2	U
8.	Explain the significance of indicator diagram.	3	U
9.	Define isothermal process with example.	3	R

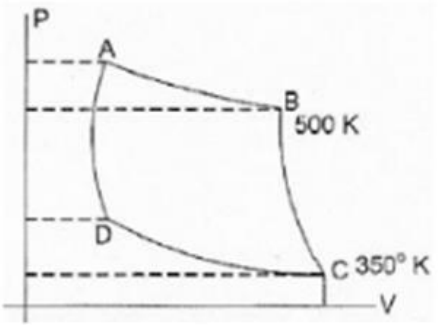
10.	State and write down the equation for I Law of thermodynamics.	3	U
11.	State the feature of an isochoric process.	3	U
12.	State the significance of Maxwell's thermodynamic equations.	4	U

(10 x 1 = 10 marks)

Part B

(Answer any six questions. Each question carries 5 marks)

Qn.No.	Questions	CO	Level of question
13.	Define and give a detailed account of elastic hysteresis. Explain stress- strain graph of a wire.	1	U
14.	Estimate the force required to stretch a steel wire 0.5 cm2 in cross section to double its length. $Y = 4 \times 10^{11}$ N/m^2	1	Ap
15.	A cantilever shows depression of 0.5cm at the loaded end. Evaluate the depression at its mid point.	1	Ap
16.	Explain surface tension on the basis of molecular theory.	2	U
17.	A small sphere falls from rest in a viscous liquid. Due to friction, heat is produced. Find the relation between the rate of production of heat and the radius of the sphere at terminal velocity.	2	Ap
18.	Two capillary tubes of the same length but different radii r_1 and r_2 are fitted in parallel to the bottom of a vessel. The pressure head is P. What should be the radius of a single tube of the same length that can replace the two tubes so that the rate of flow is the same as before.	2	An

19.	Based on the graph below, what is the efficiency of the Carnot engine?  	3	Ap
20.	A Carnot engine works at high temperature 600 Kelvin with the efficiency of 40%. If the efficiency of the engine is 75% and the low temperature kept constant, what is the high temperature?	3	Ap
21.	Set up Maxwell's thermodynamic equations.	4	U

(6 x 5 = 30 marks)

Part C

(Answer any two questions. Each question carries 10 marks)

Qn.No.	**Questions**	**CO**	**Level of question**
22.	Develop an expression for the couple per unit twist of a cylindrical rod.	1	Ap
23.	Briefly introduce a bending moment and derive the expression for the same.	1	U

24.	Develop a suitable theory to describe the motion of a small sphere through a viscous medium. Describe an experiment to deduce the viscosity of that medium.	2	Ap
25.	Discuss isothermal and adiabatic processes. Derive an equation for the work done in both these cases.	3	U

(2 x 10 = 20 marks)

CO : Course Outcomes
Level : R – Remember, U – Understand, Ap- Apply, An- Analyze, E- Evaluate, C- Create

COMPLEMENTARY PHYSICS FOR CHEMISTRY

SEMESTER II

PH2B02B23 MECHANICS AND CRYSTALLOGRAPHY

(Complementary Course for B.Sc. Chemistry)

Credits: 2

Hours per week-2 **Total lecture hours - 36**

Course Overview & Context:

This course envisages to cover mechanics, ultrasonics and crystallography and their applications in everyday life. This course will try to provide conceptual understanding of basic mechanics and crystallography to students and will reveal a theoretical basis for doing experiments in related areas.

This course exposes students to basic physics of rotational dynamics, oscillations, waves, ultrasonics and crystallography. The session rotational dynamics differentiates the translational and rotatory dynamics and application of rotatory motion in industry. The chapter ultrasonic deals with the production and applications of ultrasonic waves. Module II explains the various aspects of simple harmonic motion and wave motion. Further this course includes crystallography which provides basic knowledge of material science.

