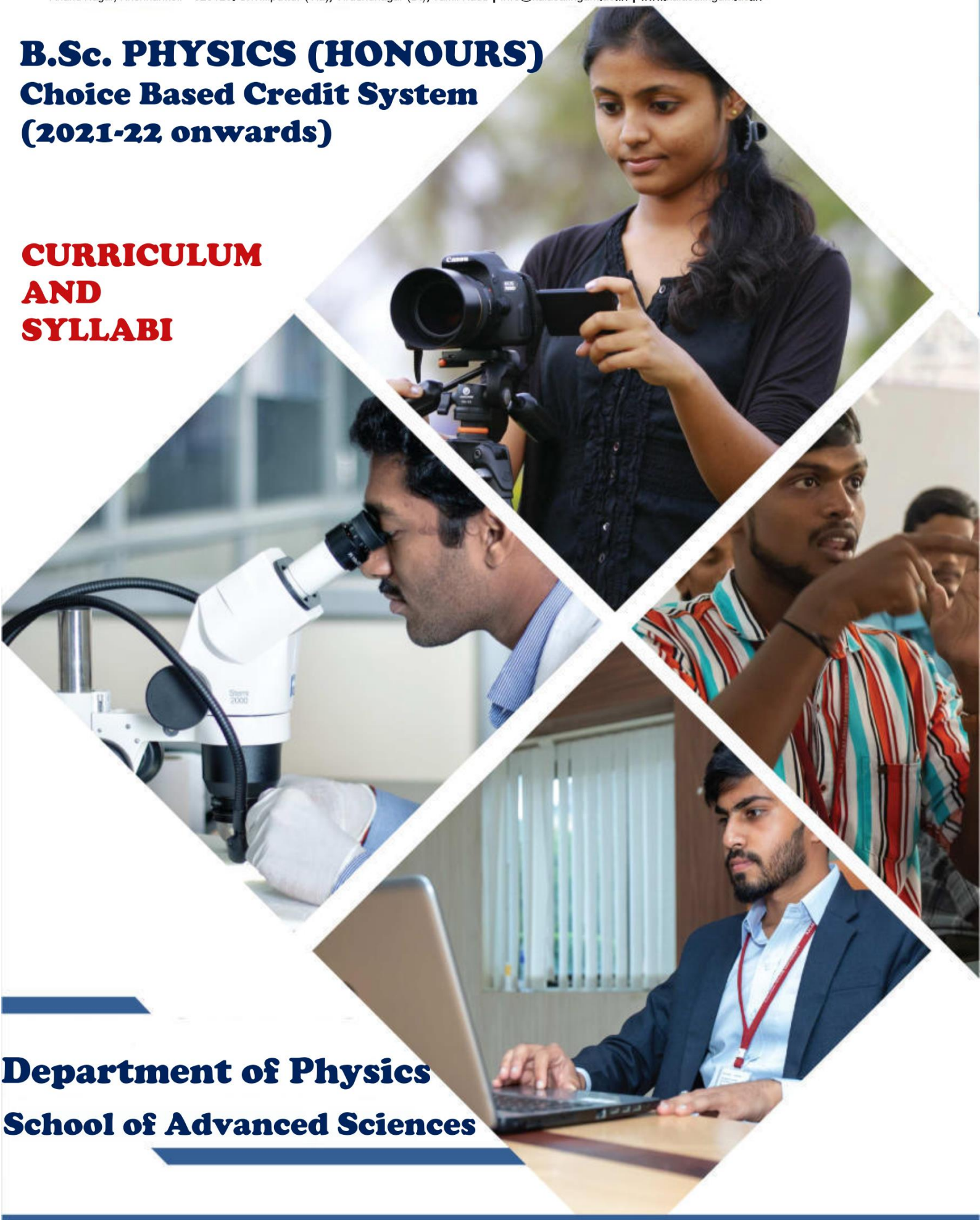
KALASALINGAM
ACADEMY OF RESEARCH AND EDUCATION
(DEEMED TO BE UNIVERSITY)
Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade
Anand Nagar, Krishnankoil - 626126. Srivilliputtur (Via), Virudhunagar (Dt), Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

B.Sc. PHYSICS (HONOURS)

Choice Based Credit System
(2021-22 onwards)

CURRICULUM AND SYLLABI



Department of Physics

School of Advanced Sciences

CURRICULUM AND SYLLABI

B.Sc. (HONOURS) IN PHYSICS

Choice Based Credit System (2021-22 onwards)

DEPARTMENT OF PHYSICS
SCHOOL OF ADVANCED SCIENCES

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
(Deemed to be University)
Anand Nagar, Krishnankoil - 626 126
Virudhunagar District, Tamil Nadu

2021

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION

Anand Nagar, Krishnankoil – 626 126

DEPARTMENT OF PHYSICS

B.Sc. Physics (Honours) Programme

University/ Department	VISION	MISSION
Kalasalingam Academy of Research and Education	**To be a Centre of Excellence of International repute in education and research**	**To produce technically competent, socially committed technocrats and administrators through quality education and research**
Department of Physics	To achieve excellence in education and research in the field of Physics and other related areas through knowledge creation and dissemination.	• Impart quality education and promote scientific temper • Blend theoretical knowledge with practical skills • Motivate basic/academic and applied research in technically important fields • Provide access to all sections of the society to pursue higher education • Inculcate moral values and ethics among students • Prepare students as responsible citizens • Hasten the process of creating a knowledgeable society

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1	**Technical Proficiency**: Succeed in obtaining employment appropriate to their interests, education and will become valuable physicist
PEO2	**Professional Growth:** Continue to develop professionally through life-long learning, higher education, research and other creative pursuits in their areas of specialization
PEO3	**Management Skills:** Improve leadership qualities in a technical and social response through innovative manner

PROGRAM OUTCOMES FOR BACHELOR OF SCIENCE

PO1	**Scientific knowledge:** Gain and apply the fundamentals of mathematics, natural sciences, and applied sciences for the usage of modern scientific instrumentation, laboratory techniques and solving the challenges in modern scientific society
PO2	**Problem analysis:** Identify, formulate, and analyse the complex scientific problems reaching substantiated conclusions.
PO3	**Design/development of solutions:** Develop the solutions for complex problems using research-based knowledge including design of experiments, analysis and interpretation of data that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal and environmental considerations.
PO4	**Modern tools usage:** Create, select, and apply appropriate techniques, resources, and modern computing/electronic tools.
PO5	**Social responsibility:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.
PO6	**Environment and sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge for sustainable development.
PO7	**Ethics and Values:** Apply and commit towards professional ethical principles, ethical responsibilities, and norms of scientific practice.
PO8	**Individual and teamwork:** Function effectively in multidisciplinary settings as an individual or leader in a group.
PO9	**Communication:** Communicate effectively on complex activities with the scientific community and with the society at large, being able to comprehend and write effective reports, design documentation and make effective presentations.
PO10	**National and International Perspectives:** Contribution towards the national development and projecting our national priorities at the international level pertaining to their field of interest and future expertise.
PO11	**Project management:** Capable of identifying/mobilizing appropriate resources required for a project, and manage a project through to completion, while observing responsible and ethical scientific conduct; and safety and laboratory hygiene regulations and practices
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning towards the broadest context of scientific and societal change

PROGRAM SPECIFIC OUTCOME (PSOS)

PSO1	Acquire a fundamental/systematic or coherent understanding of the academic field of Physics, that creates different types of professionals related to the disciplinary/subject area of Physics including professionals engaged in research and development, industry, teaching and government/public service
PSO2	Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.
PSO3	Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems in the real world for promoting safe learning, working environment and sustainability issues.

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DEPARTMENT OF PHYSICS

B.Sc. PHYSICS (HONOURS) - CURRICULUM STRUCTURE - CBCS (AY 2021-22)

BROAD STRUCTURE

Course Types	No. of Courses	Total Credits
Foundation Core Courses	08	30
Program Core Courses (7×6=42; 7×4=28)	14	70
Generic Electives (4×4=16)	04	16
Discipline Specific Electives (2×4=8; 2×3=6)	04	14
Skill Enhancement Courses (2×2=4)	02	04
Experiential Elective (1x6=6)	01	06
Total	**33**	**140**

LIST OF FOUNDATION CORE COURSES

Course Code	Course Title	L	T	P	X	H	C
211ENG1302	English - I	4	0	0	3	7	5
211ENG1305	Professional Skills	1	0	0	3	4	2
211ENG1303 / 211TAM1301	English – II / Tamil	3	0	0	3	6	4
211BCA1301	Digital Skills	3	0	2	3	8	5
211ENG1306	Communicative English	3	0	2	3	8	5
211MAT1304	Basic Statistics	2	0	0	3	5	3
211CHY1101	Environmental Science	3	0	0	0	3	3
211ENG1304	Human Values	2	0	0	3	5	3
	Total	**21**	**0**	**4**	**21**	**46**	**30**

LIST OF PROGRAM CORE COURSES

Course Code	Course Title	L	T	P	X	H	C
212PHY2301	Mechanics and Properties of Matter	4	0	4	0	8	6
212PHY2302	Electricity and Magnetism	4	0	4	0	8	6
212PHY2303	Thermal Physics and Statistical Mechanics	4	0	4	0	8	6
212PHY2304	Waves and Optics	4	0	4	0	8	6
212PHY2305	Analog Electronics	5	0	2	0	7	6
212PHY3301	Solid State Physics	4	0	4	0	8	6
212PHY3302	Spectroscopy	4	0	4	0	8	6
212PHY2101	Atomic Physics	4	0	0	0	4	4
212PHY3101	Nuclear and Particle Physics	4	0	0	0	4	4
212PHY3102	Classical Mechanics	4	0	0	0	4	4
212PHY2102	Energy Physics	4	0	0	0	4	4
212PHY3303	Quantum Mechanics	3	0	2	0	5	4
212PHY2306	Digital Electronics	3	0	2	0	5	4
212PHY2103	Astronomy and Astrophysics	4	0	0	0	4	4
	Total	**55**	0	**30**	**0**	**81**	**70**

LIST OF GENERIC ELECTIVE COURSES

Course Code	Course Title	L	T	P	X	H	C
213MAT1101	Mathematical-I	4	0	0	0	4	4
213MAT1102	Mathematical-II	4	0	0	0	4	4
213CHY1301	Chemistry-I	3	0	2	0	5	4
213CHY1302	Chemistry-II	3	0	2	0	5	4
	Total	**14**	**0**	**4**	**0**	**18**	**16**

LIST OF DISCIPLINE-SPECIFIC ELECTIVE COURSES

Course Code	Course Title	L	T	P	X	H	C
213PHY3101	Microprocessors and Microcontroller	3	0	0	3	6	4
213PHY2301	Mathematical Physics	3	0	2	0	5	4
213PHY3302	Materials Science	3	0	2	0	5	4
213PHY2302	Communication Physics	3	0	2	0	5	4
213PHY3101	Biomedical Instrumentation	4	0	0	0	4	4
213PHY3102	Theoretical Physics	3	0	0	0	3	3
213PHY3103	Medical Physics	3	0	0	0	3	3
213PHY3104	Biophysics	3	0	0	0	3	3
213PHY3105	Applied Physics	2	0	0	3	5	3

LIST OF SKILL ENHANCEMENT COURSE

Course Code	Course Title	L	T	P	X	H	C
214PHY2101	Physics Workshop skills	1	0	0	3	4	2
214PHY2102	Computational Physics	1	0	0	3	4	2
214PHY2103	Basic Instrumentation skills	1	0	0	3	4	2
214PHY2104	Applied Optics	1	0	0	3	4	2
214PHY2105	Electrical appliances	1	0	0	3	4	2

EXPERIENTIAL ELECTIVE

Course Code	Course Title	L	T	P	X	H	C
215PHY4201	Project	0	0	12	0	12	6

FOUNDATION CORE COURSES

211ENG1302	ENGLISH-I	L	T	P	X	H	C
		4	0	0	3	7	5

Pre-requisite: Nil

Course Category: Foundation Core
Course Type: Theory Course

Objective:

This course aims at facilitating the student to understand the nuances of English Language through poetry, literary essays, biographies of eminent personalities, short stories of renowned writers and Grammar.

Course Outcomes:

CO1: To understand the fundamentals of Grammar
CO2: To understand simple literary texts.
CO3: To apply the reading skills and practice it.
CO4: To develop the quality of practical application of Grammar
CO5: To apply the conversation practice in day-to-day life.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	1										3		1
CO2	3	3	1	1							1		3	1	2
CO3	3	2										1	3	2	
CO4	3	2	1	1									3		
CO5	3	2	2	1	1							1	3	2	

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Poetry

The Umbrella Man; Television -Roald Dahl
La Belle Dame Sans Merci - John Keats
Homecoming -R.Parthasarathy
Ulysses - Alfred Tennyson

Unit II: Prose

Bill Gates: A Biography - Michael B. Becraft
I Dare! Kiran Bedi- Parmesh Dangwal
My Autobiography- Charlie Chaplin
Swami Vivekananda – Chicago Speech of 1893

Unit III: Short Stories

The Ballad of Father Giligan -W.B.Yeats
The Conjurer‘s Revenge-Stephen Leacock
Little Girls Wiser than Men-Leo Tolstoy

Unit IV: Grammar

Parts of the Speech
Prefix, Suffix
Idioms and phrases
Sentence Pattern, Tenses

Unit V: Composition

Letter Writing,

Email Writing
Report Writing;
Cover Letter and Resume Writing

Text Books

1. Henderson, Archibald. George Bernard Shaw, His Life and Works: A Critical Biography; India:Wentworth Press (2016)
2. Gupta, Prashant, *The Life and Times of Bill Gates*; Prabhat Prakashan Publications, 2020

Reference Book

1. Sparkles English For Communication. Board of Editors, Emerald Publishers, 2015

211ENG1305	PROFESSIONAL SKILLS	L	T	P	X	H	C
		1	0	0	3	4	2

Pre-requisite: Nil **Course Category:** Foundation Core
Course Type: Theory Course

Objective:

Professional skills are required for an individual to be gainfully employed for a successful and satisfied life. Professional skills are part of life skills. An individual should be able to demonstrate professional skills involving the use of intuitive, logical and critical thinking, communication and interpersonal skills, not limited to cognitive/creative skills. These skills, behavior and quality of output enhance employability.

Course Outcomes:

CO1: To provide opportunity for realizing one's potential through practical experience.

CO2: To increase one's knowledge and awareness of emotional competency and emotional intelligence at place of study/work.

CO3: To develop interpersonal skills and adopt good leadership behavior for empowerment of self and others.

CO4: To set appropriate goals, manage stress and time effectively.

CO5: To manage competency- mix at all levels for achieving excellence with ethics.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3	1	
CO2	3	2		1									3	1	1
CO3	3		1										3	2	
CO4	3		1	2									3		1
CO5	3	2	2	1	1								3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Career Skills

Goal Setting – Critical Thinking- Self-esteem – Social skills– Interpersonal Skills —Public Speaking

Unit II: Team skills

Communication- Active Listening - Preparing resume/CV – Interview –

Unit III: Presentation Skills

Creative Thinking – Social Cultural Etiquettes – Presentation Skills – Body Language

Unit IV: Leadership Skills

Problem Solving – Strategic Thinking Skills – Creativity

Unit V: Management Skills

Decision Making –Stress Management – Tips to relieve from stress – Yoga - Meditation

Text Books:

1. Kevin Retz. *The Professional Skills Handbook for Engineers and Technical Professionals*, CRC Press, Taylor and Francis Group, London, 2019.
2. Stephanie Lynn Slocum. *SHE Engineers.* Engineers Rising LLC; 1st edition, 2018. USA.

Reference Books:

1. Sangeetha Sharma and Binod Mishra. *Communication Skills for Engineers and Scientists*. PHI Learning, New Delhi. 2010.
2. Wolfgang Linden. *Stress Management: From Basic Science to Best Practice.* Sage Publications, New Delhi. 2005.

211ENG1303	ENGLISH II	L	T	P	X	H	C
		3	0	0	3	6	4

Pre-requisite: Nil

Course Category: Foundation Core
Course Type: Theory Course

Objective:

The course aims to help the students achieve fluency and accuracy in English

Course Outcomes:

CO1: To introduce world-renowned poets to students.
CO2: To introduce world-renowned prose writers to students.
CO3: To make them understand the nuances of Indian plays.
CO4: To excel in Grammar.
CO5: To excel in Composition.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1										3	1	
CO2	3	2		1									3		1
CO3	3											1	3		
CO4	3		1	2									3		2
CO5	3	1	2	1	1							1	3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Poetry

Nissim Ezekiel- Enterprise
Kamala Das - The Dance of Eunuchs
Toru Dutt - Our Casuarina Tree
Sri Aurobindo- The Tiger and the Deer

Unit II: Prose

B. K. Bhattacharya – The Golden Goddess (Assamese)
Himanshu Vohra - A Member of the Family (Gujarati)
Lalithambika Antharjanam- Daughter of Man (Malayalam)
P. Lankesh – Bread (Kannada)

Unit III: Play

Girish Karnad - Hayavadana

Unit IV: Grammar

a) Parts of Speech
b) Articles
c) Sentence: Kinds, Types
d) Tense
e) Reported Speech
f) Degrees of Comparison
g) Conditional Clause
h) Voice: Active & Passive
i) Concord

Unit V: Composition

a) Expansion of Proverb
b) Letters, Email
c) Reading Comprehension
d) Cloze Test
e) Precis Writing
f) Note-Making
g) Writing Dialogues
h) Notices, Agenda, Minutes

211TAM1301	TAMIL-I இக்கால இலக்கியம்	L	T	P	X	H	C
		3	0	0	3	6	4
Pre-requisite: Nil		**Course Category:** Foundation Core **Course Type**: Theory Course					

அலகு 1

மரபுக் கவிதை

சஞ்சீவி பர்வதத்தின் சாரல் – பாரதிதாசன்

அலகு 2

புதுக்கவிதை

1. பாரதியார் – முரசு
2. கவிமணி – பெண்கள் உரிமைகள்
3. கண்ணதாசன் – ஒன்று எங்கள் ஜாதியே
4. வைரமுத்து – தேசப் பாடகனுக்குத் தெருப்பாடகனின் அஞ்சலி
5. சிற்பி – அப்துல் கலாமின் வீணை
6. கல்யாண்ஜி - கண்டும் காணாமல்
7. தமிழச்சி தங்கபாண்டியன் – புன்னகையின் வன்முறை
8. அ. வெண்ணிலா – அம்மாக் குழந்தை
9. சல்மா – விலகிப் போகும் வாழ்க்கை
10. சுகிர்தராணி – அம்மா
11. சக்தி ஜோதி – மீன்களை வரைபவள்
12. ஷக்தி – சந்தேகமேயில்லை

அலகு 3

சிறுகதை

1. கு.அழகிரிசாமி – ராஜா வந்திருக்கிறார்
2. ச. தமிழ்ச் செல்வன் – வெயிலோடு போய்
3. அம்பை – வாகனம்
4. ஜெயமோகன் – சோற்றுக் கணக்கு
5. புதுமைப்பித்தன் – காலனும் கிழவியும்
6. இரா. தமிழ்நேசன் – ஆதி மூதாதையரின் ஜீன்கள்
7. புதியமாதவி – ஒரு பெரியாரிஸ்டின் தீபாவளி
8. சோ. தர்மன் - சோகவனம்
9. எஸ்.ராமகிருஷ்ணன் – தனிமையின் வீட்டிற்கு ஆயிரம் ஜன்னல்கள்
10. வண்ணதாசன் – ஒரு சிறு இசை

அலகு 4

நாவல்

கீதாரி – சு.தமிழ்ச்செல்வி

அலகு 5

நாடகம்

ஔவை – இன்குலாப்

பாடநூல்கள்

1. சஞ்சீவி பர்வதத்தின் சாரல் – பாரதிதாசன் (உரையாசிரியர் முனைவர் கமலா முருகன்), சாரதா பதிப்பகம், சென்னை, 2012.
2. கீதாரி – சு. தமிழ்ச்செல்வி, நியு செஞ்சுரி புக் ஹவுஸ், சென்னை, 2008
3. ஔவை – இன்குலாப், அன்னம் அகரம் பதிப்பகம், தஞ்சாவூர்.

