Gandhinagar Institute of Science

Academic Regulation& Curriculum

for

Proposed Program of M.Sc.

In

Physics

M.Sc. (Physics) PROGRAMME

***w.e.f.* 2023-24**

Preamble

Physics is one of the fundamental sciences that seeks to understand the laws governing matter, energy, space, and time. It provides the conceptual framework for scientific discoveries and technological advancements and plays a significant role in diverse fields such as electronics, materials science, communication technology, computational sciences, energy systems, medical instrumentation, and advanced research. The study of physics develops analytical thinking, mathematical reasoning, experimental competence, and scientific temperament, which are essential for addressing modern scientific and technological challenges.

The M.Sc. Physics programme, structured across four semesters, is designed to provide students with advanced knowledge and specialized understanding of core and emerging areas of physics. The programme strengthens conceptual foundations while promoting higher-order thinking, research aptitude, problem-solving abilities, and practical skills. The curriculum integrates theoretical learning with laboratory work, computational techniques, seminars, and project-based activities to prepare students for advanced academic and professional pursuits.

We, the members of the Department of Physics, are committed to promoting knowledge, scientific inquiry, innovation, and academic excellence in the field of physics. We aim to create a stimulating learning environment where students are encouraged to think critically, work collaboratively, and develop practical and research-oriented skills for addressing real-world scientific challenges.

The curriculum has been designed in accordance with the principles of the National Education Policy (NEP) 2020, adopting an Outcome-Based Curriculum (OBC) and Choice-Based Credit System (CBCS) framework to promote flexibility, multidisciplinary learning, and skill development. The programme aims to build strong academic and technical competencies while preparing students for higher studies, research, teaching, entrepreneurship, and careers in industry and technology-driven sectors.

To keep pace with contemporary scientific developments, the programme includes exposure to advanced and emerging areas such as quantum mechanics, condensed matter physics, semiconductor physics, electronics, photonics, computational physics, materials science, nanoscience, and interdisciplinary research domains. Students are encouraged to undertake seminars, research projects, and MOOC courses to broaden their knowledge and gain exposure to recent scientific developments and emerging technologies.

The Department of Physics is committed to providing a vibrant academic environment through quality teaching, modern laboratories, research activities, workshops, seminars, and collaborative learning experiences. The programme seeks to inspire curiosity about the physical universe while equipping students with scientific knowledge, ethical values, and professional skills necessary for meaningful contributions to society and scientific progress.

The curriculum and syllabi are continuously updated through a structured feedback mechanism involving stakeholders such as faculty members, subject experts, industry professionals, alumni, and parents. This ensures that the programme remains relevant, practical, research-oriented, and future-ready. With a focus on continuous learning, innovation, and adaptability, the department aims to develop competent physicists, researchers, educators, and future leaders capable of contributing effectively to academia, industry, and national development..

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Table of Contents

Table of Contents

1 Institutional Vision & Mission

1.1 VISION:

Gandhinagar Institute of Science aims to strengthen quality science education and research by fostering innovation, ethical values, and scientific temperament for societal and sustainable development.

1.2 MISSION:

- To provide quality education supported by modern infrastructure and an industry- oriented curriculum, while emphasizing ethics and critical thinking.
- To promote an innovative and research-oriented environment that fosters effective problem-solving skills and entrepreneurial development.
- To encourage innovation, entrepreneurship, and scientific ethics for developing responsible and skilled graduates.
- To foster interdisciplinary learning, sustainability, and community engagement for national development.

2 Departmental Vision & Mission

2.1 VISION

The goal of the Department of Physics is to provide postgraduate students with an advanced understanding of the physical universe, its fundamental principles, structure, and emerging scientific developments, enabling them to contribute effectively to advanced research, innovation, and technological applications in the future. Through high-quality teaching, research, and scholarly activities, the department creates a platform for the dissemination and advancement of knowledge and assists students in developing a scientific mindset, critical thinking abilities, and research-oriented perspectives.

2.2 MISSION

(1) To inspire and nurture young minds and help them realize their potential in both theoretical, experimental, and computational Physics through dedication to teaching,

commitment to students, and innovative teaching methodologies such as presentations, visual learning tools, simulations, and technology-enabled instruction.

(2) To support the developmental initiatives of the institution and make the Department a vibrant center of academic excellence, research, and innovation.

(3) To make significant contributions through highly qualified faculty, modern laboratories, computational facilities, and advanced learning resources, while promoting excellence in core and emerging areas of Physics.

(4) To establish and maintain effective academic and administrative processes in the Department to achieve our goals as a leading institution with national and international standards in higher education and research.