Course Outcomes:

CO1: Apply relevant theorems and strategies to determine the physical parameters related to rotational motion of bodies (Apply)

CO2: Discuss the production and applications of ultra-sonic wave (Understand)

CO3: Represent and solve equations of oscillatory motion of particles (Apply)

CO4: Summarize different crystal systems and X-ray diffraction in crystals (Understand)

Syllabus content

Module I (14 hours)

Rotational Dynamics **(10 hours)**

Angular velocity- angular momentum- torque- conservation of angular momentum, angular acceleration- moment of inertia- parallel and perpendicular axes theorems moment of inertia of rod, ring, disc, cylinder and sphere- flywheel

Text book:

1. Mechanics- D S Mathur, (revised edition 2012), Chapter 11

Ultrasonic **(4 hours)**

Piezo electric effect – Production of ultra sonic waves- Piezo electric crystal method – Magnetostriction method – Applications.

Text book:

1. Mechanics- D S Mathur, (revised edition 2012), Chapter 10

Module II (14 Hours)

Oscillations **(9 hours)**

Periodic and oscillatory motion- simple harmonic motion- differential equation, expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion - damped oscillation- forced oscillation and resonance.

Text book:

1. Mechanics- D S Mathur (revised edition 2012), Chapter 7,8.

Waves **(5 hours)**

Waves-characteristics of waves-classifications- progressive wave- energy of progressive wave- superposition of waves- theory of beats- Doppler Effect.

Text book:

1. Mechanics by D.S. Mathur (Revised edition, 2012) – Chapter10.

Module III

Crystalline Solids **(8 hours)**

Crystalline and amorphous solids – crystal lattice and translation vectors – basis– unit cell – lattice parameters – crystal systems – crystal planes and directions –Miller indices – inter planar spacing – hcp, fcc, bcc, sc crystal structures –Bragg's law of X ray diffraction.

Text book:

1. Solid State Physics- R.K.Puri and V.K.Babbar, S.Chand& CoTextbooks:

References:

1. Elements of properties of matter, D S Mathur Mechanics- H.S.Hans and S.P.Puri. (TMH)
2. Mechanics, D S Mathur
3. Modern Physics- R. Murugeshan, Er. Kirthiga Sivaprasad
4. A text book on oscillations waves and acoustics, M.Ghosh , D Bhattacharya
5. Elementary Solid State Physics- Ali Omar
6. Mechanics by D.S. Mathur and P.S. Hemne, S. Chand.
7. Waves, Mechanics & Oscillations- S B Puri

COMPLEMENTARY PHYSICS FOR CHEMISTRY

SEMESTER III

PH3B02B23 MODERN PHYSICS AND BASIC ELECTRONICS

(Complementary Course for B.Sc. Chemistry)

Credits: 3

Hours per week-3 **Total lecture hours - 54**

Course Overview & Context:

The aim of the course is to make the students aware of the basic principles in science leading to latest emerging technologies. Electronics industry is an evolving field based upon the advancements in the Semiconductor Physics. Spectroscopy and Nuclear Physics are another emerging session deal with interactions between matter and radiation and that between the nuclei and elementary particles respectively.

The first module of the course introduces the students to basic structure of matter and its interaction with radiation. The second module gives an introductory idea about Quantum Mechanics. Third module reveals the basic idea of semiconductor and wave shaping devices.

The course also covers the nuclear disintegration, elementary particles and particle accelerators.

Course Outcomes:

CO1: Discuss different atom models used to study spectroscopy and estimate the spectral characteristics (Apply)

CO2: Discuss emergence of quantum mechanics and solve photoelectric equation, energy and uncertainties in position/momentum of a particle in a box (Apply)

CO3: Construct rectifiers, voltage regulators and explain the characteristics of transistors. (Apply)

CO4: Explain the ground state properties of the nucleus and the concept of elementary particles and demonstrate different types of nuclear disintegrations and particle accelerators (Analyze)

Syllabus content

Module I (12 hours)

Atom models & Spectroscopy (12hours)

Thomson's model - Rutherford's nuclear atom model (qualitative) - Bohr atom model – Bohr radius – total energy of the electron – Bohr's interpretation of Hydrogen atom- Sommerfeld's relativistic atom model – elliptical orbits of Hydrogen (qualitative) – Sommerfeld's relativistic theory – fine structure of Hα line - Vector atom model – quantum numbers associated with vector atom model – coupling scheme (qualitative) - optical spectra – spectral terms – spectral notation – selection rules. - Raman effect – quantum theory of Raman effect.