211BCA1301	DIGITAL SKILLS	L	T	P	X	H	C
		3	0	2	3	8	5
Pre-requisite: Nil		**Course Category:** Foundation Core **Course Type**: Theory Course					

Course Topics:

Unit I

Introduction to Computer - Basic Concepts - Basics of Operating System - Drive File Organization -File concepts and operations - File Directory - Working with command prompts- Internet- Concept of Internet - Applications of Internet - Connecting to the Internet, Troubleshooting-Internet Concept of Internet. Applications of Internet.Connecting to the Internet, Troubleshooting.

Unit II

Various applications of Internet - Dial up, ISDN and broadband- Introduction to Internet - addressing, Internet protocols - (TCP/IP, FTP and HTTP, IPV4, IPV6) - Instant messaging, - Use of Social Networking Sites. Word Processing Basics – I -Text Creation and manipulation, . Tables, pictures, Adjusting Page setting, Working with styles, Understand desktop publishing

Unit III

Google Apps – Drive - Docs and Sheet - Forms and Meet - Microsoft Excel – I - Understanding excel Interface - Typing and editing cell content - Calculating with formulas - Microsoft Excel – II - Formatting a worksheet -. Printing Worksheet - Creating Charts

Unit IV

Application of Digital Financial Services- Banking products - Payment Mode - Digital Signature- Basic Concepts of PowerPoint presentation -. Preparation of slides -. Digital Emotional Intelligence -Digital Empathy - Self-Awareness and Management - Relationship Management.

Unit V

Cyber Security - Basic concepts of threats, security policies- Security mechanisms- Data Security and protection concept - .Identifying a secure web site Https, lock symbol. Security Considerations - Digital Safety - Behavioral Cyber- Risk Management. -.Content Cyber. Risk Management. - Commercial and Community Cyber.Risk Manag

211ENG1306	COMMUNICATIVE ENGLISH	L	T	P	X	H	C
		3	0	2	3	8	5
Pre-requisite: Nil		**Course Category:** Foundation Core **Course Type**: Theory Course					

Objectives:

This course aims to impart better writing skills by sensitizing the learners to the dynamics of effective writing. To build up the learners confidence in oral and interpersonal communication by reinforcing the basics of pronunciation specially focusing on interviews / corporate meetings / international business travels.

Course Outcomes:

CO1: To improve and mould students interactive skills in different environments
CO2: To develop and improve students listening capacity
CO3: To enrich and understand students in speaking ability in different situations
CO4: To enhance students reading in through the text
CO5: To gain knowledge about written statements

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3		1										3	1	
CO2	3			2									3	1	1
CO3	3	1										1	3		
CO4	3	1	1										3		1
CO5	3	2	2									1	3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit – I Language in Professional context

Conversation - types of Conversation - steps involved in conversation - role of body language in conversation- face-to-face conversation - telephone conversation - telephone etiquette- telephone phrases- situational conversation - advantages and disadvantages - etiquettes of conversation.

Unit – II – Listening

Listening - types - techniques of effective listening – importance of active listening- barriers of listening - steps to effective listening - listening to the audio (including lyrics, telephone calls)- listening to the seminar (understanding the questions asked in seminar)- questioning skills & techniques- types of questions- question structure.

Unit – III – Speaking

Speaking - types - importance of speaking skill - fluency - self-introduction - on the spot topic - story telling - narrate any incident –story telling- Power Point Presentation- group discussion - debate.

Unit – IV – Reading

Reading - types - strategies of effective reading - skimming - scanning - reading the text - interpret the text - reading comprehension - cloze reading.

Unit – V – Writing

Writing - types - process of writing skill – general writing & professional writing- essay writing & paragraph writing- structure of an essay- blog writing- structure of blog writing- letter writing – formal & informal writing-giving instructions.

Text Books

1. Cambridge English: BEC Preliminary with answers. Cambridge University Press, New Delhi 2016.
2. Aruna Koneru, Professional Communication, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

Reference Books

1. Dr. A. Vimala, *Career Preparation and Talent Management*, Oviya Publication, Coimbatore
2. V. Shasikumar and P V Dhanija, *Spoken English*. Pub. By: Tata Mcgraw Hill, New Delhi
3. Mohan ,Krishna &MeeraBannerji . *Developing Communication Skills*. Macmillan India Ltd., Chennai. 2001.
4. Raman, Meenakshi & Sharma, Sangeetha. *Technical Communication*. Oxford University Press, 2011.

211MAT1304	BASIC STATISTICS	L	T	P	X	H	C
		2	0	0	3	5	3

Pre-requisite: Nil **Course Category:** Foundation Core
Course Type: Theory Course

Objective:
The objective of this course is to provide an understanding for the graduate student on statistical concepts to include data, measurements of location and dispersion, probability, correlation and regression

Course Outcomes:
Upon successful completion of this course, students will be able to
CO1: understand the concept of data and presentation of data
CO2: analyse statistical data using measures of central tendency
CO3: know the concept of various measures of dispersions
CO4: understand the basic concept of probability
CO5: calculate and interpret the correlation and regression between two variables

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1											3	1	
CO2	3	2	1	2									3		2
CO3	3	1	1										3	2	
CO4	3	1	2										3		1
CO5	3	2											3	2	

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Introduction to Statistics **15 Hours**
Definition of Statistics – Scope and Limitations of Statistics – Statistical investigation – Stages in conducting survey – Primary data vs Secondary data – Classification, Tabulation and presentation of data diagram (Simple problems on the above topics)

Unit II: Measures of Central Tendencies **15 Hours**
Measures of Central tendency definition; Types of averages, median, mode, Arithmetic mean, Geometric mean, Harmonic mean, Quadratic mean, Relation between mean, median and mode(Simple problems on the above topics)

Unit III: Measures of Dispersion **15 Hours**
Definition and properties of dispersion – Absolute vs relative measure of dispersion – Skewness, Kurtosis, Range, Quartile deviation, Mean deviation and Standard deviation (Simple problems on the above topics)

Unit IV: Introduction to Probability **15 Hours**
Definitions of Probability – Axioms on probability – Conditional probability (Simple problems on the above topics)

Unit V: Correlation and Regression **15 Hours**
Introduction – Types of correlation – Coefficient of Correlation – Rank Correlation – Regression – Principles of least square techniques – Fitting a straight line – Fitting a second-degree parabola (Simple problems on the above topics)

Text Books:

1. Arumugam and Issac, *Statistics*, New Gamma Publishers, July 2013.

2. A.M. Goon. M.K.Gupta and B.Dasgupta – Fundamentals of Statistics. Vol. I & II.

Reference Books:

1. S.C Gupta- Fundamental of statistics- Himalaya publishing house- 2014.

211CHY1101	ENVIRONMENTAL SCIENCE	L	T	P	X	H	C
		4	0	0	0	3	3

Pre-requisite: Basic Knowledge of Chemistry at the higher secondary curse level

Course Category: Foundation Core
Course Type: Theory Course

Course Outcomes:

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

CO1: Know the importance of environmental studies and methods of conservation of natural resources
CO2: Describe the structure and function of an ecosystem and explain the values and conservation of bio-diversity
CO3: Explain the sources, environmental effects and control measures of various types of pollutions
CO4: Select the appropriate methods for waste management
CO5: Recall social issues and legal provision and describe the necessities for environmental act

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		2									3		1
CO2	3	1	1										3	1	2
CO3	3	1	1	1									3	2	
CO4	2		2										3	1	
CO5	3			1									3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Natural resources **9 Hours**

Environmental Science: Definition, scope, importance and need for public awareness – Natural resources: forest resources, water resources, land resources, mineral resources, food resources and energy resources – Alternate renewable energy resources: Anaerobic digestion, Bio-gas production – Role of alternate renewable energy resources in environmental impact – Role of an individual in conservation of natural resources.

Unit II: Ecosystem and biodiversity **9 Hours**

Ecosystem: Concept of ecosystem and ecology, types of ecosystem, structure of ecosystem (biotic and abiotic components) – Function of an ecosystem: Energy and nutrient flow, biogeochemical cycle (C, N, S and O cycle), food chains, food webs and ecological pyramids.

Biodiversity: Definition, values of biodiversity – Hot spots of biodiversity – Threats to biodiversity – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit III: Environmental pollution **9 Hours**

Sources, consequences and control measures of air pollution, water pollution, soil pollution, thermal pollution and nuclear pollution – Environmental threats: Photochemical smog, London smog, acid rain, climate change, global warming (Greenhouse effect) and ozone layer depletion. – Pollution by trace elements (Hg, As, F, Pb and Cd): Biochemical effects, toxicology, toxicity, control and treatment – Fireworks: current environmental issues.

Unit IV: Management of environmental pollution **9 Hours**

Causes, effects, treatments methods and control measures of solid waste, municipal waste, biomedical waste, E-waste – Removal of heavy metals by adsorption methods: Zeolite process, Ion-Exchange process, ultrafiltration and reverse osmosis – Waste minimization techniques – Cleaner technology -- Disaster management: floods, earthquake, cyclone, landslides and Tsunami.

Unit V: Social issues and the environment **9 Hours**

Water conservation, rain water harvesting- Environmental impact assessment- Precautionary and polluters pay principle- environment protection act - air (prevention and control of pollution) act - water (prevention and control of pollution) act - Population explosion - Family Welfare Programmes - Environment and human health - Human Rights - Women and Child Welfare. Green Campus: Definition, need for green campus, room for improvement (waste water recycling and solar powered appliances).

Reference Books:

1. E.R. Nagarajan and A. Murugan, Environmental Science, Wiley Publishers, New Delhi, 2017
2. S.K. Dhameja, Environmental Engineering and Management, S.K. Kataria and Sons, New Delhi, 2015.
3. A. Kaushik and C.P. Kaushik, Environmental Science & Engineering, New Age international Publishers, New Delhi, 2010.
4. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., 2nd edition, 2004.
5. Erach Bharucha, Textbook for Environmental Studies, UGC, New Delhi, 2004.

211ENG1304	HUMAN VALUES	L	T	P	X	H	C
		2	0	0	3	5	3
Pre-requisite:		**Course Category:** Foundation Core **Course Type**: Theory Course					

Objectives:

- To know about universal human values and understand the importance of values in individual, social circles, career path, and national life.
- To learn from case studies of lives of great and successful people who followed and practised human values and achieved self-actualization.
- To become conscious practitioners of human values.
- To realise their potential as human beings and conduct themselves properly in the ways of the world.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Know about universal human values and understand the importance of values in individual, social circles, career path, and national life.

CO2: Learn from case studies of lives of great and successful people who followed and practised human values and achieved self-actualisation.

CO3: Become conscious practitioners of human values.

CO4: Realise their potential as human beings and conduct themselves properly in the ways of the world.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										3		3
CO2	3	1	1										3		
CO3	3	1											3	1	2
CO4	3	3											3	2	1
CO5	3	2	1										3	3	

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I

Values – Meaning and Definition – Types **–** Importance – Love & Compassion **:** Introduction – Meaning – Forms of Love – Love for self, Parents, Family, Friends, Spouse, Community, Nation, Humanity and other beings, both Living and Non living – Interrelation between Love & Compassion – Empathy – Sympathy – Non Violence – Practicing and non Practicing of Love and Compassion.

Unit II

Truth – Introduction – Meaning – Accuracy – Curiosity – discrement – Fairness – Fearlessness – honesty – honesty – integrity (unity of thought, word and deed) – Intution – Justice – Optimisim – Purity – Quest for knowledge – Reason - Self analysis – Sincerity – sprit of Enquiry – Synthesis – Trust – Truthfulness and determination – Practicing and Non Practicing of Truth.

Unit III

Non Violence – Introduction – Meaning – Need of Non Violence – Prerequisites for Non Violence – Ahimsa (Non Violence and Non- killing) – Values related to Non Violenck (Pshychological and Social) – Practicing and Non Practicing of Non Violence

Unit IV

Righteouseness – Introduction – Meaning – Righteouseness and dharma – Righteouseness and propriety – Values related to Righteouseness – Values related to Right Conduct or Righteouseness (Self help skills, Social skills and Ethical skills) – Practicing and Non Practicing of Righteouseness

Unit V

Peace and Services – Introduction – Meaning - Need of Peace – Peace vs harmony and balance – Attention – Calmness – Equality – Equanimity – Faithfulness – Focus – Gratitude – Happiness - humanity – Inner Silence – optimism – Patience – Selfconfidence – Self Control – Self discipline – Self Esteem – Self respect – Self Control – tolerence and Understanding – Practicing and Non Practicing of Peace

Services – Introduction and Meaning – Forms of Services – Service for Self, Parents, Family, Friend, Spouse, Community, Nation, Humanity and other beings—Living and Non-living, Persons in Distress or Disaster – Practicing and Non Practicing of Services.

Renunciation - Introduction – Meaning – Renunciation and sacrifice – Self restrain and ways of overcoming greed – Practicing and Non Practicing of Renunciation

Reference Books:

1. Joshi Rokeach (1973). The Nature of Human Values. New York: The Free Press
2. R S Nagarazan (2006) A text book of professional ethics and Human values, New age international publishers

PROGRAM CORE COURSES

212PHY2301	Mechanics and Properties of Matter	L	T	P	X	H	C
		4	0	4	0	8	6

Pre-requisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objectives

- To understand the basic concepts of mechanics and apply it to various physical problems.
- To analyse the different properties of matter

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Acquire fundamental knowledge in Newtonian mechanics of linear motion

CO2: Understand the basic concepts of rotational motion of bodies

CO3: Gain the knowledge of gravitational force between bodies including planets and understand the role of Kepler's laws in satellites

CO4: Analyze the elastic properties of the materials and its experimental verifications

CO5: Understand the concepts of viscosity and surface tension of liquids.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										3	3	2
CO2	3	3	1	1				1			1		3	3	1
CO3	3	2	1					1	1			1	3	2	
CO4	3	2	1	1		1				1			3	2	1
CO5	3	3	3	1	1	1	1			1		1	3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Motion **12 Hours**

Motion, Frames of Reference, Newton laws of motion, Friction, properties of friction, Drag force and terminal speed, Uniform circular motion. Centre of mass, Newton's second law for a system of particles, Linear momentum, Collision and impulse, conservation of linear momentum, Work and energy, Momentum and kinetic energy in collisions.

Unit II: Rotation **12 Hours**

Rotational variables, Relating the linear and angular variables, Kinetic energy of rotation, Moment of Inertia(Rod, circular disc, Solid Sphere) - Parallel and perpendicular axes theorem, Torque, Newton's second law for rotation, work and rotational kinetic energy, Newton's second law in angular form, conservation of angular momentum

Unit III: Gravitation **12 Hours**

Newton's law of gravitation, Gravitation near earth's surface, Gravitation inside earth, Gravitational field, potential and potential energy, Gravitational field and potential due to a solid sphere and spherical shell, Determination of G by Boy's experiment, Compound Pendulum-Planets and satellites: Kepler's laws, satellites: orbits and energy, motion of satellites, geostationary orbit.

Unit IV: Elasticity **12 Hours**

Definition, stress – strain, Elastic moduli-Hooke's law – Stress-strain diagram, Poisson's ratio – definition – limiting values – relation between q , n , k - Poisson's ratio - Twisting couple on a wire - Torsional pendulum (with and without weights) – determination of rigidity modulus of a rod by static torsion method - Bending of beams, Expression for Bending moment- Cantilever –

expression for depression – Experiment to find Young's modulus – Cantilever oscillation – expression for period – uniform bending – I form gird

Unit V: Viscosity and Surface tension **12 Hours**

Viscosity: Definition, Coefficient of Viscosity – stream lined motion & turbulent motion – Reynold's number and its significance – Poiseuilli's formula to determine (without correction for pressure head) – equation of continuity – Bernoulli's theorem (Statement only), Stoke's experiment with theory (dimension method).

Surface Tension: Molecular forces – Surface tension and surface energy– Excess pressure across a curved surface (special cases : spherical, cylindrical drop and bubble) – angle of contact – capillarity – ST determination by capillary rise - experiment to determine ST & IST by drop weight method.

Experiments **60 Hours**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
4. To determine the Elastic Constants of a Wire by Searle's method.
5. Determination of acceleration due to gravity (g) by Compound pendulum
6. Determination of Young's modulus by Non-uniform bending (Pin and Microscope method).
7. Determination of Young's modulus by Uniform bending (Optic lever method).
8. Determination of (i) Rigidity modulus of the given wire, (ii) Moment of inertia of the disc, by Torsional Pendulum.
9. To determine the Surface tension of the given liquid using Capillary rise method.
10. Experiment to determine coefficient of viscosity of low viscous liquid by Stoke's method.
11. To determine the Surface Tension of the given liquid using Drop weight method
12. To determine the viscosity of the given liquid by using Burette method
13. Determination of the thickness of the given glass plate using Single Optic lever

Text Books:

1. Principles of Physics, J.Walker, Davis Halliday, Robert Resnick, Wiley, 10th ed., 2016
2. Properties of Matter, R. Murugesan , S. Chand & Co. publication, 2016.

Reference Books:

1. Properties of Matter – Brijlal & N. Subrahmanyam – S. Chand & Co, 2002.
2. University Physics, FW Sears, MW Zemansky and HD Young13/e, Addison-Wesley 1986.
3. Mechanics Berkeley Physics course,: Charles Kittel, et. Al. 2007, Tata McGraw-Hill
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. Mechanics – D.S. Mathur – S. Chand & Co., - Reprint 2000
6. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
7. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
8. Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage LearningIndia Pvt. Ltd.
9. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

212PHY2302	Electricity and Magnetism	L	T	P	X	H	C
		4	0	4	0	8	6

Prerequisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objectives:

- To provide the students a firm understanding of the basics of Electricity and Magnetism.
- To introduce the students, the application of Electricity and Magnetism and Electromagnetism

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the fundamental concepts of static charges.
CO2: Understand the basic knowledge on current electricity.
CO3: Understand the basics of thermoelectricity
CO4: Understand the fundamentals of magnetism.
CO5: Apply the knowledge on electromagnetism in solving real world problems

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	1									3		1
CO2	3	2	2	1					1			1	3	2	2
CO3	3	2	2				1						3	1	1
CO4	3	2	2		1	1		2				1	3	2	1
CO5	3	2	3	1		1	1	1		1	1	1	3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Electrostatics **12 Hours**

Electric field-Gauss Law- Applications of Gauss Law: Electric field due to infinite wire, plane sheet, charged spherical shell and charged sphere-Electric potential energy-Electric potential-Electric potential due to a point charge-Equipotential surface-Electric dipole- Electric potential due to dipole-Electric field due to dipole-Torque on an dipole-Capacitors-Calculation of capacitance-Combinations of capacitors-Energy stored in capacitors-Parallel-plate capacitor with dielectric.