(5) To provide advanced academic programmes in Physics and interdisciplinary areas, and to generate intellectual property through innovative research, quality publications, projects, and patents.

(6) To establish state-of-the-art research facilities and collaborative research environments that will benefit M.Sc. students, research scholars, faculty members, and the wider academic community.

3 Program Objectives

The program aims to:

1. Provide a strong foundation in theoretical and experimental physics.
2. Develop analytical, computational, and problem-solving abilities.
3. Foster research aptitude, innovation, and scientific temper.
4. Prepare students for higher education, research, and professional careers.
5. Inculcate ethical values, leadership, and social responsibility.
6. Promote lifelong learning and adaptability to emerging scientific and technological advancements.

4 Program Educational Objectives (PEOs)

PEO1

"Graduates will acquire advanced knowledge and strong conceptual understanding in various branches of Physics to analyze and solve complex scientific problems."

PEO2

"Graduates will develop analytical ability, laboratory competence, experimental techniques,

computational skills, and research aptitude required for higher studies, research, and industrial applications."

PEO3

"Graduates will cultivate scientific temper, innovation, critical thinking, and research skills for contributing to scientific and technological advancements."

PEO4

"Graduates will gain communication skills, teamwork, leadership qualities, ethical values, and interdisciplinary problem-solving abilities necessary for academia, research, and professional careers."

PEO5

"Graduates will understand the social relevance of Physics and demonstrate ethical responsibility, environmental awareness, and commitment toward sustainable development."

PEO6

"Graduates will engage in lifelong learning and adapt to emerging scientific developments and technological advancements in academia, research, and industry."

5 Program Details

5.1 Program Structure & Duration

- **Duration & Intake:** 2 Years & 30 Seats
- **Semesters:** 4
- **Mode:** Full-Time
- **Credit Structure:** As per NEP/University norms
- **Medium of Instruction:** English

5.2 Eligibility Criteria for Admission

Candidates must have passed a **Bachelor's Degree (B.Sc.) with Physics as a major subject** from a recognized university. Applicants should have secured the minimum percentage/CGPA prescribed by the University from time to time. Candidates from allied disciplines may also be considered as per University regulations.

5.3 Admission Procedure

Admission through Merit-Based Selection

1. Candidates may apply online/offline as per the University's admission notification.
2. Admissions shall be granted based on merit obtained in the qualifying examination and/or as per University guidelines.
3. Eligible candidates may be required to attend counseling, interaction, or document verification conducted by the Admission Committee.
4. Selected candidates must complete fee payment and document verification within the stipulated time to confirm admission.

Admission through GCAS Portal (if applicable)

1. Register on the GCAS Portal using Mobile Number, Email ID, and Aadhaar details.
2. Pay the registration fee through the prescribed online mode.
3. Complete the profile and upload the required documents.
4. Select preferred universities and affiliated colleges in order of priority.
5. Submit the application form.
6. Admission offers will be generated based on merit and preferences filled by the candidate.
7. Accept the admission offer and confirm admission by completing document verification and payment of prescribed fees.
8. Candidates may participate in subsequent admission rounds as per GCAS guidelines if they wish to seek a different admission offer.

The University reserves the right to modify the eligibility criteria and admission procedures in accordance with UGC, State Government, GCAS, and University regulations.

5.4 Department Credibility

"A Department of Physics derives its unique credibility from its commitment to scientific inquiry, analytical reasoning, experimental precision, and technological innovation. The department serves as a foundation for understanding the laws of nature and their applications in modern science, engineering, industry, healthcare, energy, communication, and emerging technologies.

Through rigorous academic training, laboratory experimentation, computational skills, and research orientation, the department nurtures scientifically competent, ethically responsible, and socially aware graduates capable of addressing contemporary scientific and technological challenges.

The department distinguishes itself by integrating theoretical knowledge with practical applications through laboratory-based learning, research projects, interdisciplinary

collaborations, and exposure to modern scientific instruments and computational tools. It promotes critical thinking, problem-solving abilities, quantitative analysis, and innovation-driven learning essential for higher education, research, entrepreneurship, and employment in academia, industry, and government sectors.

By nurturing graduates with scientific aptitude, technological proficiency, digital literacy, and lifelong learning skills in line with the goals of higher education and the changing global scientific landscape, the department makes a substantial contribution to national development."