Text Book:

1. Modern Physics, R. Murugeshan, S. Chand and Co. 18thEdn, Chapter 6,19

Module II (12 hours)

Quantum mechanics (12 hours)

Introduction – breakdown of classical physics – black body radiation and Planck's quantum hypothesis (qualitative) – photoelectric effect – Einstein's explanation of photoelectric effect – de Broglie hypothesis – matter wave – Davisson Germer experiment – uncertainty principle (derivation and application not required) - wave packet – wave function – properties of wave function – probabilistic interpretation of wave function – normalisation condition – time independent Schrödinger equation – particle in a box problem.

Text Books:

1. Modern Physics, G. Aruldhas and P. Rajagopal, Tata McGraw-Hill, 5thedn.
2. Quantum Mechanics, Aruldhas, PHI Pub.
3. Modern Physics, Arthur Beiser, Tata McGraw-Hill

Module III (11 Hours)

Basic Electronics (11 hours)

Energy bands in solids - conduction in solids – semiconductors - majority and minority charge carriers - intrinsic conduction. PN junction diodes – biasing - diode equation (derivation not required), diode parameters, diode ratings - diode characteristics – junction break down. Rectifiers - half wave, full wave and bridge rectifiers. Zener diode characteristics – voltage regulation. Bipolar junction transistors – biasing - transistor currents- transistor circuit configurations - common emitter configurations.

Text Book:

1. Basic Electronics, B. L. Theraja - Chapter12 (12.17, 12.20, 12.22, 12.23- 26, 12.30), Chapter 13, Chapter14, Chapter15(15.1-2), Chapter 18 (18.1-18.8).

Module IV (19 Hours)

Nuclear Physics (8 hours)

Classification of nuclei - general properties of nucleus - binding energy - nuclear stability -theories of nuclear composition - nuclear forces - magic numbers - natural radioactivity -alpha- beta & gamma rays - properties of alpha rays - properties of beta rays - properties of gamma rays- fundamental laws of radioactivity – Soddy Fajan's displacement law - law of radioactive disintegration – half life - mean life - units of radioactivity - law of successive disintegration - radioactive dating.

Text Book:

1. Modern Physics, R Murugeshan, Kiruthiga Sivaprasath, S. Chand and Co.,Chapter 27- sections:27.1 to 27.7 & 27.10, Chapter 31- sections:31.1 to 31.5, 31.29 to 31.31 & 31.33 to 31.35.

Particle Physics (6 hours)

Fundamental interactions in nature- gauge particles- classification of particles-antiparticles- elementary particle quantum numbers- conservation laws- quark model (qualitative)

Particle Detectors & Accelerators (5 hours)

GM counter-scintillation counter- Linear accelerator- Cyclotron- Synchrotron - betatron.

Text Book:

1. Modern Physics- R. Murugeshan (S. Chand and Co.)
2. Mechanics- J.C. Upadhyaya (Ram Prasad and sons)

References:

1. Concepts of Modern Physics- A. Beiser , Tata McGraw-Hill, 5th Edn.
2. Modern Physics, G. Aruldas and P. Rajagopal, PHI Pub.
3. Quantum Physics- S. Gasiorowicz (John Wiley & Sons)
4. Electricity and Magnetism - D C Tayal

COMPLEMENTARY PHYSICS FOR CHEMISTRY

SEMESTER IV

PH4B02B23 PHYSICAL OPTICS, LASER PHYSICS, SUPER CONDUCTIVITY AND DIELECTRICS

(Complementary course for B. Sc. Chemistry)

Credits: 3

Hours per week-3 **Total lecture hours - 54**

Course Overview & Context:

The syllabus is expected to provide a comprehensive knowledge and understanding of physics that will cater to the basic requirements for his/her higher studies. It also aims to make the learner to have knowledge about various phenomena in optics interference, diffraction, polarization of light, lasers, and also covers a topic on dielectrics and superconductivity. It inculcates an appreciation of the physical world and the discipline of physics.

The students acquire knowledge of the basic phenomena in optics such as Interference, diffraction and polarization. The course begins with revision of fundamentals in optics and extends into important applications. A good knowledge of optics is essential for the understanding of photonics in further. The course also covers the principle and applications of laser, dielectric and superconductivity.