Unit-II: Current Electricity **12 Hours**

Electric current-Current density-Drift Speed-Ohm's Law-Temperature dependence of resistivity-Battery and EMF- Kirchhoff's Junction Law and Kirchhoff's Loop Law-Combinations of resistors-Wheatstone bridge-Potentiometer: Comparison of EMF's of two batteries-Internal resistance of a battery- Charging and discharging of capacitors-Atmospheric electricity.

Unit-III: Thermoelectricity

Joule's Law of heating-Verifications of Joule's Laws-Seebeck Effect-Peltier effect-Thomson effect-Origin of Thermoelectric effects-Experimental Laws of Thermoelectric circuits-Thermoelectric diagram-Applications of Thermoelectric effects-Electrolysis-Faraday's Laws of electrolysis-Verifications of Faraday's Laws-Voltameter-Primary and secondary cells: Daniel Cell, Leclanche Cell, Dry Cell, Lead Accumulator

Unit-IV: Magnetism **12 Hours**

Introduction-Magnetic field-Motion of a charged particle in a uniform magnetic field-Magnetic force on a current carrying wire-Torque on a current loop-Biot-Savart Law-Magnetic field due to current in a straight wire-Field due to circular current-Ampere's Law-Solenoid-Toroid

Magnetic Poles and Bar magnets-Torque on a Bar magnet placed in magnetic field-Magnetic field due to a Bar magnet- Terrestrial Magnetism- Tangent Galvanometer- Moving coil galvanometer-Deflection magnetometer- Determination of M and B_H

Unit V: Electromagnetic induction, Maxwell's equation and Alternating Current 12 Hours

Faraday's laws of electromagnetic induction, Lenz's law, origin of induced emf-Eddy current-Self-induction-Mutual induction-Energy stored in inductor-Transformer

Maxwell's Displacement Current-Maxwell's equations- Maxwell's equations in vacuum

Alternating Current-AC generator-Instantaneous and RMS current-Simple AC circuits: AC circuits containing only a resistor, only a capacitor and only a inductor's-Impedance-CR circuit-LR Circuit- LCR Circuit-Power in an AC circuits-Choke coil

Experiments **60 Hours**

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c)DC Current, and (d) checking electrical fuses.
2. Capacitors in series and parallel
3. Compare capacitances using De Sauty's bridge.
4. Potentiometer-compare two EMFs
5. Internal resistance of a cell
6. To determine a Low Resistance by Carey Foster's Bridge.
7. Determination of Thermo emf- direct method – BG
8. To study the Characteristics of a Series RC Circuit.
9. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b)Quality Factor
10. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and(b) Quality factor Q
11. Deflection magnetometer – m and BH – TAN C position
12. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
13. BG – Determination of absolute capacitance
14. B.G - Self-inductance - Anderson method.

Text Books:

1. Concepts of Physics, volume 2, H.C. Verma, Bharathi Bhavan Publishers, New Delhi, 2019
2. Electricity and Magnetism, R Murugesan, S. Chand & Co. 2011
3. Electricity and Magnetism, Brijlal and Subramaniam, S. Chand & Co. 1996

Reference Books:

1. Electricity and Magnetism, D. Purcell, F. Purecll and D. Morin, Cambridge University Press, 2013.
2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol. I, Oxford Univ. Press, 1991.
3. Introduction to Electrodynamics, David J. Griffiths, Prentice Hall, 1999.
4. Electromagnetism, Hilary D. Brewster, Oxford, 2010
5. Advanced Practical Physics for students, B. L. Flint & H .T. Worsnop, Asia Publishing House, 1971.
6. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, Kitab Mahal, New Delhi, 2011.
7. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted, Heinemann Educational Publishers, 1985.

212PHY2303	Thermal Physics and Statistical Mechanics	L	T	P	X	H	C
		4	0	4	0	8	6

Prerequisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objective:

This course aims to focus on the complete knowledge on thermodynamics and statistical mechanics

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Acquire knowledge on the fundamental laws of thermodynamics

CO2: Understand the basic principles of thermodynamic potentials and their relationships

CO3: Describe the basic knowledge on low temperature physics

CO4: Understand the fundamental concepts and laws in thermal radiation

CO5: Analyse the various distribution laws in statistical mechanics

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										3	2	1
CO2	3	3	2				1		1			1	3	3	1
CO3	3	2	2	1	1	1		1		1	1		3	3	3
CO4	3	2	2		1	1		1			1	1	3	3	3
CO5	3	3	3										3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Thermodynamics **12 Hours**

Thermodynamic systems - Zeroth Law- Concept of heat and work –Internal energy- First law of thermodynamics - Applications of First Law: General Relation between CP & CV - work done during isothermal and adiabatic processes - Reversible process – Irreversible process - Second law - Carnot's reversible engine - Concept of entropy - Third law of thermodynamics, - Entropy-temperature diagrams

Unit II: Thermodynamic Relationships **12 Hours**

Extensive and intensive variables - Thermodynamic potentials – their significance – Relation of thermodynamic potentials - Maxwell's thermodynamic relations & their applications - Clausius - Clapeyron Equation - Expression for Cp-Cv- TdS equations- Energy equations -Joule-Thompson cooling and its coefficient(μ)

Unit III: Low Temperature Physics **12 Hours**

Joule Thompson(Kelvin) expansion effect – Production of low temperature –Theory of Porous plug experiment – Liquefaction of gases– Linde's air liquefier - Adiabatic expansion process – adiabatic demagnetisation – Liquefaction of Helium and Hydrogen–Practical applications of low temperature – Refrigeration machine.

Unit IV: Radiation **12 Hours**

Radiation– Stefan's Boltzmann law– Experimental determination of Stefan's constant - Blackbody radiation, Distribution of energy in Black body spectrum - Derivation of Planck's law-Deduction of Wien's distribution law, Rayleigh-Jeans Law – Radiation Pyrometry – Solar constant.

Unit V: Statistical Mechanics **12 Hours**

Phase space, Macrostate and Microstate, Statistical Equilibrium - Probability theorems in statistical thermodynamics- Maxwell Boltzmann distribution - Ideal gas -Quantum statistics - Fermi-Dirac distribution - electron gas - Bose-Einstein distribution - photon gas - comparison of three statistics.

List of Experiments **60 Hours**

1. Specific heat of liquid - Newton's law of cooling.
2. Determination of the coefficient of thermal conductivity of a bad conductor by Lee's disc method.
3. Specific heat capacity of a liquid - Joule's calorimeter.
4. Determination of the temperature coefficient of resistance by Platinum resistance thermometer.
5. Measurement of Planck's constant using black body radiation.
6. Determination of Stefan's Constant.
7. Determination of the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
8. To study the phase change of a substance from liquid to solid by plotting the cooling curves using SciLab.
9. Determination of the coefficient of thermal conductivity of copper by Searle's Apparatus.
10. Study the variation of thermo emf across two junctions of a thermocouple with temperature.
11. Understand the probability distribution
12. Plot the characteristics of thermistor and hence find the temperature coefficient of resistance using SciLab.

Text Books:

1. Heat, Thermodynamics and Statistical Mechanics, Brijlal & Subramaniam, S. Chand Publication, 2012
2. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill.
3. Heat and thermodynamics by D.S. Mathur, Sultan Chand, 1978.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill.
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears &G. L. Salinger. 1988, Narosa
6. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
7. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
8. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.

212PHY2304	Waves and Optics	L	T	P	X	H	C
		4	0	4	0	8	6

Prerequisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objective: This course aims to expose the fundamental concepts of waves, optics and their applications.

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the behaviour of Harmonic oscillation and the concept of wave motion.
CO2: Analyse the basic concepts on sound wave and application of ultrasonics
CO3: Acquire the optical interference mechanism.
CO4: Apply the knowledge on creating the optical diffraction phenomena.
CO5: Understand the basic concepts of polarization phenomena.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2						1				3	3	2
CO2	3	2	2	1		1			1			1	3	3	2
CO3	3	2	2		1			1					3	3	2
CO4	3	2	2	1	1	1		2		1		1	3	3	2
CO5	3	2	2	1	1	1	1		1	1	2	2	3	3	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit-I: Harmonic Oscillation and wave motion **12 hours**

Simple harmonic oscillation- superposition of two mutually perpendicular harmonic oscillations 1) having equal frequencies 2) having different frequencies (lissajous figures.1:1 and 1:2 and their uses.

Wave motion -Mechanical Waves - Group Velocity and Pulse Dispersion. Wave Resonance - Wave Optics- Electromagnetic nature of light. -Huygens Principle. Temporal and Spatial Coherence. The Spherical wave – harmonic wave -superposition principle

Unit-II: Sound **12 hours**

Intensity and loudness of sound - Decibels – Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - Properties Melde's Experiment for the frequency of electrically maintained tuning fork – Transverse and longitudinal modes – Ultrasonics –Properties and application- Magnetostriction method, Piezo-electric oscillator

Unit-III: Interference **12 hours**

Principle of Superposition – Interference –Theory of interference - Young's Double slit experiments–Fresnel biprism – Experimental arrangement –Determination of wavelength of light-plane parallel film Interference due to reflected light-Variable thickness film(Air wedge) -– Theory of Newton's Rings - Michelson interferometer and its applications – Determination of wavelength and thickness of thin transparent sheet – Fabry-Perot interferometer-Determination of wavelength and difference in wavelength.

Unit-IV: Diffraction **12 hours**

Huygen–Fresnel's theory - Half period zones –Types of diffraction- Fresnel's diffraction – Diffraction at a circular aperture - straight edge –Fraunhofer diffraction at a single slit(calculus method)–Double slit– Missing order in a double slit - diffraction pattern– N slits (calculus method)- Plane diffraction grating with theory- Determination of N & amp; λ.

Unit V: Polarization **12 hours**

Polarization - Plane of polarization and vibration-Superposition of linearly polarized waves at right angles -Types of polarisation- Double refraction – Huygens explanation – Nicol prism Double image polarizing prism- Production and Detection of plane, partially, elliptically and circularly polarized lights –Quarter wave plate–Half wave plate–Babinet's compensator –Optical activity– Laurent's half shade polarimeter – Specific rotator power.

List of Experiments: **60 Hours**

1. To study Lissajous Figures
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.
3. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
4. To determine Dispersive Power of the Material of a given Prism using Mercury Light
5. To determine the value of Cauchy Constants of a material of a prism.
6. To determine the Resolving Power of a Prism.
7. To determine wavelength of sodium light using Fresnel Biprism.
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine the wavelength of Laser light using Diffraction of Single Slit.
10. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
11. To study the Polarization of Light by Reflection and to determine the Polarizing Angle for air-glass interface.
12. To determine the particle size by using LASER

Text books

1) Fundamentals of Waves & Optics, Shaweta Mohan (Author), T.S. Bhatia
2) Waves and Optics (Physics Paper-IV) B.Sc IV-Sem (O.U) 2021 SIA Publishers and Distributors Pvt LTD.

Books for reference:

1) Optics, Ajoy Ghatak, 3rd Edition, Tata McGraw Hill, New Delhi, 2005
2) Optics Fifth Edition Eugene Hecht, Pearson Education, 2017.
3) Wave optics- Suresh Garg, Sanjay Gupta, C.K.Gosh, PHI Learning Private Limited New Delhi-110001, 2012

212PHY2305	Analog Electronics	L	T	P	X	H	C
		5	0	2	0	7	6

Prerequisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objective:

This course aims to give exposure to the students on basic electronic components, devices and their applications

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of semiconductor diodes and special purpose diodes.

CO2: Understand the basics of characteristics transistors

CO3: Analyse the characteristics of transistor amplifiers

CO4: Design the different types of oscillators and multivibrator using transistors

CO5: Understand the basic concepts of Field effect Transistor and OP-Amp.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	1	1						1	3	1	1
CO2	3	2	2	1	1						1	1	3	1	1
CO3	3	3	2	2	1	1						2	3	2	3
CO4	3	2	3	3	3	2		2			2	3	2	3	3
CO5	3	1	1	3	2							1	3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Semiconductor diodes and Special purpose diodes **15 Hours**

Semiconductor Basics: P-type and N-type semiconductor - PN-Junction diode, characteristics of junction diode - Half wave rectifier-full wave bridge rectifier -Ripple factor-filters and their Types - Special purpose diodes: Zener diode - Zener as voltage stabilizer - Tunnel diode - Light Emitting Diode - Photo diode - Schottky diode – Varactor diode.

Unit II: Transistors **15 Hours**

Transistor – connections (CB,CE,CC)-Characteristics (CE only)-Comparison - Transistor load line analysis-operating points-transistor biasing and its essentials- stability factor-voltage divider bias-Midpoint Biasing -hybrid parameter - Determination of h-parameter - Equivalent circuit - Performance of linear circuit in h parameter – the h-parameters of a transistor – nomenclature for transistor h-parameters

Unit III: Amplifiers **15 Hours**

Classification of amplifier: Single stage transistor amplifier, transistor amplification and its graphical demonstration - Practical circuits of transistor amplifier-multistage amplifier -RC coupled amplifier-transformer coupled amplifier-direct coupled amplifier -comparison-performance of power amplifier-classification of power amplifier -feedback amplifier - principle of negative feedback amplifier-advantages of negative feedback-feedback circuit.

Unit IV: Oscillators and Multivibrators. **15 Hours**

Oscillators-oscillatory circuits-undamped oscillation from tank circuit-Explanation of Barkhausen criterion for self - Feedback requirements for oscillators - sustained oscillations - Hartley oscillator -Colpitts oscillator - RC Phase shift oscillator -Wien bridge oscillator -Crystal oscillator:

Piezoelectric crystals -Multivibrators: astable, monostable, bistable multivibrator,555-Timers (qualitative).

Unit V: Field Effect Transistors and OP AMP **15 Hours**

Introduction – Types of FETs – working principle of JFET– Output characteristics of JFET – Important terms– advantages of JFET – parameters of JFET– relation among JFET parameters - JFET Applications, JFET as an amplifier. MOSFET (Qualitative) - Operational amplifier and their Characteristics- OPAMP parameters - Inverting amplifiers – Non-inverting amplifiers - Applications: Addition, Subtraction, Integration and differentiation.

List of Experiments **30 Hours**

1. Full-Wave Rectifier with capacitance filter
2. Bridge Rectifier with filter circuit
3. Zener Regulated Power supply
4. Transistor Characteristics – CE mode
5. Single-stage amplifier – discrete components
6. Hartley Oscillator
7. Colpitt's Oscillator
8. Phase shift Oscillator
9. Astable multivibrator
10. FET characteristics
11. FET amplifier
12. OP-AMP applications - Adder, Subtractor, Integrator and Differentiator

Text Books:

1. Basic Electronics: Solid State, B.L.Theraja, S.Chand & Co., 2005.
2. Principles of electronics, V.K.Mehta & Shalu Mehta, S. Chand Publications, 8th Ed., 2003.
3. A TextBook of Practical Physics by M.N.Srinivasan, S.Balasubramanian, R.Ranganathan-Sultan Chand &Sons, 2007.

Reference Books:

1. A Textbook of Applied Electronics, R.S. Sheda, S.Chand & Co., 2003.
2. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, Tata Mc-Graw Hill, 2003.

212PHY3301	Solid State Physics	L	T	P	X	H	C
		4	0	4	0	8	6

Pre-requisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objective:

The aim of this course is to expose knowledge on the structural, electrical, magnetic and dielectric properties of materials.

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the structural behaviours of materials.
CO2: Understand the fundamental concepts of elementary lattice dynamics.
CO3: Learn the concepts of semiconducting properties of solids.
CO4: Understand and analyse the magnetic and dielectric properties of materials.
CO5: Get the basic theoretical knowledge on superconducting materials.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1		1			1		1		3	1	1
CO2	3	2	2	2		1			2				3	2	1
CO3	3	2	2	1		2		1	2	1		1	3	2	2
CO4	3	2	1	2	1	1	1		1		1	1	3	2	1
CO5	3	2	1	2	1	2		1	1		1	1	3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Crystal Physics **12 Hours**

Lattice Points and Space Lattice - Basis and Crystal Structure - Unit Cell and Primitive Cell - Direction, Plane and Miller indices - d-spacing – Bravais Lattice - Crystal systems - Simple Cubic, BCC, FCC and HCP Crystal Structures; Diamond, Zinc Blende, Sodium Chloride, Caesium Chloride Structures; Imperfections in crystals (qualitatively).

Unit II: Elementary Lattice Dynamics **12 Hours**

Lattice Vibrations and Phonons: Linear Monatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Specific Heat; Classical Theory (Dulong and Petit's Law) (qualitatively); Einstein theory and Debye's theories of specific heat of solids; T^3 law.

Unit III: Semiconductor physics **12 Hours**

Band Gaps - Conductors, Semiconductors and insulators - Carrier concentration of Intrinsic Semiconductor, Carrier concentration P and N type Semiconductors - Conductivity of Semiconductors for Different Temperature, mobility - Hall Effect (Theory and Experiment).

Unit IV: Magnetic and Dielectric Properties of Materials **12 Hours**

Dia, Para, Ferri and Ferromagnetic Materials - Classical Langevein Theory of dia and Paramagnetic Domains - Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains.

Polarisation - Various Polarisation mechanisms in dielectrics: electronic, ionic, orientation and space charge polarization - Internal field or Local field; Clausius-Mossotti relation - Classical Theory of Electric Polarisability - Langevein-Debye equation.

Unit V: Superconductivity **12 Hours**

Super Conductivity – Superconducting Materials – Meissner Effect - Properties of Superconductors: (Meissner Effect; Thermal properties; Energy Gap; Isotope Effect; Mechanical Effects; penetration Depth) - Type I and Type II Superconductors - London Equation and Penetration depth - BCS Theory -High Temperature Superconducting Oxides – Technological Applications.

List of Experiments **60 Hours**

1. Particle Size determination.
2. Band gap energy of a semiconducting Crystal (Ge) by four probe methods (from room temperature to 150° C).
3. Verification of Newton's law of cooling.
4. Specific heat capacity of solid.
5. Hall coefficient of a semiconductor sample.
6. Measurement of Dielectric Constant of a liquids dielectric Materials with frequency
7. Measurement of susceptibility of paramagnetic solution (Quincke's Tube Method).
8. To draw the B-H curve of iron using a Solenoid and determine the energy loss from Hysteresis.
9. To measure the Magnetic susceptibility of Solids.
10. To determine the Resistance of semiconducting materials using Four probe method.
11. To determine the refractive index of a dielectric layer using SPR.