5.5 Credit Summary for M.Sc. Physics Course in Department of Physics with effect from academic year 2024

Course Type-wise Distribution for M.Sc. Physics

Sr. No.	Course Type	Abbreviation	Description
1	Major Course	MJ	Core Chemistry subjects related to the discipline
2	Minor Course	MIN	Supporting interdisciplinary subjects
3	Multi / Interdisciplinary Course	MDC	Courses from allied or other disciplines
4	Ability Enhancement Course	AEC	Language, communication, and personality development courses
5	Skill Enhancement Course	SEC	Skill-oriented practical and employability courses
6	Value Added Course	VAC	Ethics, wellness, Indian knowledge system, and value-based education
7	Internship / Research Project / OJT	INT/RP/OJT	Hands-on industrial training and research exposure

Definition of Credit (as per NEP):

Teaching Component	Credit Definition
4 Hour of Theory (Lecture) per week	1 Credit
2 Hours of Practical/Laboratory Work per week	1 Credit

Range of Credits (as per NEP):

Qualification	Minimum Credits Required
Post-Graduation (Semester 1)	20 Credits
Post-Graduation (Semester 2)	22 Credits
Post-Graduation (Semester 3)	22 Credits
Post-Graduation (Semester 4)	24 Credits

Semester-wise Credit Structure (M.Sc. Physics)

Semester	Total Credits
Semester I	20
Semester II	22
Semester III	22
Semester IV	24
Grand Total	**88 Credits**

Proposed Abbreviation Table for Chemistry Curriculum

Sr. No.	Category	Suggested Code
1	Major	MJ
2	Minor	MIN
3	Multi / Interdisciplinary	MDC
4	Ability Enhancement Course	AEC
5	Skill Enhancement Course	SEC
6	Value Added Course	VAC
7	Indian Knowledge System	IKS
8	Internship / OJT / Research Project	INT / RP / OJT

6 Curriculum Structure

1st Year 1st Semester:

Sr. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10250101	Quantum Mechanics-I and Mathematical Physics-I	4	-	-	4	4
2	Major	10250102	Classical Mechanics-I and Statistical Mechanics	4	-	-	4	4
3	Major	10250103	Electrodynamics-I and Programming in C-I	4	-	-	4	4
4	Major	10250104	Solid State Physics and Plasma Physics	4	-	-	4	4
5	Practical	10250105	Physics Laboratory Practicals-I		-	8	8	4
Total				**16**	**0**	**08**	**24**	**20**

1st Year 2nd Semester:

Sr. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10250201	Quantum Mechanics-II and Mathematical Physics-II	4	-	-	4	4
2	Major	10250202	Classical Mechanics-II and Solid State Properties	4	-	-	4	4
3	Major	10250203	Semiconductor Physics and Devices	4	-	-	4	4
4	Major	10250204	Analog Electronics	4	-	-	4	4
5	Practical	10250205	Physics Laboratory Practicals-II	-	-	8	8	4
6	IKS	IKS0201	Indian Ancient History and Cultural Heritage	2	-	-	2	2
Total				**18**	**0**	**08**	**26**	**22**

NCrF Credit Level	Semester	Major (core)	VAC/ IKS	Practical	Total Credit per sem.
First Year	I	16	-	4	20
	II	16	2 (IKS)	4	22
1st Year Total Credits		32	2	8	42

2nd Year 3rd Semester:

Sr.No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10250301	Nuclear Physics-I, Advanced Quantum Mechanics-I and Instrumentation	4	-	-	4	4
2	Major	10250302	Numerical Methods and Digital Electronics	4	-	-	4	4
3	Major	10250303	Satellite communications, Fibre optics and Microprocessor-I	4	-	-	4	4
4	Major	10250304	Electronics Communication-I	4	-	-	4	4
5	Practical	10250305	Physics Laboratory Practicals-III	-	-	8	8	4
6	Elective	10260306	Vedic Mathematics	3	-	-	3	2
Total				**19**	**-**	**8**	**27**	**22**

2nd Year 4th Semester:

Sr.No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10250401	Research Methodology	4	-	-	4	4
2	Major	10250402	Assignment	-	4	-	4	4
3	Major	10250403	Research Projects	-	-	16	16	16

Total	**17**	**0**	**10**	**24**	**24**

The fourth semester offers two optional pathways based on students' career goals. Students may choose either a **Research Project Track** for higher studies and Ph.D. aspirations, or a **Coursework with Internship Track** for lectureship and professional career development. This flexible structure supports both research and career-oriented learning.