Course Outcomes:

CO1: Interpret interference of light in thin film, diffraction at straight edge and in grating (Apply)

CO2: Explain different types of polarised light and compute thickness of retardation plates. (Apply)

CO3: Examine basic properties and applications of lasers and superconductors (Apply)

CO4: Examine the behaviour of dielectrics in the presence of electric field (Apply)

Syllabus content

Module I (20 hours)

Interference (12 hours)

Interference of light - Principle of superposition - conditions for maximum and minimum intensities - coherent sources - Interference by division of wave front and division of amplitude - Young's double slit experiment (division of wave front) – Expression for fringe width - Newton's rings by reflected light (division of amplitude) - measurement of wavelength of sodium light by Newton's rings - interference in thin films.

Diffraction (8 hours)

Introduction – Difference between Interference and diffraction - Fresnel and Fraunhofer diffraction - Fresnel Diffraction at a straight edge - Theory of plane transmission grating - Determination of wavelength (normal incidence) – resolving power - dispersive power.

Text Book:

1. A Text book of Optics- N. Subrahmanyam, Brijlal and M. N. Avadhanulu (S.Chand and Co.)

Module III (12 hours)

Polarization (12 hours)

Polarization - preferential direction in a wave - polarized light - natural light - production of linearly polarized light – polarization by reflection – Brewster's law - polarization by double refraction – calcite crystal – optic axis – principal section – positive and negative crystals – Huygen's explanation of double refraction - phase difference between O and E rays – superposition of linearly polarized lights - types of polarization – retardation plates (only half wave plate and quarter wave – Nicol prism –Malus's law.

Text Book:

1. Modern Physics, R Murugeshan, Kiruthiga Sivaprasath, S. Chand and Co.

Module III (10 hours)

Lasers **(10 hours)**

Interaction of light and matter - quantum behaviour of light - energy levels – population - thermal equilibrium - absorption and emission of light - the three processes - Einstein relation- condition for large stimulated emissions - condition for light amplification – population inversion – pumping - active medium - metastable state - pumping schemes - solid state lasers – ruby laser & yag laser - gas laser – helium-neon laser - applications (basic ideas).

1. An Introduction to LASER – theory and applications, M.N. Avadhanulu., SChand & Company, First edition, Chapter 1- sections: 1.3 to 1.13-1.15 to 1.16 & 1.18 to1.20- Chapter 2- sections:2.2- 2.2.1 & 2.2.2 - 2.3 & 2.3.1. & Chapter 5.

Module IV (12 hours)

Superconductivity **(8 hours)**

Super conducting phenomenon- Occurrence- BCS theory (qualitative) Meissner Effect- Type I and Type II superconductors- Josephson effects (qualitative) - High temperature

superconductors- Applications of Superconductivity

Text Book:

1. Modern Physics – R Murugeshan- KiruthigaSivaprasath, S Chand & Company, Chapter 41- Sections: 41.13-41-14 & 41.15- Chapter 42- Sections: 42.1 & 42.2 & Chapter 44 - Sections: 44.1- 44.5 &44.6

Dielectrics **(4 hours)**

Dielectrics- polar and non-polar dielectrics- polarization- sources of polarization-Gauss's law in dielectrics- permittivity- dielectric displacement vector- dielectric constant susceptibility.

Text Book:

1. Electricity and Magnetism – R. Murugeshan

Refererence:

1. Introduction to Modern Physics- H.S. Mani and G.K. Mehta (Affiliated East West press Pvt. Ltd)

2. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5th Edn.)

3. Optics- Satyaprakash (RatanprakashMandir)

4. Modern Physics- G.Aruldas and P.Rajagopal (PHI Pub)

5. Optics- A. Ghatak (Tata McGraw-Hill)

6 Heat & Thermodynamics - Brijlal & Subramaniam, Reprint 1998, S. Chand & Company Ltd.

7. Electricity and Magnetism , D C Tayal

8. Electricity and Magnetism- J. H. Fewkes& John Yarwood

COMPLEMENTARY PHYSICS PRACTICAL FOR MATHEMATICS & CHEMISTRY

Practical I

Codes: PH2BP01B23 (for B.Sc. Mathematics) & PH2BP02B23 (for B.Sc. Chemistry)

Credit: 2

Hours per week-2 **No. of hours: 72**

Course overview& Context:

This complementary practical course is mainly focused on basic measuring instruments and experiments based of properties of matter such as density, viscosity, surface tension and Young's Modulus. The measurement of refractive index using Spectrometer and construction of basic electronic circuits and their characteristics is also included.