Text Books:

1. Solid State Physics, S.O. Pillai, 6th Ed., 2012, New age International Publishers.
2. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
3. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Reference Books:

1. Elements of Solid-State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
2. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
3. Elementary Solid-State Physics, 1/e M. Ali Omar, 1999, Pearson India
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
5. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi.
6. Elements of Solid-State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

212PHY3302	Spectroscopy	L	T	P	X	H	C
		4	0	4	0	8	6

Pre-requisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objective:

This course aims to focus on the complete knowledge on the fundamentals of spectroscopy and its wide range applications.

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Gain basic knowledge on the principles, theory and applications of microwave spectroscopy.
CO2: Apply the principles, theory and applications of infrared spectroscopy
CO3: Gain the knowledge on Raman spectroscopy
CO4: Get knowledge about fundamentals of UV-Visible spectroscopy
CO5: Acquire the detailed knowledge in NMR and ESR spectroscopy

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1			1						3	2	2
CO2	3	3	2	2	1			1	1	1			3	2	2
CO3	3	3	2	2	1			1	1	1	1		3	3	2
CO4	3	2	2	2	1	1		1			1	1	3	3	2
CO5	3	3	3	2		1				1			2	2	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Microwave Spectroscopy **12 Hours**

The rotation of molecules – Rotational spectra – Diatomic molecules – Rigid molecule – Intensities of spectral line – isotopic substitution – Non-rigid rotator – Polyatomic molecules – Techniques and Instrumentation – Chemical analysis

Unit II: Infrared spectroscopy **12 Hours**

Vibrating diatomic molecule – Diatomic vibrating rotator –Vibration – Rotation spectrum of Carbon Monoxide – Breakdown of the Born-Oppenheimer approximation – Vibration of Polyatomic molecules – Analysis by infra-red techniques - Techniques and Instrumentation

Unit III: Raman Spectroscopy **12 Hours**

Classical theory & Quantum theory of Raman scattering – Pure rotational Raman spectra – Vibrational Raman spectra – Polarization of Light and the Raman effect – Structure determination from Raman and IR spectroscopy - Techniques and Instrumentation – Near IR – FT Raman spectroscopy

Unit IV: UV-Visible Spectroscopy **12 Hours**

Vibrational coarse structure – Vibrational analysis of band systems – Deslanders table – Progressions and sequences – Franck-condon principle – Rotational fine Structure of electronic vibration spectra –photoelectron spectroscopy – Instrumentation – information from photoelectron spectra

Unit V: NMR and ESR spectroscopy **12 Hours**

NMR: Magnetic properties of nuclei – resonance condition – NMR instrumentation – relaxation systems – Bloch equations – chemical shift.

ESR: Principle – ESR spectrometer – Hyperfine structure – ESR spectra of Hydrogen atom- Comparison of NMR & ESR

List of Experiments

1) IR Spectral Analysis of (a) diatomic and (b) triatomic molecules a) O2, CO, NO etc. b) CO2, NO2, H2O etc.
2) IR Spectral Analysis of the following functional groups with examples a) Hydroxyl groups b) Carbonyl groups c) Amino groups d) Aromatic groups
3) Identification of simple organic compounds (methane, ethane, benzene, etc.) by IR spectroscopy.
4) Raman Spectral Analysis of (a) diatomic and (b) triatomic molecules a) O2, CO, NO etc. b) CO2, NO2, H2O etc.
5) Raman Spectral Analysis of the following functional groups with examples a) Hydroxyl groups b) Carbonyl groups c) Amino groups d) Aromatic groups
6) Identification of simple organic compounds (methane, ethane, benzene, etc.) by Raman spectroscopy.
7) Study the 200-500 nm absorbance spectra of samples (water, ethanol, glycerol etc.) and determine the max values.
8) From the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.
9) Determination of band gap from the absorption spectra using Tauc's plots.
10) Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
11) Identification of simple organic compounds by NMR spectroscopy (Spectra to be provided).
12) Identification of simple organic compounds by ESR spectroscopy (Spectra to be provided).
13) Verification of Beer-Lambert's law (Virtual lab)
14) Determination of the Molar Absorptivity of a Light Absorbing Molecule (Virtual lab)
15) To understand the basic principle of Electron Paramagnetic Resonance Spectroscopy (Virtual lab).

Text Books:

1) Molecular structure and spectroscopy, G. Aruldhas, second edition, practice - Hall of India, Pvt Ltd., New Delhi - 110001, 2007.
2) Fundamentals of molecular spectroscopy, C.N. Banwell, Tata McGraw Hill Publishing Co. Ltd., 3rd Edition, 1972.
3) Spectroscopy (Atomic and Molecular) - G.R Chatwal and S.K Anand, Himalaya Publishing House, 2016.

Reference Books:

1) Vibrational spectroscopy, D. N. Sathyanarayana, New Age International, 2004.
2) Introduction to Atomic Spectra, H.E. White, Mc-Graw Hill, 1934.
3) NMR, NQR, EPR and MÖssbauer Spectroscopy in inorganic chemistry - R.V. Parish, Ellis, Harwood, 1991.
4) Atomic Physics - J.B. Rajam, S. Chand & Co., 1966.
5) Basic principles of spectroscopy - Chang Raymond, McGraw Hill, 1970.
6) Electron Spin Resonance Elementary Theory and Practical Applications- John E. Wertz and James R. Bolton, Chapman and Hall, 1986.
7)

212PHY2101	Atomic Physics	L	T	P	X	H	C
		4	0	0	0	4	4

Prerequisite: Nil **Course Category:** Program Core
Course Type: Theory

Objective: To understand and study the structure of an atom, its energy states, and its interactions with other particles and with electric and magnetic fields.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: This course will provide basic behaviour of atoms in materials physics

CO2: Acquire the knowledge about different types properties of the materials

CO3: Able to make atom calculations to show that he/she understood the atoms electron structure at the deeper level

CO4: To make familiarity with theory concepts and working methods within atomic physics.

CO5: Be able to use relevant measurement equipment and be able to evaluate experimental results for applications.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	2		1			1		1	3	3	3
CO2	3	2	1	1	2		1		1		1		3	3	3
CO3	3	2	2	1	1								3	3	3
CO4	3	1	3	3	3	2		1	1			1	3	3	3
CO5	3	1	3	3	3	2		1		1	1		3	3	3

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I : Discharge Phenomenon Through Gases and Photo-electric Effect **12 hours**

Moving of a charge in transverse electric and magnetic fields - specific charge of an electron - Dunnington's method - positive rays – Aston's , Dempster's mass spectrographs. Richardson and Compton experiment - Laws of photoelectric emission - Einstein photoelectric equation - Millikan's experiment - verification of photoelectric equation - photo electric cells – photo emissive cells - photovoltaic cell - photo conducting cell - photomultiplier.

Unit II: Atom model **12 hours**

Introduction - Bohr atom model (no derivation) - Excitation and ionization of atoms - Sommerfeld relativistic atom model – Elliptical orbits – Fine structure of spectral lines – Vector atom model-Quantum numbers associated with vector atom model-Coupling Schemes-Pauli's exclusion principle – electronic configuration of elements and periodic classification – magnetic dipole moment of electron due to orbital and spin motion – Bohr magneton - Stern and Gerlach experiment.

Unit III: Fine structure of spectral lines **12 hours**

Spectral terms and notations – Selection rules – intensity rule and interval rule – Fine Structure of sodium D lines – Alkali spectra – Fine structure in Alkali spectra – Spectrum of Helium – Zeeman effect – Larmor's theorem – Debye's quantum mechanical explanation of the normal Zeeman effect – Anomalous Zeeman effect – theoretical explanation, Lande's 'g' factor and explanation of splitting of D_1 and D_2 lines of sodium. Paschen-Back effect - Stark effect (qualitative study only).

Unit IV: X-Rays **12 hours**

X-Rays – Production of X-rays-Absorption of X-rays - Bragg's Law – Bragg's X-ray spectrometer – origin and analysis of continuous X-ray spectrum and characteristic X-ray spectrum – Moseley's law and its importance – Compton effect –derivation of expression for change in wavelength – its experimental verification.

Unit V: Lasers **12 hours**

Basics principles of LASER: Absorption, Spontaneous and Stimulated emission – population inversion – pumping schemes - two level – three level lasers - Einstein coefficients – Rate equations for two level and three level lasers - different types of lasers – Nd:YAG laser – Semiconductor lasers – Applications of lasers – holography and others applications.

Text Books:

1. Atomic and Nuclear Physics, Brijlal and Subrahmanyam, S. Chand Publications, 1999
2. Modern Physics, R. Murugesan, S. Chand Publications, 2003.
3. An Introduction to laser: Theory and Applications by M. N. Avadhanulu, S. Chand and Co., New Delhi, 2001.

Reference Books:

1. Modern Physics, Sehgal and Chopra, Sultan Chand & Co., 2000.
2. Nuclear Physics, D. C. Tayal, Himalaya Publishing House, 5th edition, 2020
3. Atomic Physics, J.B.Rajam, S. Chand Publications, 2002.
4. Fundamentals of Modern Physics, Duggal and Chhabra, Shobanlan Nagin, Chand & Co., 1997.
5. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, Asia Publishing House, 1971.
6. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted, Heinemann Educational Publishers, 1985.
7. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, Kitab Mahal, New Delhi, 2011.

212PHY3101	Nuclear and Particle Physics	L	T	P	X	H	C
		4	0	0	0	4	4

Prerequisite: Nil **Course Category:** Program Core
Course Type: Theory

Course Objective:

To give the student a brief introduction to the nuclear and particle physics, by explaining the fundamental concepts, properties, processes and Applications

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the fundamental properties of nuclei.

CO2: Gain knowledge about various nuclear models.

CO3: Understand various types of decay processes.

CO4: Understand the nuclear process through various nuclear reactions, and gain knowledge about various types of particle accelerators.

CO5: Understand the fundamental concepts and interactions of elementary particles

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	1					1				3	3	1
CO2	3	3	2			1			1			1	3	2	2
CO3	3	3	2	1	2	2				1		1	3	2	1
CO4	3	3	2		2	2	1	2	1	2	1		3	2	2
CO5	3	3	2	1	2	1	1				1	1	3	2	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit-I: General Properties of Nuclei **12 hours**

Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excited states

Unit-II: Nuclear Models **12 hours**

Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force

Unit-III: Decays **12 hours**

Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. β-decay: energy kinematics for β- decay, positron emission, electron capture, neutrino hypothesis. Gamma decay: Gamma rays emission & kinematics, internal conversion – Safety measurements in Gamma radiation.

Unit-IV: Nuclear Reactions and Particle Accelerators **12 hours**

Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering)

Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear

accelerator, Cyclotron, Synchrotrons

Unit-V: Particle physics **12 hours**

Particle interactions; basic features, types of particles and its families - Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Iso-spin, Strangeness and charm, concept of quark model, color quantum number and gluons.

Text Books:

1. Nuclear Physics, D. C. Tayal, Himalaya Publishing House, 5th Edition, 2020

Reference Books:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
5. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
7. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
8. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)

212PHY3102	Classical Mechanics	L	T	P	X	H	C
		4	0	0	0	4	4

Pre-requisite: Nil **Course Category:** Program Core
Course Type: Theory

Course Objective:

The course deals with the advanced concepts of mechanics. It gives a good understanding of Lagrangian mechanics, conservation principles, oscillations and waves, gravitation, central force, scattering, rigid body etc. They are also exposed to small amplitude oscillations

Course Outcome:

At the end of the course, students will be able to

CO1: classify the types of constraints and describe the constrained motion;
CO2: formulate the Lagrange's equations of motion and describe Hamilton's principle;
CO3: articulate the Kepler's laws and arrive at equations of motion using Hamilton's equations;
CO4: explain Poisson and Lagrange's brackets and describe rigid body dynamics; and
CO5: apply the theory of small oscillations and find normal modes of coupled oscillations.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2									3	3	2	3	3
CO2	3	3	2	1			1				3	2	2	3	3
CO3	3	3	2	1	1	1			1	3	2		2	2	3
CO4	3	2	2	2		1	1	1		3	2		1	2	3
CO5	3	3	3	1	1		1	1	1	3	3		1	3	3

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Review of Newtonian Mechanics and Constrained Motion 12 hours

Frames of reference - inertial and non-inertial frames - Mechanics of a particle - Motion under constant, time- dependent, velocity dependent forces. Motion of charged particle in Magnetic field - System of particles: centre of mass – conservation of linear and angular momentum - kinetic energy for a system of particles - Energy conservation of system of particles. Constraints – Holonomic – Non-holonomic constraints – Scleronomous and Rheonomous constraints

Unit II: Lagrangian Formulation and Variational Principle 12 hours

Generalized coordinates - degrees of freedom - configuration of space - Lagrange's equations – Kinetic energy in generalized coordinates - generalized momentum - first integrals of motion - and cyclic coordinates - velocity dependent potential - dissipative force - Newtonian and Lagrangian formalisms. Variational Principle: Hamilton's principle-deduction of Hamilton's principle-Lagrange's equation from Hamilton's principle

Unit III: Central force Motion and Hamiltonian Formalism 12 hours

Reduction to one-body problem-general properties of central force motion effective potential classification of orbits-Motion in a central force field inverse square law of force-Kepler's laws-laws of gravitation from Kepler Scattering in a central force field. Hamiltonian formalism: The Hamiltonian of system- Hamilton's equations of motion-Hamilton's equations from variational principle-Integrals of Hamilton's equations

Unit IV: Canonical Transformations, Poisson Brackets and Rotational motion 12 hours

Canonical transformations-Poisson brackets-Poisson bracket and integrals of motion-the canonical invariance of Poisson bracket-Lagrange's brackets - Degrees of freedom of a free rigid body,

Angular momentum and kinetic energy of rigid body - Principal moments of inertia, products of inertia, the inertia tensor - Euler equations of motion for a rigid body - Torque free motion of a rigid body.

Unit V: Small oscillations **12 hours**

Small oscillations of mechanical system: Introduction, types of equilibria, Quadratic forms of kinetic and potential energies of a system in a equilibrium, General theory of small oscillations, secular equation and Eigenvalue equation, small oscillations in normal coordinates and normal modes, examples of two coupled oscillators, vibrations of a linear triatomic molecule.

Text Books:

1. G.Aruldhas, *Classical Mechanics***,** PHI Learning Private Limited, 2013.
2. Introduction to classical mechanics – R.G.Thakwale and P.S.Puranik (Tata-McGraw Hill).
3. Classical Mechanics of Particles and Rigid Bodies: K. C. Gupta

Reference Books:

1. J. C. Upadhyaya, *Classical Mechanics*,HimalayaPublishing House.
2. K. SankaraRao, *Classical Mechanics,* PHI Learning Private Limited, 2011
3. H. Goldstein, *Classical Mechanics*,Narosa Publishing Home, New Delhi
4. Mechanics: L . D. Landau and E. M. Lifshitz
5. Introduction to Classical Mechanics: R. G. Takwale and Puranik.
6. Introduction to Classical Mechanics: N. C. Rana and P. Joag.

212PHY2102	Energy Physics	L	T	P	X	H	C
		4	0	0	0	4	4
Prerequisite: Nil		**Course Category:** Program Core **Course Type**: Theory					

Objective:

To make the students understand the present day energy crisis, the need for conserving energy and alternatives are provided.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the existence of different forms of energy, by which it can be produced and utilized. It also illustrate the need, variety of Renewable energy sources and its concepts

CO2: Understand the concepts of solar energy, production and its utilization

CO3: Understand the theoretically and practically to the utilization of Non-conventional technologies related to wind and Ocean Energy.

CO4: Energy harvesting by Biomass and Biogas, Geothermal and Hydrothermal Energy can be understand well.

CO5: Understand the new concepts of other energy conversion system and its applications.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3				2							3	2	
CO2	3	2	2			2							3	3	1
CO3	3	2	2	2						2		1	3		2
CO4	3	2	1		1		1			2		1	3		2
CO5	3	2	3	2	2		1	1	1		1		3	2	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I Conventional and Non-conventional Energy Sources **12 Hours**

Conventional Energy Sources:- Introduction and limitation of Coal – Oil – Gas – Agriculture And Organic Wastes – Water Power – Nuclear Power – thermal Power. **Non-Conventional Energy Sources**: - Solar Energy – Wind Energy – Energy From BioMass And Biogas – Ocean Energy – Tidal Energy – Geo-Thermal Energy – Other renewable energy sources: Piezoelectric – Electromagnetic – Fuel cell -Advantages Of Renewable Energy.

Unit –II Solar Energy and its utilization **12 Hours**

Origin of Solar Energy - Principle of conversion of solar energy into heat - Classification of solar collectors: Flat plate and concentrating collectors, construction, Thermal efficiency and coating, Heat losses. Photo thermal Devices: Solar cooker, Solar dryer, solar hot water systems- Principles and Working. Photovoltaic Systems: Solar cell and its efficiency, P.V. Panels - Solar lantern, Water Pumps and Street lights- Principles and Working

Unit-III Wind and Ocean Energy **12 Hours**

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Biomass.

Unit IV Biomass and Biogas, Geothermal and Hydrothermal Energy **12 Hours**

Energy from biomass and biogas: Energy from biomass: Biomass conversion technologies – wet and dry process – Photosynthesis. Biogas generation: Introduction – basic process and energetic- Advantages of anaerobic digestion- factors affecting digestion and generation of gas – biogas from waste fuel – properties of biogas – utilization of biogas. **Geothermal Energy:** Geothermal Resources, Geothermal Technologies. **Hydro Energy:** Hydropower resources, hydropower technologies, environmental impact of hydro power sources

Unit V Energy from other renewable sources: 12 Hours

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, piezoelectric parameters and modelling piezoelectric generators, piezoelectric energy harvesting applications. **Electromagnetic Energy Harvesting:** (a) Linear generators (b) Carbon captured technologies, cell, batteries, and power consumption. **Fuel cell:** Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells.

Text Books

1. Non-conventional energy sources, G.D Rai, Khanna Publishers, 4th Edition, New Delhi (2005)

Reference Books:

1. Energy Technology: Nonconventional, Renewable & Conventional, S. Rao, Khanna Publishers (2005)
2. John Twidell and Tony weir, Renewable energy resources, Taylor and Francis group, London and New york, 2005.
3. Solar energy, principles of thermal collection and storage by S.P. Sukhatme 2nd
4. Edition, Tata McGraw-Hill publishing co. Ltd., New Delhi, 1997
5. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rd Edn., Oxford University Press, 2012.
6. Photovoltaics, J.Balfour, M.Shaw and S. Jarosek, Lawrence J Goodrich (USA)
7. E. W. Golding . E and F. N. Spon The Generation of Electricity by wind power, Cambridge University Press, London (1955)
8. L. L. Freris : Wind energy conversion systems, Prentice hall, NewYork.(1990)

212PHY3303	Quantum mechanics	L	T	P	X	H	C
		3	0	2	0	5	4

Pre-requisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objective:

This course aims to make the students understand the basics of quantum physics and its applications.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand and analyse the time dependent Schrodinger wave equation.

CO2: Understand and analyse the time independent Schrodinger wave equation.

CO3: Learn the basic concepts on bound states in an arbitrary potential

CO4: Understand and apply the Schrodinger wave equation to solve the hydrogen-like atoms.

CO5: Understand the quantum mechanics concepts in many electron atoms.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3										3	2	
CO2	3	3	2						1				3	2	2
CO3	3	2	2	2			1					1	3	2	1
CO4	3	2	2			1				1	1	1	3	3	2
CO5	3	2	2	1	1	1	1	1	1	1	1		3	3	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Basics of Quantum Mechanics **9 Hours**

Origin of Quantum theory, Black body Radiations, Photoelectric effect, Laws of photoelectric emission, Ritz combination principle, Planck's radiation - Wave particle dualism for light and matter De Broglie's Wave and Uncertainty Principle: superposition Principle- two slit experiment, wave Velocity and group velocity, Heisenberg uncertainty Principle

Unit II: Time dependent Schrodinger equation **9 Hours**

Introduction; Time dependent Schrodinger equation; Properties of Wave Function - Interpretation of Wave Function - Probability density and probability current density in three dimensions; Normalization. Eigenvalues and Eigen functions - Position, momentum & Energy operators - commutator of position and momentum operators - Expectation values of position and momentum - Wave Function of a Free Particle.

Unit III: Time independent Schrodinger equation **9 Hours**

Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wave packet for a free particle in one dimension; Position-momentum uncertainty principle.

Unit IV: General discussion of bound states in an arbitrary potential **9 Hours**

Continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem – square well potential; Quantum mechanics of simple harmonic oscillator – energy levels and energy eigen functions using Frobenius method.

Unit V: Quantum theory of hydrogen-like atoms **9 Hours**

Time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wave functions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells (idea only).

List of Experiments for practical **30 Hours**

***Use C/C++/Scilab for solving the following problems based on Quantum Mechanics Like* List of Experiments:**

1. Calculate the probability that a particle in a one-dimensional box of length L can be found between 0.4 L to 0.6 L for the (a) ground state, (b) first excited state, (c) second excited state.
2. Think of the nucleus as a cubical box of length 10^{-14} m. Compute the minimum energy of a nucleon confined to the nucleus. Given: mass of a nucleon = 1.6 x 10^{-27} kg.
3. Solving Schrödinger equation for an electron in one dimensional region using SciLab.
4. An electron of energy 100 eV is passed through a slit of width 10^{-6} m. Estimate the uncertainty introduced in the angle of emergence.
5. Calculate the uncertainty in the momentum of a proton confined in a nucleus of radius 10^{-14} m. From this result, estimate the kinetic energy of the proton.
6. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$$\frac{d^2y}{dr^2} = A(r)u(r),\ A(r) = \frac{2m}{\hbar^2}[V(r) - E]$$

   For the anharmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$$

   for the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c2, k = 100 MeV fm-2, b = 0, 10, 30 MeV fm-3 In these units, cħ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

7. Solve the s-wave radial Schrodinger equation for an atom:

$$\frac{d^2y}{dr^2} = A(r)u(r),\ A(r) = \frac{2m}{\hbar^2}[V(r) - E]$$

   Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

$$V(r) = -\frac{e^2}{r}e^{\frac{-r}{a}}$$

   Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wave function. Take e = 3.795 (eVÅ)1/2, m =

0.511x106eV/c2 , and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

8. The Hα line of the Balmer series is obtained from the transition from n = 3 (energy = – 1.5 eV) to n = 2 (energy = – 3.4 eV). Calculate the wavelength for this line.
9. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$$\frac{d^2y}{dr^2} = A(r)u(r),\ A(r) = \frac{2m}{\hbar^2}[V(r) - E] \text{ where } V(r) = -\frac{e^2}{r}$$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 $(eVÅ)^{1/2}$, ħc = 1973 (eVÅ) and m = 0.511x106eV/c2.

10. The energy of the ground state of a hydrogen atom is –13.6 eV. Find the energy of the photon emitted in the transition from n = 4 to n = 2.
11. To find the eigenvalues and plot the corresponding eigen functions of the hydrogen atom.
12. Calculate the three lowest energy levels (in eV) for an electron inside a one-dimensional infinite potential well of width 2Å. Also determine the corresponding normalized eigen functions. Given mass of electron m = 9.1 x 10^{-31} kg, h = 1.05 x 10^{-34}Js, 1 eV = 1.6 ¥ 10^{-19} J.

Laboratory based experiments:

13. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
14. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
15. To study the quantum tunnelling effect with solid state devices, e.g. tunnelling current in backward diode or tunnel diode.

Text Books:

1. A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, McGraw Hill, 2nd Ed., 2010.
2. Quantum Mechanics, G. Aruldhas, PHI Learning of India, 2nd Ed., 2002.

Reference Books:

1. Quantum Mechanics, Robert Eisberg and Robert Resnick, Wiley, 2nd Ed., 2002.
2. Quantum Mechanics, Leonard I. Schiff, Tata McGraw Hill, 3rd Ed., 2010.
3. Quantum Mechanics, Bruce Cameron Reed, Jones and Bartlett Learning, 2008.
4. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Publications.
5. Numerical Recipes in C: The Art of Scientific Computing, W.H.Press et al., 3rd Edn., 2007, Cambridge University Press.
6. Elementary Numerical Analysis, K.E.Atkinson, 3 r dEdn. , 2007, Wiley India Edition.
7. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
8. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB:Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer ISBN: 978-3319067896
9. Scilab by example: M. Affouf 2012 ISBN: 978-1479203444
10. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand and Company, New Delhi ISBN: 978-8121939706
11. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing ISBN: 978-6133459274A

212PHY2306	Digital Electronics	L	T	P	X	H	C
		3	0	2	0	5	4

Pre-requisite: Nil **Course Category:** Program Core
Course Type: Integrated Course

Objective:

This course aims to provide knowledge on the principles and design of digital circuits.

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the binary number systems.
CO2: Apply the basics arithmetic circuits.
CO3: Design the decoder, encoder and comparator
CO4: Design the circuits on flip flops and various types of Registrars
CO5: Understand the circuits of various counters and A/C and D/C converters

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3		2			1	1					3	1	
CO2	3	3		2			1	1					3	1	
CO3	1	3	1	2	1				2	1	1	1	2	2	1
CO4	1	2	3	3	2			1	2	1	1	2	2	1	2
CO5	1	1	3	3	2			1	2	1		1	3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit-I: Number Systems and Logic Gates **9 Hours**

Introduction to number systems, Inter conversions, BCD code, Excess – 3 code, Gray code – One's and two's complements –arithmetic operations, Binary subtraction using one's and two's complements – Positive and negative logic – Basic and derived logic gates, symbols and their truth tables – AND, OR, NOT, NAND, NOR, XOR, and XNOR – Universality of NAND and NOR gates.

Unit-II: Boolean Algebra and Simplification of Logic Expressions **9 Hours**

Boolean algebra, Basic laws of Boolean algebra, De-Morgan's theorems Reducing Boolean expressions using Boolean laws, SOP and POS forms of expressions minterms and maxterms, Karnaugh map simplification.

Unit-III: Data Processing Circuits **9 Hours**

Adders: Half and Full adders – Subtractor: Four bit adder- Subtractor. Multiplexers, Demultiplexers, Decoders: 1-of-16 Decoder, BCD-to-decimal Decoders, Seven-segment Decoders, Encoders: Decimal to binary, Decimal to BCD, Octal to binary and Priority Encoders, Exclusive - OR Gates, Parity checker, Parity generator, Magnitude comparator, Programmable Array Logic, Programmable Logic Arrays

Unit-IV: Flip-Flops and Registers **9 Hours**

Flip-flops: RS Flip Flop, Clocked RS Flip Flop, D Flip Flop, JK Flip Flop, JK Master/Slave Flip Flop, T Flip-flop. Shift Register, Types of Shift Registers – Serial in-Serial out – Serial in-Parallel out – Parallel in –Serial Out – Parallel in Parallel out

Unit-V: Counters **9 Hours**

Counters- Binary ripple counter- - Synchronous and Asynchronous Counters, Mod-3 and mod-6 counters, Decade Counters. D/A converters (Ladder type), A/D Converter (Counter type)

List of Experiments **30 Hours**

1. Logic gates using discrete components
2. NAND, NOR as universal gates
3. Half adder and Full adder – Using NAND/NOR gates.
4. Half subtractor and full subtractor
5. Verification of De-Morgan's theorems
6. RS, T Flip flops using NAND gates only
7. JK Flip Flop
8. Shift Register
9. Simplification of Boolean expression using Karnaugh map.
10. Multiplexer
11. Demultiplexer
12. Decoder
13. Encoder
14. A/D converter (R-2R Ladder Type)
15. Ring counter

Text Books

1. Digital Principles and Application, A.P. Malvino, D.P.Leach, IV Edition, McGraw Hill, New Delhi, 1986.

References

1. Digital Fundamentals, V.Vijayendran, S.Viswanathan, Printers & Publishers Private Ltd, Chennai, 2004.
2. Digital design- M Morris Mano PHI., 2013.
3. Digital Electronics, W.H.Gothmann, Prentice Hall of India, Pvt, New Delhi 1996

212PHY2103	Astronomy and Astrophysics	L	T	P	X	H	C
		4	0	0	0	4	4

Pre-requisite: Nil **Course Category:** Program Core
Course Type: Theory

Objective: To give the student an introduction to the different physical phenomena happening in the Universe, formation of celestial objects, and their activities.

Course Outcomes:

Upon successful completion of this course, students will be able to
CO1: Understand the tools for space observation.
CO2: Understand the fundamentals of astronomy.
CO3: Understand the properties of the Sun, activities in the Sun and their planets.
CO4: Understand the evolution of stars and their life cycle.
CO5: Understand the galaxies and the expansion of the universe with theoretical models.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1		1	1	1	2		2	1	3	2	3
CO2	3	2	1	1		1	1		2		2	1	3	2	3
CO3	3			1		1	1		2		2	1	3	2	3
CO4	3	2		1		1	1		2		2	1	3	2	3
CO5	3	1		1	1	1	1	1	2	1	2	1	3	2	3

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I Tools for Astronomy **12 Hours**

Basic optical definitions for astronomy: Magnification, light gathering power, resolving power and diffraction limit - Elements of the telescope-Properties of images - Kinds of Optical telescopes-Refracting and Reflecting telescopes- Telescope mountings - Radio telescope- Hubble space telescope- Spectrograph – limitations – Photographic photometry – Photoelectric photometry-Spectrophotometry-Detectors and image processing.

Unit II Positional Astronomy **12 Hours**

Astronomical distance, mass and time scales – Brightness, Radiant flux and luminosity – Measurement of astronomical quantities (Stellar parallax, Stellar radii, Masses of stars, stellar temperature) –Celestial Sphere, Astronomical Coordinate Systems(Geographical Coordinate Systems, Horizon System, Equatorial System) - Measurement of Time(Sidereal Time, Apparent Solar Time, Mean solar time) – Equation of time – Calendar - Kepler's laws of planetary motion – Newtonian gravitation.

Unit III The Sun and Celestial bodies **12 Hours**

Solar Parameters, Solar Atmosphere, Photosphere, Chromosphere. Corona, Solar Activity - Sunspot cycle-Butterfly diagram - Solar wind- Auroras-Solar prominences-Coronal mass ejections (CMEs) – Solar flares - Basics of Solar Magneto-hydrodynamics. Helioseismology-**The solar family** (Solar System: Facts and Figures - Terrestrial and Jovian planets - Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extrasolar Planets - Asteroids- Meteoroids-Comets.

Unit IV The Universe of Star **12 Hours**

Atomic spectra revisited - Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification - Birth of star – Fusion in

stars: CNO cycle, Heavy element fusion, Pressure temperature thermostat – Stellar structure – Energy transport – Stellar models – Main-sequence stars – Life of a main sequence star - Supernova explosion-White Dwarfs- Black holes-Neutron stars-Pulsars.

Unit V Galaxies and cosmology **12 Hours**

Galaxy nomenclature-Types of Galaxies-Spiral-Elliptical-irregular galaxies- Milky Way and its structure-Galactic clusters – Differential Galactic rotation-Rotation and Mass distribution-Rotation curve and doppler shift - Cosmological models-Big bang theory-Steady State theory-Hubble's law-Olber's paradox-Interstellar extinction-Dark matter.

Text Books:

1. Michael A. Seeds, Dana E. Backman , Astronomy: The Solar System and Beyond, Sixth Edition, Brooks/Cole, Cengage Learning, 2010.
2. Baidyanath Basu, An introduction to Astrophysics, Prentice Hall of India, New Delhi.Second Edition, 2010.
3. Mujiber Rahman, Concepts of Astrophysics, Scitech Publications (India) Pvt. Ltd 2018.

Reference Books:

1. Bradley W. Carroll Dale A. Ostlie, Introduction to Modern Astrophysics, 2nd ed., Pearson International, 2014.
2. H. Karttunen et al. Fundamental of Astronomy, Fifth Edition, Springer, 2007.
3. M. Zeilik and S. A. Gregory, Introductory Astronomy and Astrophysics, 4th Edition, Saunders College Publishing, 1998.

GENERIC ELECTIVE COURSES

213MAT1101	MATHEMATICS I - FUNDAMENTALS OF CALCULUS	L	T	P	X	H	C
		4	0	0	3	4	4

Pre-requisite: Nil **Course Category:** Generic Elective
Course Type: Theory

Objective:

To enable the students to acquire the basic knowledge of differentiation and complex variables

Course Outcomes:

Upon successful completion of this course, the students will be able to

CO1: know about the differentiation and its applications.
CO2: understand the fundamental concepts of partial differentiation
CO3: know about the idea on definite integrals and reduction formulae
CO4: apply the concept and consequences of differential equations
CO5: study about analytic functions and bilinear transformation

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3		2								1	3	2	1
CO2	2		1	1									3		
CO3		2		1									3	1	
CO4	3		2	3									3		1
CO5	3	2	1	3								1	3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Simple Applications of Differentiation **9 Hours**

Radius of Curvature, Centre of curvature of Plane Curves - Involute and Evolute

Unit II: Fundamental Concepts Of Partial Differentiation **9 Hours**

Partial Differentiation -Homogeneous functions and Euler's Theorem

Unit III: Integration **9 Hours**

Definite integrals, Reduction formulas for sinnx, cosnx, secnx, cotnx, cosecnx, and sinmx.cosnx and simple problems

Unit IV: Differential Equation **9 Hours**

Exact differential equations- second order equations- second order equations with right hand side in the forms x^n, e^{ax}, sin ax, cosax, e^{ax}sin bx, e^{ax}cosbx, $e^{ax}x^n$

Unit V: Complex Variables **9 Hours**

Analytic function – C. R. Equations (without proof) – Bilinear Transformation, Cross Ratios.

Text Books:

1. S. Arumugam, Ancillary Mathematics, Paper I, New Gamma Publishing House, Reprint 2002.
2. S. Arumugam and Thangapandi, Issac, Ancillary Mathematics PaperIII, New Gamma Publications,2003.

Reference Books:

1. Narayanan &ManickavasagamPillai, Differential Equations, S.V. Publication – Reprint, 2003.

2. P.DuraiPandian, Lakshmi DuraiPandian& D. Muhilan, Complex Analysis, Emerald Publishers, 1995.
3. S.Arumugam,A.TangapandiIsaac,A.Somasundaram.Mathematics for Engineers,Scitech Publications Pvt.Limited,Chennai2008

213MAT1102	MATHEMATICS II - PRINCIPLES OF HIGHER CALCULUS	L	T	P	X	H	C
		4	0	0	3	4	4

Pre-requisite: Nil **Course Category:** Generic Elective
Course Type: Theory

Objective:

To empower the students to understand the fundamental concepts of partial differential equations; double and triple integrals; vector calculus; Fourier Series and Laplace transform and apply them to solve real life problems.

Course Outcomes:

Upon successful completion of this course, the students will be able to

CO1: construct partial differential equation and apply Lagrange's form for the given physical problems.

CO2: evaluate multiple integrals for regions in the plane and also to find area of the region bounded by curves and to find volume, surface area, Mass, C.G and M.I of solid geometric figures

CO3: understand the central concepts in multivariable analysis, directional derivative; gradient; multiple integrals; line and surface integrals; vector fields; divergence and curl

CO4: find the Fourier series representation of a function of one variable and to find half-range Fourier series for even/odd functions

CO5: solve ordinary differential equations using Laplace transform.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3											1	3	1	2
CO2		2	3										3		1
CO3	3	2		1									3	2	
CO4	3	1	2										3	1	1
CO5	3	2	1									1	3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit-I: Partial Differential Equations **9 Hours**

Partial differential equations – Formation of partial differential equations – Lagrange's equation – some standard forms

Unit-II: Multiple Integrals **9 Hours**

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variable between Cartesian and polar – Area as double integral – Triple integration in Cartesian, cylindrical and spherical polar coordinates – Volume as triple integral.

Unit-III: Vector Calculus **9 Hours**

Vector differential operators, Gradient, Divergence, curl and their simple properties - Directional derivatives-Solenoidal -Irrotational vectors.

Unit-IV: Fourier Series **9 Hours**

Fourier series-Trigonometric Series – Even and odd functions – Half range Fourier series

Unit-V: Laplace Transform **9 Hours**

Laplace transform-Inverse Laplace Transformation-Solution of differential equations using Laplace Transforms

Text Books:

1. S. Arumugam, Ancillary Mathematics, Paper I, New GammaPublications,2002
2 S. Arumugam, Ancillary Mathematics, Paper II, New Gamma.Publications,2002.
3. S. Arumugam and Thangapandi, Issac, Ancillary Mathematics PaperIII, New Gamma Publications,2003.

Reference Books:

1. Narayanan &ManickavasagamPillai, Differential Equations, S.V. Publication – Reprint,2003.
2. P.DuraiPandian, Lakshmi DuraiPandian& D. Muhilan, Complex Analysis, Emerald publishers,1995.

213CHY1301	CHEMISTRY - I	L	T	P	X	H	C
		3	0	2	0	5	4

Pre-requisite: Basic knowledge of Chemistry at the higher secondary course level

Course Category: Generic Elective
Course Type: Theory

Course Outcome:

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

CO1: Understand the atomic and molecular structure.
CO2: Analyze the equilibrium reactions and apply distribution law for several applications
CO3: Establish the relation between electron density of an organic molecule and mechanism of formation
CO4: Analyze the mechanism of formation of products in general organic reactions
CO5: Predict the stereochemistry different organic molecules

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	2									3		
CO2	3	1	1									2	3	1	1
CO3	3	3	2			1					1		3	1	
CO4	3	1	1	1									3		1
CO5	3	3	2	1			1		1			1	3	2	3

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit-1: Atomic and molecular structure **9 Hours**

Dual behaviour of matter and radiation, Schrodinger equation, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations (s, p & d). Molecular Orbital Theory: Rules for the LCAO method, bonding and antibonding MOs. MO treatment of homonuclear and heteronuclear diatomic molecules viz., H_2, O_2, N_2, CO, NO and NO^+. Molecular orbitals of diatomic molecules (Hydrogen, nitrogen, oxygen, carbon monoxide and nitric oxide) and plots of the multicentre orbitals. Crystal field theory and the energy level diagrams for transition metal ions (iron and Ni) and their magnetic properties.