The course will nurture analytical skill and experimentation aptitude in students. This learning experience will serve as the prerequisite for future employment aspects.

Course Outcomes:

CO1: Apply the knowledge of basic concepts in Physics to identify and select appropriate measuring instruments. (Apply)

CO2: Analyse basics experiments in Properties of Matter, Mechanics and construct diode circuits. (Analyse)

Syllabus content

1. Vernier Calipers - Volume of a cylinder- sphere and a beaker

2. Screw gauge - Volume of a sphere and a glass plate

3. Beam balance - Mass of a solid (sensibility method)

4. Radius of a capillary tube- Using (1) travelling microscope

5. Density of a liquid - U-Tube and Hare's apparatus

6. Viscosity of a liquid - Variable pressure head

7. Surface Tension – Capillary rise method.

8. Cantilever - Pin & Microscope – Determination of Young's Modulus

9. Symmetric Compound Pendulum-Determination of radius of gyration(K) and acceleration due to gravity (g)

10. Spectrometer – Angle of the Prism.

11. Cantilever – Scale and Telescope-Determination of Young's modulus

12. Asymmetric Compound Pendulum-Determination of K and g

13. Coefficient of Viscosity – Constant pressure head

14. Spectrometer - Refractive Index of material of prism.

15. Liquid lens - Refractive Index of glass using liquid of known refractive index

16. Potentiometer-Calibration of low range voltmeter

17. Characteristics of Zener diode

18. Construction of half wave rectifier with and without filter – Ripple factor and Load regulation

19. Characteristics of p-n junction diode

20. Torsion pendulum - Rigidity modulus

Practical II

Codes: PH4BP01B23 (for B.Sc. Mathematics) & PH4BP02B23 (for B.Sc. Chemistry)

Credit: 2 **No. of hours: 72**

Course overview& Context:

This complementary practical course is mainly focused on general experiments in elasticity and magnetism. Construction of circuits of rectifiers, logic gates, amplifiers and analyze transistor characteristics, Potentiometer and Carey Foster's Bridge, and the measurement of refractive index, dispersive power using Spectrometer is also included.

The course will nurture analytical skill and experimentation aptitude in students. This learning experience will serve as the prerequisite for future employment aspects.

Course Outcomes:

CO1: Interpret general experiments in elasticity and magnetism (Apply)

CO2: Construct rectifiers, logic gates, amplifiers and analyze transistor characteristics, Potentiometer and Carey Foster's Bridge (Apply)

CO3: Determine wavelength of light source, refractive index of material and dispersive power (Apply)

Syllabus content

1. Non-uniform bending-Young's Modulus-Pin and Microscope method

2. Field along the axis of circular coil- Variation of magnetic field and determination of BH

3. Carey Foster's Bridge - Measurement of resistivity

4. Liquid lens - Refractive index of liquid

5. Searle's vibration Magnetometer-magnetic moment

6. Tangent Galvanometer – Ammeter calibration

7. Spectrometer – Prism – Dispersive power

8. Potentiometer-Calibration of low range ammeter

9. Construction of full wave rectifier with and without filter – Ripple factor and Load regulation

10. Construction of regulated power supply using Zener diode

11. Uniform bending – Young's Modulus-Optic lever method

12. Torsion pendulum (Equal mass method) - Rigidity modulus and Moment of Inertia

13. Fly wheel - Moment of Inertia

14. Static Torsion - Rigidity modulus

15. Spectrometer - Grating Dispersive power

16. Newton's rings - Wave length

17. Deflection and Vibration Magnetometer- m & Bh

18. Conversion of Galvanometer into voltmeter

19. Transistor characteristics- CE configuration

20. Gates – AND - OR- NOT- verification of truth table

21. Transistor Characteristic study – Common Base configuration

22. Transistor Characteristic study – Common Emitter configuration