Unit-2: Chemical equilibria **9 Hours**

Spontaneity of a reaction – Standard free energy change – Chemical equilibrium: Thermodynamic derivation of Law of Mass Action – van't Hoff reaction isotherm: Derivation of integrated van't Hoff equation – Equilibrium constant: K_p, K_c and K_x and its relation – Homogeneous equilibria: Dissociation of dinitrogen tetroxide, phosphorous pentachloride, formation of sulphur trioxide from sulphur dioxide

Le Chatelier's Principle: Concept and application on selected physical and chemical equilibria

Nernst distribution law: Concept, association of solute, dissociation of solute in solvents – Application of Nernst distribution law

Unit-3: Fundamentals of organic chemistry **9 Hours**

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting *pKa* values. Aromaticity: Benzenoids and Hückel's rule.

Unit-4: Organic reaction mechanism **9 Hours**

Introduction to reactions involving substitution (S_N1, S_N2, S_Ni, S_NAr, benzyne, halogenation, sulphonation, nitration, Friedel Crafts alkylation and acylation), addition (Electrophilic and nucleophilic), elimination (E1

and E2), cyclization (Diels Alder) and ring opening (Epoxide). Synthesis (conventional and green routes) of commonly used drug molecules (aspirin and ibuprofen).

Unit-5: Stereochemistry **9 Hours**

Representations of 3-D structures, structural isomers and stereoisomers, configurations. Symmetry and chirality, enantiomers, diastereomers, optical activity, polarimetry, absolute configurations and conformational analysis of ethane, propane, butane and cyclohexane. Geometrical isomerism in alkenes. CIP rule: E-Z nomenclature and R-S configuration.

Laboratory component: **30 Hours**

1. Determination of Fe (III) ion in the given complex by spectrophotometric method
2. Preparation of coordination compound
3. Preparation of Buffer solution and measuring the pH of the solution
4. Determination of strength of weak organic acid by conductivity or volumetric method
5. Purification of organic compounds by chromatography techniques
6. Separation of organic compounds in a binary mixture by solvent switch method
7. Separation of organic compounds in a binary mixture by solvent switch method
8. Separation of organic compounds in a binary mixture by solvent switch method
9. Separation of organic compounds in a binary mixture by solvent switch method
10. Separation of organic compounds in a binary mixture by solvent switch method
11. Estimation of unsaturation in the given compound
12. Synthesis of a polymer / drug (Bakelite / Urea-formaldehyde / Aspirin)

Organic compounds containing monofunctional group will be analyzed. General compounds which can be analyzed are aldehydes, alcohols, amines, sugars, esters, amides, urea and thiourea.

Note: Any ten experiments with atleast two per unit will be covered.

Reference Books:

1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, Vishal Publishing House, 2020.
2. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2019.
3. B. R. Puri, Madan S. Pathania and L. R. Sharma, Principles of Physical Chemistry 47th edition, Vishal Publishing Company 2020.
4. Paula Yurkanis Bruice, Organic Chemistry, 8th edition, Pearson Education, 2013.
5. Morrison Boyd and Bhattacharjee, Organic Chemistry, 7th edition, Pearson Education, 2010.
6. Arun Bahl and B.S. Bahl, A Textbook of Organic Chemistry, 22nd edition, S Chand Publishing, 2019.
7. V. Venkateswaran, R. Veerasawamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S.Chand and Sons, 2017.
8. Mann and Saunders, Practical Organic Chemistry, 4th edition, Pearson Education, 2009
9. B.S. Furnis, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell,Vogel's Textbook of Practical Organic Chemistry, 5th edition, Pearson Education, 2003

213CHY1302	CHEMISTRY - II	L	T	P	X	H	C
		3	0	2	0	5	4

Pre-requisite: Basic knowledge of Chemistry at the higher secondary course level

Course Category: Generic Elective
Course Type: Theory

Course Outcome:

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

CO1: Apply the concept of phase equilibria in laboratories and other related fields.
CO2: Explain the concept of emf and its variety of applications
CO3: Analyze the physical and chemical properties of s-block elements
CO4: Analyze the physical and chemical properties of p-block elements
CO5: Understand the fundamentals and theories of chemical kinetics

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3										1	3		
CO2	3	2	1	1									3	1	1
CO3	3	1	2	1								1	3	1	1
CO4	3	1			1	1			1				3	1	1
CO5	3	2	1	1		1	1				1		3	3	

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit-1: Phase equilibrium **9 Hours**

Phase Equilibria: Concept of phases, components and degrees of freedom – Derivation of Gibbs phase rule for reactive and non-reactive systems. Phase diagram of one component (water, sulphur and carbon dioxide) and two-component (Ag-Pb, Bi-Cd and KI-H_2O) systems. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions.

Unit-2: Electrochemistry **9 Hours**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Standard Hydrogen Electrode (SHE). Standard electrode potential. Electrochemical series. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

Unit-3: Chemistry of s-block elements **9 Hours**

General characteristics of group I elements: Atomic and ionic radii, ionization enthalpy, electropositive character, formation of univalent positive ions, hydration of ions, reducing properties, Electrode potentials, characteristic flame coloration, lattice enthalpy, general physical and chemical properties, uses of alkali metals.

General characteristics of group II elements: Atomic and ionic radii, ionization enthalpy, reducing properties, electrode potentials, characteristic flame coloration, chemical properties, gradation in properties. Uses of alkaline earth metals.

Unit-4: Chemistry of p-block elements **9 Hours**

General characteristics of p-block elements (Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electro negativity, Catenation). Comparative study of elements of III A & their compounds. Compounds of boron – borazine, diborane boric acid. Allotropy of Carbon; inert pair effect, diagonal relationship between B and Si Compounds of nitrogen and phosphorous – NH_3, $NH_2.NH_2$, N_3H, N_2O_5, NO_2 H_3PO_4, HPO_3 $POCl_3$, PCl_3, PCl_5. Chemistry of oxides of carbon (CO, CO_2).

Unit-5: Chemical kinetics **9 Hours**

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated rate laws for first, second and fractional order reactions, pseudo unimolecular reactions, determination of the order. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

Laboratory component: **30 Hours**

1. Construction of phase diagram: Naphthalene-Biphenyl
2. Construction of phase diagram: Urea-Benzoic acid
3. Potentiometric redox titration
4. Potentiometric acid-base titration
5. Simple salt analysis (Salt - 1)
6. Simple salt analysis (Salt - 2)
7. Mixture of salts – 1 (Combination of 2 cations & 2 anions**)**
8. Mixture of salts – 1 (Combination of 2 cations & 2 anions**)**
9. Mixture of salts – 1 (Combination of 2 cations & 2 anions**)**
10. Mixture of salts – 1 (Combination of 2 cations & 2 anions**)**
11. Kinetics of ester hydrolysis-Comparison of acid strengths
12. Kinetics of ester hydrolysis

Note: Any ten experiments with atleast two per unit will be covered.

Reference Books:

1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, Vishal Publishing House, 2020.
2. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2019.
3. B. R. Puri, Madan S. Pathania and L. R. Sharma, Principles of Physical Chemistry 47th edition, Vishal Publishing Company 2020.
4. V. Venkateswaran, R. Veerasawamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S.Chand and Sons, 2017.
5. Amita Dua, Navneet Manav, Practical Chemistry for Undergraduates, Ane Books Pvt. Ltd., 2014.
6. Shailendra K. Sinha, Physical Chemistry-A Laboratory Manual, Narosa publishing house, 2014.

DISCIPLINE SPECIFIC ELECTIVE COURSES

213PHY3101	Microprocessor and Microcontroller	L	T	P	X	H	C
		3	0	0	3	6	4

Pre-requisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Theory

Objective:

The aim of this course is to give thorough understandings of the functioning of the microprocessor 8085 and also provide them with basic skills in developing assembly language programs.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the designing of the microprocessor architecture µP 8085

CO2: Get the basic knowledge on address & data bus, Opcodes and addressing modes of µP

CO3: Learn the different types of instruction sets and programing of µP 8085

CO4: Understand the internal structure, various flags and addressing modes of µC 8051

CO5: Learn about internal architecture, I/O port and memory organization of µC 8051

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	1		1			1		3	3	1	1
CO2	3	2	1	1	1		1					2	3	2	2
CO3	2	2	2	1	1	1	1			1		2	3	1	1
CO4	3	3	2	3	2	1	2	1	1	2		2	3	2	1
CO5	3	2	1	3	1		2	1	1	2	1	3	3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Microprocessors 8085 architecture **9 Hours**

Introduction- evolution of microprocessors –CPU- input device – output device-memory–RAM, ROM, EPROM, Non-volatile RAM-Microprocessor architecture 8085 and its operations- ALU-timing and control unit – registers

Unit II: Buses, Op-codes and addressing modes **9 Hours**

Data and address bus – pin configuration – Intel 8085 instructions – Opcodes and operands – instruction word size-Introduction - addressing modes – direct addressing mode – register, register indirect, immediate, implicit addressing modes–status flags – symbols and abbreviations.

Unit III: 8085 instructions and Programming **9 Hours**

8085 instructions – data transfer group – arithmetic group – logical, branching groups –I/O and machine control group. Stack operations, subroutine, call and return instructions- Timing diagrams-assembly language–8-bit addition–8-bit subtraction.

Unit IV: Microcontroller of 8051 **9 Hours**

Introduction, different types of microcontrollers, embedded microcontrollers, Assembly Programming–The Program Counter and ROM–Data Types and-Directives–Flag Bits and PSW Register–Register Bank and Stack–Loop and Jump Instructions – Addressing Modes.

Unit V: 8051 Microcontroller architecture **9 Hours**

Architectural block Diagram, Pin diagram and Pin Functions, General Purpose and Special Function Registers, Oscillator and clock circuit, Reset circuit, I/O Port circuits, Memory organization, Internal program and data memory.

List of Experiments for X-components

1. Addition of two 8-bit numbers (Sum 8 Bit)
2. Addition of two 8-bit numbers (Sum 16 Bit)
3. 1's complement of 8-bit number/2's complement of 8-bit number
4. Find the largest number in the data array
5. Ascending order /Descending order
6. Square and rectangular W/f generator using microprocessor 8085
7. DC motor control using microprocessor 8085
8. Stepper motor control using microprocessor 8085
9. LCD module Display using microprocessor 8085
10. A/D Convertor using microprocessor 8085
11. Arithmetic and Logical Programs in 8051
12. Key Interface with 8051
13. Stepper Motor Interface with 8051

Text Books:

1. Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing (India) LTD, 2013.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2nd Edition, Pearson Education, 2006.
3. B.Ram, Fundamentals of Microprocessor & Microcomputer, Danpat Rai Publications, 2008.

Reference Books:

1. A. Mathur, 'Introduction to Microprocessor' Third Edition, Tata McGraw-Hill Publishing Co. Ltd., 1993.
2. Mazidi,E. and Mazidi,F., The 8051 Microcontroller And Embedded Systems, Prentice Hall of India (2004) 2nd ed.

213PHY2301	Mathematical physics	L	T	P	X	H	C
		3	0	2	0	5	4

Prerequisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Integrated Course

Objective:

This course aims to enable the students to apply the mathematical concepts in physics
Course outcomes

Course Outcomes:

Upon successful completion of this course, Students will be able to
CO1: Understand the basic concepts of Fourier series to solve the physical problems
CO2: Analyse the concepts of vectors towards physical problems
CO3: Understand the knowledge on beta and gamma functions
CO4: Learn the basic concepts on partial differential equation and numerical methods
CO5: Analyse the complex variables towards solving the real world problem

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2							3	3	3	3	1
CO2	3	3	3	1			1				2	3	2	3	1
CO3	2	3	1	2	1	1					2	2	2	1	1
CO4	3	3	3	2			1		1	1	3	3	3	2	3
CO5	3	3	3	2	1	1	1	1			3	3	3	3	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Fourier series **9 hrs**

Periodic functions. Fourier transform Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions.

Unit II: Vectors **9 hrs**

Vectors. – Addition and subtraction of vectors- properties of addition of vectors- Products for two vectors- scalar or dot product – cross product- vector product expressed as a determinant, - vector product of three vectors- scalar product of four vector and vector product of four vector, Gradient, div, curl vectors – orthogonal curvilinear coordinates

Unit III: Some Special Integrals **9 hrs**

Gamma function, transformation of Gamma function, Beta function, Evaluation of Beta function, Transformation of beta function, Relation between Beta and Gamma Functions. Dirac delta function, Legendre, Bessel, Hermite and Laguerre Differential Equations, Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality.

Unit IV: Partial Differential Equations **9 hrs**

Introduction to differential equations, **Partial Differential Equations** -Method of separation of variables for solving second order partial differential equations, Form of two-dimensional Laplace differential equation in Cartesian coordinates and its solution, Three-dimensional partial differential equation in Cartesian coordinates and its solution, Applications of Partial Differential

Equations - The differential equation of progressive wave and its solution, Equation of Vibrating String, One Dimensional Heat Flow, Two-Dimensional Heat Flow

Unit V: Complex Analysis **9 hrs**

Brief Revision of Complex Numbers and their Graphical Representation. Argant diagram, Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula, Cauchy residue theorem.

List of Experiments for practical **30 hrs**

List of Experiments:

1. Introduction to Scilab
2. Simple pendulum experiment to explain the periodic motion
3. Full wave rectifier for production of sine waves
4. Calculating and plotting Fourier Series by Scilab
5. Vector addition by force table
6. Parallelogram Triangle law of vectors by Grave sand apparatus
7. Scilab plot for Legendre function
8. Scilab plot for Bessel function
9. Standing Waves On A Stretched String
10. Solution of differential equations by Scilab
11. Representation complex number by Scilab
12. Addition and subtraction of Complex numbers by Scilab

Text Books:

1. Mathematical physics, H.K.Dass, S. Chand publications, 2009.
2. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
3. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Pvt. Ltd.
4. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill.

Reference Books:

1. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
2. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
3. An Introduction to Ordinary Differential Equations, Earl A Coddington, 1961, PHILearning.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Essential Mathematical Methods, K.F. Riley and M.P. Hobson, 2011, CambridgeUniversity Press
6. Numerical Recipes in C++: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.
7. A first course in Numerical Methods, Uri M. Ascher and Chen Greif, 2012, PHI.
8. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn ., 2007, Wiley India Edition.
9. Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.

213PHY3302	Materials Science	L	T	P	X	H	C
		3	0	2	0	5	4

Prerequisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Integrated Course

Objective:

The aim of this course is to make students to understand the characteristics of different types of materials and their applications

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the internal atomic arrangement of atoms in crystals
CO2: Acquire the knowledge on the properties and applications of Nanomaterials
CO3: Learn the basic characteristics and applications of advanced materials
CO4: Analyse the different mechanical behaviour of materials
CO5: Understand the different techniques to characterize the materials

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	1										3	2	2
CO2	3	3	1			1				1			3	2	1
CO3	3	3	2	1						1			3	3	1
CO4	3	2	2	1	1		1	1				1	3	2	2
CO5	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Crystal Structure **9 Hours**

Crystallography–Crystal systems- Symmetry, Scattering factor, Structure factor - Examples of Crystal structures- Bonding of solids -Imperfections in crystals- 1D, 2D and 3 Dimensional defects (No derivation) - Crystal growth- Czochralski method.

Unit II: Nano Materials **9 Hours**

Introduction to Nanomaterials- Quantum confinement- Classification of Nanosystems- synthesis of nanomaterials – Ball milling, CVD, Sol gel techniques, Green synthesis - Properties of nanomaterials– Carbon based nanomaterials (Graphene & CNT) - Application of nanomaterials

Unit III: Advanced Materials **9 Hours**

Metallic glass and its applications – Biomaterials– Ceramic materials- Piezoelectric materials- Nuclear engineering materials- SMART materials – Conducting polymers- Photonics materials and their applications.

Unit IV: Mechanical Behaviour of Materials **9 Hours**

Different mechanical properties of engineering materials – creep – Fracture technological properties – factors affecting mechanical properties of material-Heat treatment-cold and hot working-types of mechanical tests- metal forming process deformation of metals-Deformation of crystals and polycrystalline materials.

Unit V: Materials Characterization **9 Hours**

Structural Analysis: X-ray diffraction methods - Morphology: Scanning electron microscopy (SEM), Transmission Electron Microscopy (TEM) – X-ray Photoelectron Spectroscopy XPS - Atomic Force Microscope- Thermal Analytical Techniques: differential thermal analysis and thermo gravimetric analysis (TG and DTA)- UV-Vis Spectroscopy

List of Experiments **30 Hours**

1. Analysis of powder X-ray spectrum for BCC structure
2. Analysis of X-ray spectrum for FCC structure
3. Analysis of Scherer's formula for a given X-ray spectrum
4. Ferroelectric curie temperature measurement
5. Computer simulations for Brilloun zones for high symmetry cases
6. To measure the Dielectric Constant of a dielectric Materials with frequency
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. Computer simulations for Fermi surfaces for high symmetry cases
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four probe methods (from room temperature to 150° C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Text Books:

1. M.N. Avadhanulu, *Material science,* S.Chand & Company, New Delhi, 2014.
2. M.Arumugam, *Material science,* Anuradha publishers, 2010.
3. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Reference Books:

1. V. Raghavan, *Material Science and Engineering* , Prentice Hall India.,2004.
2. V. Rajendran, *Material Science*, Tata McGraw Hill Ltd, New Delhi,2001.
3. Introduction to Solid State Physics, C. Kittel, 8th Ed., 2004.
4. H. Willard, L. Merritt, J. Dean, Wadsworth Publishing Company, 7th Ed., 1988.
5. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi.
6. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

213PHY2302	Communication Physics	L	T	P	X	H	C
		3	0	2	0	5	4

Prerequisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Integrated Course

Objective:

This course aims to disseminate knowledge to the students on various communication systems

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the transmission and reception modes in radio communication
CO2: Learn the basics of fibre optic communication systems
CO3: Understand the communication mechanisms of RADAR
CO4: Learn the concepts and components of satellite communication systems
CO5: Understand the basic concepts of mobile communication systems.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	2				2	2	2	3	3	2	3
CO2	2	2	2	1	1	1			2	1	1	2	3	3	2
CO3	3	1	2	2	1			1	3	2	2	2	2	2	1
CO4	2	2	2	2	1		1		2	2	3	2	3	2	2
CO5	3	3	2	3	2	1	1	1	2	2	2	2	3	3	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Radio transmission and reception **9 Hours**

Transmitter-modulation-need for modulation- types of modulation amplitude, frequency and phase modulation- modulation factor-Radio broadcasting, Transmission and Reception. Amplitude modulation and Its Limitations – frequency modulation-Demodulation- Block diagram of AM and FM Transmitter. Receiver- demodulation-AM & FM radio receivers-super heterodyne radio receiver.

Unit II: Fiber Optic Communication **9 Hours**

Introduction –structure of optical fibre –total internal reflection in optical fibre – principle and propagation of light in optical fibre - acceptance angle – numerical aperture – types of optical fibers based on material – number of modes – refractive index profile - fiber optical communication system (block diagram) - fiber optic sensors – Temperature sensor – fiber optic endoscope.

Unit III: Radar Communication **9 Hours**

Basic radar system -Radar range –Antenna scanning – Pulsed radar system – Plan position indicator- Tracking radar- Moving target indicator- Doppler effect-MTI Principle- CW Doppler Radar- Frequency modulator CW Radar-Detection of signal in Noise-Radar Cross Section of Targets.

Unit IV: Satellite Communication **9 Hours**

Introduction – history of satellites – satellite communication system – satellite orbits – classification of satellites – types of satellites – basic components of satellite communication – constructional features of satellites- multiple access – communication package – antenna- power source – satellite foot points- satellite communication in India.

Unit V: Mobile Communication **9 Hours**

GSM – mobile services- concept of cell – system architecture – radio interface – logical channels and frame hierarchy – protocols – localization and calling – Handover- facsimile (FAX) – application – VSAT (very small aperture terminals) – Modem – IPTV (internet protocol television) – Wi-Fi - 3G (Basic ideas only).

List of Experiments for practical **30 Hours**

1. Amplitude Modulation and Demodulation
2. Frequency Modulation
3. Pulse Amplitude Modulation
4. Pre-emphasis and De-emphasis
5. Pulse width modulation
6. Measurement of propagation or attenuation loss in optical fiber.
7. Measurement of the Numerical Aperture (NA) of the fiber.
8. Performance analysis of Half wave dipole antenna
9. Performance analysis of Loop antenna
10. Performance analysis of Yagi-Uda antenna

Text Books:

1. Anokh Singh and Chopra A.K., *Principles of Communication Engineering*, S. Chand & Company PVT. Ltd., 2013.
2. Mehta V.K. and Rohit Mehta, *Principles of Electronics*, S. Chand & Company Ltd., 2020

Reference Books:

1. Mehta V.K. and Rohit Mehta, *Principles of Electronics*, S. Chand & Company Ltd., 2020.
2. Mani P., *A textbook of Engineering Physics-II*, Dhanam Publications, Chennai- 42, 2014.
3. Poornima Thangam I, *Satellite communication*, Charulatha Publications, 2012.
4. Dennis Roddy and John Coolen, *Electronic Communication*, PHI, 1990.
5. William C.Y. Lee, *Mobile Cellular telecommunication* (second edition), Tata Mcgraw hill, 1995.
6. Anokh Singh and Chopra A.K., *Principles of Communication Engineering*, S. Chand & Company PVT. Ltd., 2013.

213PHY3101	Biomedical Instrumentation	L	T	P	X	H	C
		4	0	0	0	4	4

Prerequisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Theory

Course Objectives:

- To make the student familiar with different instruments in the medical field, their working and their applications.

Course outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the basics of cardiographic instruments.

CO2: Understand the principles of artificial organs, and their applications.

CO3: Understand the principles and working of biomedical instruments

CO4: Understand about the safety measurements and radiation safety instrumentation.

CO5: Understand the biochemical measurements and biosensors.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2										3	3	
CO2	3	2	2			1			1	1		1	3	1	1
CO3	3	3	1		1		1						3	2	2
CO4	3	3	1	1	1	3	1	1	1		1		3	2	2
CO5	3	3	1	2	1	2	1	1	1	1		1	3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Cardiographic instruments **12 Hours**

Electro - Cardiography (ECG) - Electrical activity of the heart - Action potentials in cardiac muscle- ECG waveforms and their significance- Arrhythmias– abnormal rhythms- heart blocks- Electromyography (EMG) - Electrical activity of muscles -Electro - Encephalo Graphy (EEG) - Electrical activity of brain - Electrodes for ECG, EEG, EMG- Phonocardiography.

Unit II: Artificial organs **12 Hours**

Pacemakers - Introduction - External and Internal pacemakers - regular and ectopic pacemakers- Synchronous and asynchronous pacemakers-programmable pacemakers- power sources- Pacing system analyzers- Artificial heart valves - (Principle - block diagram and operation). Tissue engineering, scaffolds, Implants for Bone

Unit III: Biomedical instrumentation **12 Hours**

Anesthesia machine - Recording fetal heart movements and blood circulation using Doppler ultrasonic method - Ultrasound pulse echo imaging system- Laser based Doppler blood flow meter - Blood cell counter - B.P. measurement - Direct and indirect method - Haemocytometer - counting of RBCs and WBCs- Surgical microscope- Magnetic Resonance Imaging.

Unit IV: Radiation Safety instrumentation **12 Hours**

Radiation safety instrumentation - safety precautions – Hazardous effects of radiation– Allowed level protection methods- Effects of radiation exposure – Radiation monitoring instruments - Pocket dosimeter - pocket type radiation alarm- Various components of Radiography systems –

Exposure switching and control of exposure time – Types of timer circuits, Filament circuit and KV– mA controls – HT units – X-ray tubes for various medical applications**.**

Unit V: Biochemical Measurement and Biosensors 12 Hours

Biochemical sensors – pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors- Flame photometers, Introduction to Spectrophotometry- Blood gas analyzers, Sodium Potassium Analyser– Biosensors – Principles – amperometric and voltometric techniques- Fibre optic sensors

Text Book:

1. Bio-medical Instrumentation - Dr. M. Arumugam - Anuradha Agencies, 2017

Reference Books:

1. Bio instrumentation - John G. Webster, editor - John Wiley& Sons, Inc, 2003
2. Biological Instrumentation and methodology, P.K. Bajpai, S. Chand Publications, 2010

213PHY3102	Theoretical Physics	L	T	P	X	H	C
		3	0	0	0	3	3

Prerequisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Theory

Objective:
This course aims to give exposure in key concepts on classical and quantum mechanics

Course Outcomes:
Upon successful completion of this course, Students will be able to
CO1: Learn the fundamentals of Lagrangian formulation
CO2: Understand the Hamilton's formulation
CO3: Analyse the dual nature of matter
CO4: Understand the basic concepts of quantum mechanics
CO5: Apply the basic concepts of quantum mechanics in solving quantum mechanical problems.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2								3	3	3	2	
CO2	3	3	3								3	3	3	2	
CO3	2	1	1	1							1	1	2	2	1
CO4	3	2	2	2			1	1		1	1	1	3	2	
CO5	3	3	3	3	1	1	1	1	1		3	3	3	3	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Fundamental Principles and Lagrangian Formulation **9 Hours**
Mechanics of a particle and system of particles – Conservation laws – Constraints -Generalized coordinates – Principle of virtual work-D' Alembert's principle and Lagrange's equation – Hamilton's principle –Lagrange's equation of motion –symmetry properties –Atwood's machine – Simple pendulum. Linear Harmonic Oscillator

Unit II: Hamilton's Formulation **9 Hours**
Hamilton's canonical equations of motion – Hamilton's equations from variational principle – Principle of least action – Phase space – Generalized momentum – Cyclic coordinates Conservation theorem for generalized momentum – Conservation theorem for energy- Poisson bracket-canonical transformations- Liouville's Theorem

Unit III: Basics of Quantum Mechanics **9 Hours**
Quantum Theory: Origin of Quantum theory, Black body Radiations, Photoelectric effect, Laws of photoelectric emission, Ritz combination principle, Planck's radiation. Wave particle dualism for light and matter De Broglie's Wave and Uncertainty Principle: superposition Principle- two slit experiment, wave Velocity and group velocity, Heisenberg uncertainty Principle.

Unit IV : Schrodinger Equation and its Application **9 Hours**
Wave Mechanical Concepts: Wave nature of particle - Probability Density -Normalization-wave packet -time dependent Schrodinger equation – interpretation of wave function— Expectation Value, Operators, Time Independent Schrodinger equation (Steady State form), Particle in one dimensional box, energy Quantization, Wave function.

Unit V: Exactly Solvable Quantum Systems **9 Hours**

One Dimensional Energy Eigenvalue Problems: Square-well potential with rigid walls - square well potential with finite walls - square potential barrier - alpha emission – linear harmonic oscillator: Schrodinger method.

Text Books:

1. S.L.Gupta., V. Kumar and H.V.Sharma, Pragathi Prakasan, *Classical Mechanics* Educational Publisher, Meerut, 25th edition, 2011.
2. Murughesan, R., *Modern Physics,* S.Chand & Co., New Delhi, 2006.

Reference Books:

1. Arthur Beiser, *Concept of Modern Physics*: McGraw Hill Ed. V (1999).
2. H.Goldstein, *Classical Mechanics*, Narosa Book distributors, New Delhi 1980.
3. N.C.Rana and P.S.Joag, *Classical Mechanics*, Tata Mc Graw Hill, New Delhi, 1991.
4. P M. Mathews and K. Venkatesan, *A Text Book of Quantum Mechanics,* Tata McGrawHill, New Delhi, 1987.
5. Elementary Numerical Analysis, K.E.Atkinson, 3rd Ed.,Wiley India Edition, 2007,

213PHY3103	Medical Physics	L	T	P	X	H	C
		3	0	0	0	3	3

Prerequisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Theory

Objective:

- To understand the basics about the biological systems in our body, their behavior, and the diagnostic devices.

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic anatomical structure of Human Body.

CO2: Understand the fundamental concepts of pressure and electricity measurements in Human Body.

CO3: Learn the concepts of Radiation Physics.

CO4: Understand and analyse the mechanism of Medical Imaging Methods.

CO5: Get the basic theoretical knowledge about X-ray production and various analysis methods.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	3		1							2	3	1	1
CO2	2	1	3		1	1			1			2	3	1	2
CO3	2	1	3		2	1						2	3	1	1
CO4	2	1	3	2	3	2	1		2			2	3	2	2
CO5	2	1	3	2	3	2	1	1	2	1	1	2	3	2	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Physics of the Body - I **9 Hours**

Basic Anatomical Terminology: Standard Anatomical Position, Planes. Familiarity with terms - Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal and Distal

Mechanics of the Body: Skeleton, forces, and body stability. Muscles and dynamics of body movement

Physics of Locomotors Systems: joints and movements, Stability and Equilibrium

Energy Household of the Body: Energy balance in the body, Energy consumption of the body, Heat losses of the body, Thermal Regulation.

Unit II: Physics of the Body - II **9 Hours**

Acoustics of the Body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound.

Optical system of the Body: Physics of the eye.

Pressure System of the Body: Physics of Breathing, Physics of Cardiovascular system.

Electrical System of the Body: Physics of the nervous system, Electrical signals and information transfer.

Unit III: Radiation Physics and Radiation Detectors **9 Hours**

Radiation Physics: Radiation units exposure, absorbed dose, units: rad, gray, relative biological effectiveness, effective dose- Rem & Sievert, inverse square law. Interaction of radiation with matter Compton & photoelectric effect, linear attenuation coefficient.

Radiation Detectors: ionization (Thimble chamber, condenser chamber), chamber. Geiger Muller counter, Scintillation counters and Solid-State detectors, TFT.

Unit IV: Medical Imaging Physics **9 Hours**

Evolution of Medical Imaging, X-ray diagnostics and imaging - Physics of nuclear magnetic resonance (NMR) - NMR imaging - MRI Radiological imaging -Ultrasound imaging - Physics of Doppler with applications and modes, Vascular Doppler.

Radiography: Filters, grids, cassette, X-ray film, film processing, fluoroscopy.

Computed Tomography Scanner: Principle and function, display, generations, mammography.

Unit V: X-Ray and Various Measuring Instruments **9 Hours**

X-rays - Production of X-rays - X-ray spectra - continuous spectra and characteristic spectra - Coolidge tube - Electrocardiograph (ECG) - Block diagram - ECG Leads - Electro Encephalo Graph (EEG) - Electromyography (EMG) - EMG recorder- Computer Tomography (CT) Principle - Block diagram of CT scanner.

Text Books:

1. Physics of the human body, Irving P. Herman, Springer (2007).
2. Medical Physics –John R. Cameron and James G.Skofronick, 1978, John Willy & Sons.
3. Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition (2003)
4. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
5. Bio medical instrumentation – E D II, Dr M. Arumugam, Anuradha Agencies 1997.

Reference Books:

1. M. Arumugam, Biomedical Instrumentation, Anuradha Publishing Co.,
2. Kumbakkonam, Tamilnadu, 2004.
3. Jacobson and Webster, Medicine and clinical Engineering, Prentice Hall of India, New Delhi, 1979.
4. Handbook of Physics in Diagnostic Imaging: R.S.Livingstone: B.I. Publication Pvt Ltd.
5. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978)

213PHY3104	Biophysics	L	T	P	X	H	C
		3	0	0	0	3	3

Prerequisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Theory

Objectives:

- apply fundamental physical principles and concepts to biological phenomena
- recognize multiscale nature of biophysics, from molecular to cellular and organism levels
- appraise recent nanoscale advances in biophysics
- apprehend synergetic contributions of theory, experiment, and computer simulation to the field of biophysics

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: To know the cell biology and its physics like energy, chemical process, role and structure based things.

CO2: Understand the metabolites and its simulation, mathematical models for computations.

CO3: To understand the biophysical properties and molecular alphabets in life.

CO4: Understand the mechanical properties of part of the various living objects.

CO5: Apply the knowledge of biophysics into the medical application and its uses

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1		1		1		1	2		1	3	2	1
CO2	3	2	1		1	1	1	1			1	1	3	2	1
CO3	3	2	2	2	1	1			2			1	3	1	2
CO4	3	2	2	2	1					1		1	3	3	1
CO5	3	2	2	2	1		1		1		1	1	3	3	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Basics of Biophysics **9 Hours**

Cellular biophysics: Scope & meaning of Biophysics - Cell as basic unit of life - The orgeneller constituents of cell - The chemical composition of cells - membrane potential and its physical basis. The boundary, interior and exterior environment of living cells. Processes: exchange of matter and energy with environment – metabolism – maintenance - reproduction, evolution. Bioenergetics: Energy requirements in cell metabolism - role and structure of mitochondria

Unit II: Molecules of life **9 Hours**

Metabolites - proteins and nucleic acids - Their sizes - types and roles in structures and processes. Transport - energy storage - membrane formation - catalysis, replication, transcription, translation, signaling. Typical populations of molecules of various types present in cells - their rates of production and turnover. Energy required making a bacterial cell. Simplified mathematical models of transcription and translation - small genetic circuits and signaling pathways.

Unit III: Molecular alphabets of life & Biophysical Properties **9 Hours**

Amino acids, nucleic acid bases and lipids - classification and properties of amino acids, peptides and polypeptides. Nucleosides – nucleotides – polynucleotides - pentose and hexose polysaccharides. Surface tension - adsorption, diffusion, osmosis, dialysis and colloids, hemodynamic, fluid flow in plants.

Unit IV: Bio-mechanics **9 Hours**

Types of muscles- striated, cardiac, tonic muscles, properties of muscles-Excitability – conductivity-contractility – extensibility – tonicity – structure of striated muscles – Newton's laws – centre of mass – Biomechanical analysis of movements of snakes – swimming of fishes – aerodynamic basis of flights. Physical forces exemplified in man - human muscular- skeletal system, Integrity of Joints, articular surfaces, Mechanical properties of bones, Degrees of freedom of movements at various joints, Axes & planes.

Unit V: Radiation biophysics & Nuclear Medicine **9 Hours**

Natural and artificial Radioactivity - Properties of α, β and γ radiations – Half-life –Units of radioactivity – Biological effects of radiation – Radiation Detectors – Electrometer. Basic principles of Nuclear Medicine, Diagnostic use of Radioisotopes In-vivo & In-vitro procedures, (Single isotope, Double isotope methods), Radioimmunoassay counting system, General principles & procedures of organ scanning - radioisotopes rectilinear scanner, the gamma Camera

Text Books:

1. Essentials of Biophysics by P Narayanan, Second Edition, New Age Publishers, 2007.
2. Biophysics by Vasanth Pattabhi and N Gautham, Kluwer Academic Publishers, 2002.
3. Elementary biophysics: An introduction by P K srivastava, Narosa publication, 2005.

Reference Books:

1. Fundamentals of Biophysics by Andrey B. Rubin, Scrivener Publishing LLC, 2014
2. Biophysics: An Introduction by Rodney M. J. Cotterill, John Wiley & Sons Ltd., 2002
3. Physics in Molecular Biology; Kim Sneppen & Giovanni Zocchi, Cambridge University Press, 2005
4. Biological Physics: Energy, Information, Life by Philip Nelson, W H Freeman & Co., 2004

213PHY3105	Applied Physics	L	T	P	X	H	C
		2	0	0	3	5	3

Prerequisite: Nil **Course Category:** Discipline Specific Elective
Course Type: Theory

Objective:

This course aims to provide the knowledge on the principles and design of various instruments and to impart the concepts on instrumentation.

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the concepts of electric and electronic instruments.
CO2: Apply the basics in the scientific equipment to characterize the materials.
CO3: Understand the concepts of Biological Instruments
CO4: explore the optical concept for developing optical Instruments
CO5: Understand the basic principles of Mechanical Instruments

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3				1		2	3	2		1	3	1	1
CO2	3	2	1	3	1					1	3	2	2	3	1
CO3	3	1	1	3	1		2	2	2			2	2	1	3
CO4	3	1		3	1					2	3	2	3	3	
CO5	3	3				1		1		1			3	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit-I: Electric and Electronic Equipments **6 Hours**

Electric motor – principles of working, Microwave oven – principle – technical specifications applications – advantages, Public address system – Block diagram representation – function of each unit - CD player and drives – DVD player and drives – Telephonic communication (Cable and cellular) – Principles (qualitative using block diagrams) – Cell phone – SIM card – technical specifications – Radio –History of radio revolution – different types of radios

Unit-II: Scientific Instruments **6 Hours**

Tunneling Electron Microscope (TEM) – working principle- schematic representation – applications - technical specification - Scanning Electron Microscope (SEM) -working principle - schematic representation –applications - technical specifications - Atomic Force Microscope (AFM) - working principle- schematic representation – applications – Technical specifications XRD – Principle and applications

Unit-III: Bio PHYSICS Instruments **6 Hours**

Basis of biomolecules and molecular system-Membrane biophysics - nerve cell - bio physical basis of nerve impulse conduction – membrane potential – resting potential and action potential – Gross bioelectrical phenomenon of ECG and EEG-Molecular basis of muscle contraction, ultra structure and molecular basis of vision and hearing

Unit-IV: Optical Instruments **6 Hours**

Microscope, Electron microscope, Camera – History of evolution of camera – Digital camera, Holography, Optical communication network- building blocks – Overhead Projector (OHP), LCD

Projector, OMR reader, radar CT Scan – basic principle – applications & advantages, Ultra sound scan.

Unit-V: Common Mechanical devices **6 Hours**

Vacuum - Importance of Vacuum technology in Industry – unit of vacuum – Pumps: Cenco-havoc rotating oil pump, Mercury diffusion pump - Gauges: Pirani gauge, Penning gauge – Refrigerator – working principle – technical specifications – Heat engines- Automobile engines working (Qualitative description only) – Different types – Brakes – Different types of brakes

List of X- Component activity

Demonstration of the following,

1. CD and DVD player
2. Radio
3. Television
4. Tunnelling Electron Microscope
5. SEM
6. XRD
7. Different potential system
8. ECG and EEG
9. X- Work model – Digital Camera
10. Lab : Optical Communication system
11. X- Model : Ultrasound Scan
12. Lab Expt : Oil Pumps
13. X- Model : Gauge
14. X- Model- Heat Engines

Reference Books:

1. Audio and video Systems, R.G.Gupta, Tata McGraw hill Publications, 1995
2. Mobile Satellite Communication Network (Ch 1 & 2), Ray E Sherrif & Y.Funttu,Wiley India, 2001.
3. Television Engineering & Video System, R.G.Gupta, Tata McGraw hill Publications, 2007.
4. Electrical Technology (Vol I & II), B.L.Theraja. S.Chand Publications, 1959.
5. A Text book of elements of Mech. Engg (page 105-114), S.Trynbaka Moorthy,I.K International Publishing house, 2010.
6. Physical principles of electron microscopy- An introduction to TEM, SEM, AFM, Springer, 2005
7. M. V. Volkenshtein , Biophysics, Mir Publications, 1983.
8. Straughan and Walker, Spectroscopy — Vol. I, II and III, Springer Link Publications, 1976
9. V.V. Rao etal, Vacuum Science and Technology, Allied Publishers Ltd.,2001
10. Narayanan.P, Essentials of Bio-Physics, New Age Publications, 2010.

SKILL ENHANCEMENT COURSES

214PHY2101	Physics Workshop skills	L	T	P	X	H	C
		1	0	0	3	4	2
Prerequisite: Nil		**Course Category:** Skill Enhancement Course **Course Type**: Theory					

Objective:

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the basic measuring units and the working of different measuring instruments.
CO2: Gain the hands on experience on various mechanical manufacturing methods
CO3: Acquire skills in the usage of multimeters, soldering iron and oscilloscopes
CO4: Understand the basics and uses of prime movers, including gears and levers.
CO5: Gain knowledge on working principles of simple machines.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3											3	2	
CO2	3	2	1								1		2	2	
CO3	3	2	1	1							1		2	2	1
CO4	3	2	2		1		1			1		1	3	1	2
CO5	3	2	1	1		1	1	1	1	1		1	3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Introduction to measuring systems **3 Hours**

Measuring units. Conversion to SI and CGS. Familiarization with meterscale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc.

Unit II: Mechanical Skill **3 Hours**

Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood.

Unit III: Electronic Skills **3 Hours**

Use of a Multimeter - Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB - Operations of an oscilloscope.

Unit IV: Introduction to prime movers **3 Hours**

Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using a lever.

Unit V: Simple machine **3 Hours**

Braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment-applications

List of Experiments/Activities: **45 Hours**

1. Measure the quantities, volume, area and dimension of the given materials in CGS and SI units
2. Discuss the role of least count and zero errors of meter scale, vernier caliper and screw gauges and utilise it in real time measurements
3. Determine the length, breadth and thickness of the given material using meter scale, vernier caliper and screw gauge respectively
4. Visit the mechanical workshop and understand the concepts of workshop practices
5. Investigate the types of welding joints available in the mechanical workshops and analyse the types of defects present in the welded joints
6. Analyze the different types of plywood available in the market and find out the components of each plywood's
7. Measure the AC and DC voltages, AC and DC currents, resistance and the electrical continuity of the given circuit using a multimeter
8. Construct the given electronic circuit on the PCB by soldering the discrete components and study its performances
9. Generate the different types of waveforms on the oscilloscope and characterize the generated waveforms
10. Prepare a detailed report on a gear system, types and applications in automotive industries
11. Demonstrate the fixing of gears with motor axel
12. Explain the working mechanism of a lever by lifting a heavier object using a lever
13. Construct a simple machine using pulleys to lift a heavier object to certain heights and explain its working principles
14. Industry visit to understand the working principles of power generation systems
15. Determining the Work/Energy of a Pulley System

Text Books:

1. A textbook in Electrical Technology, B L Theraja, S. Chand and Company, New Delhi, 2006.
2. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480], 2015.

Reference Books:

1. Performance and design of AC machines – M.G. Say, ELBS Edn., 2002
2. Mechanical workshop practice, K.C. John, PHI Learning Pvt. Ltd., 2010
3. Workshop Processes, Practices and Materials, Bruce J Black, 3rd Edn., Editor Newnes, 2005

214PHY2102	Computational Physics	L	T	P	X	H	C
		1	0	0	3	4	2
Prerequisite: Nil		**Course Category:** Skill Enhancement Course **Course Type**: Theory					

Objective:

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- Use of computer language as a tool in solving physics problems (applications)
- Course will consist of hands-on training on Problem solving on Computers.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the fundamentals of programming languages and parameters.

CO2: Understand and use different programming statements.

CO3: Understand and use different loop control structures in programming

CO4: Understand and apply different functions in programming

CO5: Apply the knowledge of program techniques to develop C-programs for solving simple problems in Physics.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2						1				3	2	
CO2	3	2	1	1	1		1				1		3	3	1
CO3	3	2	1	1		1		1	1		1		3	2	1
CO4	3	2	2		1		1		1	1		1	3	1	2
CO5	3	3	1	1		1	1	1	1	1	1	1	3	2	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Introduction **3 Hours**

Importance of computers in Physics, Algorithms and Flowcharts:

Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types.

Examples: Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series. Algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal

Unit II: C Language Fundamentals **3 Hours**

Constants, Variables, Keywords, rules for constructing integer constants, real constants, character constants. Types of C variables and rules for constructing variable names. Declaration instruction, arithmetic instruction, Integer and float conversion,

Unit III: Decision Structure **3 Hours**

if statement, if-else, nested if-else. The logical operator: the if-else clause, the not operator, conditional operator, Switch statement. while loop, for loop, nesting of loop, multiple initializations in the for loop. The break statement, the continue statement and the do-while loop.

Unit IV: Functions **3 Hours**

Function, Passing values between function, Scope rule of functions, Calling convention. Advanced features of functions: return type of function, call by value and call by reference. Introduction to pointers.

Unit V: Programmes **3 Hours**

Simple pendulum, Project motion, Nuclear decay, Wave motion, specific heat, Ohms law, Kepler's Laws. Solution of linear equation.

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate the sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write a program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting data and saving the output for seeing on the screen. SavingE it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation using a switch case.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particles in a central force field and plot the output for visualization.
13. Pendulum using C in graphics.
14. To write a program Reverse a number (i) with while loop, (ii) without while loop, (iii) with for loop, (iv) using function.
15. Program to solve algebraic equations.
16. Solve the poisson equation using C program.

Text Book:

1. Let Us C- Yashwant Kanetkar, 15th Edn., BPB Publishers, 2016.

Reference Books:

1. An Introductory Course in Computational Physics-Richard Fitzpatrick, Create Space Independent Publishing Platform, 2015
2. Computational Physics-Nicholas Giordano & Hisao Nakanishi, Pearson Education, Second edition, 2006
3. An Introduction to Computational Physics, Tao Pang, Cambridge University Press; 2nd edition, 2006

214PHY2103	Basic Instrumentation skills	L	T	P	X	H	C
		1	0	0	3	4	2

Prerequisite: Nil **Course Category:** Skill Enhancement Course
Course Type: Theory

Objective:

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the basic parameters of instruments like accuracy, precision, sensitivity etc.
CO2: Understand the working of different measuring instruments.
CO3: Understand the basics of Cathode Ray Oscilloscopes and their applications.
CO4: Understand the basics of analytical instruments and their applications.
CO5: Understand the basics and working of LCR bridges and their applications.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1			1			1	1			3	2	2
CO2	3	2	3	1						1			3	3	1
CO3	3	2	3	1				2		1	1	2	3	2	1
CO4	3	3	1		1	1	1		1	1	1	1	3	2	
CO5	3	2	1	2	1	1	1	1	1	1	1	1	3	2	2

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Basics of Measurement **3 Hours**

Instrument's accuracy, precision, sensitivity, resolution range etc. Errors in measurements with types Statistical Analysis, Probability of Errors, Limiting Errors, Calibration of instruments

Multimeter: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Specifications of a multimeter and their significance, Block diagram and working of a digital multimeter.

Unit II: Electronic Voltmeter **3 Hours**

Principles of voltage measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. Type of AC milli voltmeters: Amplifier- rectifier, and rectifier-amplifier.

Unit III: Cathode Ray Oscilloscope **3 Hours**

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization Use of CRO for the measurement of voltage (dc and ac frequency, time period.

Unit IV: Signal Generators and Analysis Instruments **3 Hours**

Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Unit V: Impedance Bridges & Q-Meters **3 Hours**

Block diagram of bridge. working principles of basic(balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.

List of experiments

1. Circuit tracing of Laboratory electronic equipment.
2. Use of Digital multimeter/VTVM for measuring voltage
3. Circuit tracing of Laboratory electronic equipment,
4. Study the layout of the receiver circuit.
5. Troubleshooting a circuit
6. Balancing of bridges
7. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
8. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
9. To measure Q of a coil and its dependence on frequency, using a Q- meter
10. CRO
11. LCR- parallel and Series Resonance

Text Books:

1. A textbook in Electrical Technology, B L Theraja, S. Chand and Company, New Delhi, 2006.
2. Performance and design of AC machines - M G Say ELBS Edn., 2005.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.

Reference Books:

1. Digital Electronics, Subrata Ghoshal, Cengage Learning, 2012.
2. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., Tata Mc Graw Hill, 2012.
3. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, Springer, 2008
4. Electronic Devices, 7/e Thomas L. Floyd, Pearson India, 2008.

214PHY2104	Applied Optics	L	T	P	X	H	C
		1	0	0	3	4	2

Prerequisite: Nil **Course Category:** Skill Enhancement Course
Course Type: Theory

Objective: To make the student familiar with principle, working of different types of laser, optical fibers, nanophotonics and their applications.

Course Outcomes:

Upon successful completion of this course, students will be able to
CO1: Understanding the basic principle and theory behind Laser.
CO2: Acquire the knowledge about different types of lasers.
CO3: Apply the uses of lasers in various fields.
CO4: Understand the basic principle of optical fibers and their applications.
CO5: Understanding the nanophotonics and their various applications

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	1					1			2	1	1
CO2	3	2	2	2	1				1	1			3	2	2
CO3	3	2	2	2	2	1			1	2	1	2	3	2	3
CO4	3	2	2	2	2	2			1	2	2	2	3	2	3
CO5	3	2	2	3	2	1	1	1	1	2	2	2	3	2	3

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Sources and Detectors **3 Hours**

Basic principle of Lasers - Characterization of laser beam – population inversion – pumping - Einstein's theory of laser- LED- LDR

Unit II: Types of Lasers **3 Hours**

Solid State Lasers –Nd-YAG Laser – Gas Lasers – He-Ne laser – semiconductor lasers – Homo and heterojunction Lasers.

Unit III: Applications of Laser **3 Hours**

Application of laser in industry: cutting, welding and drilling – communication – military - Medical –Holography – Theory of recording and reconstruction.

Unit IV: Optical Fibers **3 Hours**

Principle of light transmission in a fiber - Propagation within a fibre: Numerical Aperture and Acceptance angle; Active and passive fibre sensors – Endoscope.

Unit V: Nano photonics **3 Hours**

Basics of nanophotonics - Introduction to MEMS and NEMS-Working principles - Applications in automotive industry - health care - aerospace.

List of Experiments:

1. Determination of the wavelength of He-Ne Laser using transmission diffraction grating.
2. Determination of the size of particles (lycopodium powder) using LASER source.
3. V-I characteristics of LED.
4. Study the characteristics of LDR.

5. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
6. To find the polarization angle of laser light using polarizer and analyser.
7. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
8. Recording and reconstructing holograms.
9. White light Hologram.
10. Determination of the numerical aperture (NA) and acceptance angle of the fibre cable.
11. To study the variation of the bending loss in a multimode fibre.
12. To determine the power loss at a splice between two multimode fibre.
13. Synthesis of metal and semiconductor nanoparticles by chemical route.
14. XRD pattern of nanomaterials and estimation of particle size.
15. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in the UV-Visible region.

Text Book:

1. Laser theory and applications by K. Thyagarajan and Ajoy Ghatak, Cambridge University Press, 1999.
2. Introduction to Fiber optics by K. Thyagarajan and Ajoy Ghatak, Cambridge University Press, 1999.
3. Optical Fiber Communications by John M. Senior, Cambridge University Press, 1996.
4. Fiber-Optic Communication Systems, Govind P. Agarwal, John-Willey & Sons, 2010.
5. RahmanFaiz, Nanostructures in Electronics and Photonics, Pan Stallion press, united Kingdom, 2008.

Reference Books:

1. An Introduction to laser: Theory and Applications by M. N. Avadhanulu, S. Chand and Co., New Delhi, 2001.
2. P.K. Palanisamy, Physics for Engineering, Scitech Publishing Pvt. Ltd., Chennai, 2008.
3. Laser and Non Linear Optics by B.B.Laud, New Age international, 2011.
4. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. Viva Books, 2009.
5. Laser systems and applications by Niyanad Choudhary and Richa Verma, PHI, New Delhi, 2011.
6. Guozhong Cao, Nano structures & nanomaterials: synthesis, properties & applications, Imperial College Press, United Kingdom, 2004.
7. Todd D. Steiner, Semiconductor nanostructures for optoelectronic application, Artech House, INC., USA, 2004.

214PHY2105	Electrical appliances	L	T	P	X	H	C
		1	0	0	3	4	2

Prerequisite: Nil **Course Category:** Skill Enhancement Course
Course Type: Theory

Objectives: To make the student competent enough in installing, operating and servicing different electrical appliances.

Course Outcomes:

Upon successful completion of this course, students will be able to
CO1: Understand the basic electricity principles.
CO2: Understand the principles and applications of generators and transformers.
CO3: Understand the principles, types and applications of electric motors.
CO4: Understand the working of different home appliances, installation and servicing.
CO5: Understand the different types of electrical wiring and its applications.

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1									3	1	1
CO2	3	3	2	2	2	1		1	1	2	2	2	3	3	2
CO3	3	3	2	2	2	1		1	1	2	2	2	3	3	2
CO4	3	3	2	2	2	1		1	1	2	2	2	3	3	2
CO5	3	2	2	2		1	1			1	1	1	2	1	1

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit I: Basic Electricity Principles **3 Hours**

Voltage, Current, Resistance, and Power- Ohm's law - Series, parallel, and series-parallel combinations - AC Electricity and DC Electricity.

Unit II: Generators and Transformers **3 Hours**

DC Power sources - AC/DC generators- Principle of operation – Transformer -classification of transformers - EMF equation - Voltage Ratio - Current ratio.

Unit III: Electric Motors **3 Hours**

Single-phase, three-phase & DC motors - Basic design- Interfacing DC and AC sources to control heaters & motor - Speed & power of AC motor.

Unit IV: Domestic appliances **3 Hours**

Principles of working, parts and servicing of Electric fan- Wet grinder - Water heater – Electric iron box- Microwave oven – Refrigerator.

Unit V: Electrical Wiring **3 Hours**

Different types of conductors and cables - Basics of wiring - Star and delta connection - Voltage drop and losses across cables and conductors.

List of Experiments/activities:

1. Studying the electrical performance and power consumption of a given number of bulbs connected in series and parallel circuits.
2. Measuring parameters in combinational DC circuits by applying Ohm’s Law for different resistor values and voltage sources.
3. Observing the response of inductor and capacitor with DC and AC sources.

4. Identifying primary and secondary windings and measuring primary and secondary voltages in various types of transformers.
5. Observing the working of the transformer under no-load and full load conditions.
6. Observing the connections of elements and identifying current flow and voltage drops.
7. To study the resonance condition of a series LCR circuit.
8. To study the resonance condition of a parallel LCR circuit.
9. Studying electrical circuit protection using MCBs, ELCBs.
10. To find the heating efficiency of an electric kettle.
11. Condenser checking and servicing electric fans.
12. Checking the specific gravity of lead acid batteries in UPS and topping-up with distilled water.
13. Awareness of electrical safety tools and rescue of persons in contact with live wire.
14. Identifying Phase, Neutral and Earth on power sockets.
15. To study the balanced three phase system for star & delta connected load.

Text Books:

1. A textbook in Electrical Technology, B.L. Theraja, S. Chand and Company, New Delhi, 2006.
2. Study of Electrical Appliances & Devices, Khanna Publishers, 1988.
3. Electrical Appliances: The Complete Guide to the Maintenance and Repair of Domestic Electrical Appliances Haynes Manuals Inc, 1995.

Reference Books:

1. A text book on power system Engineering, M.L. Soni, P.V. Gupta & V.S. Bhatnagar, Dhanpat Rai and Company Private Limited; Reprint 2009 Edition.
2. Utilisation of Electrical Energy, E.O. Taylor, Orient Longman, 1971.
3. Art & Science of Utilisation of Electrical Energy, H. Partas, M/s. Dhanpat Raji & Sons, New Delhi, 2017.
4. A Course in Electrical Power, J.B. Gupta, M/s. B.D. Jaataris & Sons, 2013.
5. An Integrated Course In Electrical Engineering, J.B. Gupta, S.K. Kataria & Sons, 2013.
6. Handbook of Repair & Maintenance of domestic electronics appliances; BPB Publications, 2016.
7. Consumer Electronics, S.P.Bali, Pearson Education India, 2004.
8. Domestic Appliances Servicing, K.P.Anwer, Scholar Institute Publications, 2013.

EXPERIENTIAL ELECTIVE COURSE

215PHY4201	Project	L	T	P	X	H	C
		0	0	12	3	12	6

Prerequisite: Nil **Course Category:** Experiential Elective

Course Type: Theory

Objectives: To develop the students' knowledge towards solving, analysing and/or exploring the real time difficult problems.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Demonstrate the fundamental physics concepts

CO2: Undertake the problem identification, formulation and solution

CO3: Demonstrate knowledge of contemporary issues in their chosen field of research.

CO4: Design the new solution/product

Mapping of COs and POs

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1					1			2	3	1	2
CO2	3	3	2	2	2	1	1	1				1	3	1	2
CO3	3	3	3	3	3	2		2	2	2	1	1	3	3	3
CO4	3	3	3	3	3	3		2	1	2	2	2	3	3	3

3 - Strong Correlation; 2- Medium Correlation; 1- Low Correlation

This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. The following few fields are listed below.

- Electronic circuit design
- Electronic instrumentation
- Development of Electronic devices
- Communication devices
- Computer simulation towards physics problems
- Materials synthesis
- Materials characterization
- Theoretical Physics
- Condensed Matter Physics
- Materials Science
- Thin Film
- Energy Physics
- Astrophysics
- Nuclear and Particle Physics
- Biophysics
- Medical physics
- Atmospheric Physics
- High Energy Physics
- Energy Materials

Those who want to select the project fields which are not listed above, they are also permitted to do the project on their own interest with the permission of supervisor and department.

Anand Nagar, Krishnankoil - 626126. Srivilliputtur (via),
Virudhunagar (Dist), Tamilnadu, India