2nd Year 4th Semester:

Sr.No.	Category	Course Name	Contact Hours/Week				Credit Points
			L	T	P	Total	
1	Major	Nuclear Physics-II and Advanced Quantum mechanics-II	4	-	-	4	4
2	Major	Numerical Techniques and Programming in C - II	4	-	-	4	4
3	Major	Microprocessor-II and Microwaves	4	-	-	4	4
4	Major	Remote Sensing and Electronic Communication-II	4	-	-	4	4
5	Practical	Physics Laboratory Practicals-IV	-	-	8	8	4
6	Internship	Research project				-	4
Total			**16**	**0**	**8**	**24**	**24**

NCrF Credit Level	Semester	Major (core)	VAC/ Assignment	Practical	Reseach Methodology	RP/ OJT	Total Credit per sem.	Qualification/ Certificate
Fourth Year	III	16	2	4			22	Post-Graduate Degree
	IV		4		4	16	24	
		16		4		4		

4th Year Total Credits	**32**	**2**	**8**	**4**		**46**	

Successful completion of all semesters and programme requirements will lead to the award of the Postgraduate (M.Sc.) degree.

7 Teaching, Learning & Evaluation

7.1 Teaching Methodology

The M.Sc. Physics program shall adopt a learner-centric and research-oriented approach through the following methods:

- Classroom Lectures and Interactive Teaching
- Tutorials and Problem-Solving Sessions
- Laboratory Experiments and Demonstrations
- Computational Physics and Scientific Programming Training
- Simulation and Modeling using Physics Software Tools
- Seminars, Group Discussions, and Presentations
- Research Projects and Dissertation Work
- Guest Lectures by Academicians and Industry Experts
- Workshops, Conferences, and Scientific Events
- Industrial Visits and Research Laboratory Visits
- Internship/Research Training (where applicable)
- AI-enabled Learning Tools and Digital Resources
- Blended Learning and Online Learning Platforms

7.2 Attendance Rules

- A minimum of **75% attendance** shall be mandatory in each course.
- Students failing to meet the prescribed attendance requirements may not be permitted to appear in the End Semester Examination.

- Separate attendance requirements may be applicable for laboratory courses, project work, internships, seminars, and dissertation activities.
- Attendance regulations shall be governed by University rules and amendments issued from time to time.

7.3 Examination and Evaluation System

7.3.1 Evaluation Components

The evaluation system shall consist of **Continuous Internal Evaluation (CIE)** and **End Semester Examination (ESE)**.

Continuous Internal Evaluation (CIE) may include:

- Mid-Semester Examination
- Assignments and Problem Sheets
- Class Tests and Quizzes
- Seminar Presentations
- Laboratory Performance and Practical Records
- Viva Voce
- Computational/Simulation-Based Assignments
- Mini Projects
- Research Project/Dissertation Progress Evaluation
- Participation in Academic Activities

End Semester Evaluation (ESE) may include:

- Theory Examination
- Practical Examination
- Viva Voce Examination
- Project/Dissertation Evaluation (where applicable)

7.3.2 Suggested Weightage

- **Continuous Internal Evaluation (CIE): 50%**
- **End Semester Examination (ESE): 50%**

(The exact weightage may be revised as per University/NEP regulations.)

7.3.3 Passing Standards

- A student shall secure a minimum of **40% marks** in each evaluation component, wherever applicable.
- A minimum of **45% aggregate marks** shall be required for successful completion of the course/program, subject to University regulations.
- Separate passing requirements may be applicable for **theory, practical, seminar, project, dissertation, and viva voce examinations**.
- The award of grades and declaration of results shall be governed by the University's examination ordinances and NEP guidelines.

7.1 Grading System

The program shall follow Gandhinagar University grading norms.

7.4.1 Grade Table

Grade	Grade Points	From Marks	To Marks
AA	10	80	100
AB	9	75	79
BB	8	70	76
BC	7	65	69
CC	6	60	64
CD	5	55	59
DD	4	50	54
DF	0	0	49

7.5 Dissertation / Research Project Work

Students shall undertake a **Research Project/Dissertation** in a specialized area of Physics during the final semester of the program. The research work may be carried out in the department, research laboratories, industries, or collaborating institutions.

The requirements may include:

- Research Proposal Presentation
- Literature Survey and Problem Identification
- Periodic Progress Reviews
- Experimental/Computational/Theoretical Research Work
- Dissertation Report Submission
- Seminar Presentation
- Viva Voce Examination

The dissertation/project shall be evaluated by **internal and external examiners** as per University regulations.

8. Rules and Regulations

8.1 Rules for Promotion

A student shall be promoted to the next semester as per **Gandhinagar University regulations**, subject to fulfillment of academic requirements, minimum attendance requirements, and successful completion of the prescribed credits.

8.2 Maximum Duration for Completion

The maximum duration for completing the **M.Sc. Physics** program shall be **4 years from the date of admission** or as prescribed by the University from time to time.

8.3 Internship Guidelines

8.3.1 Students may undergo Internship/Research Training in areas such as:

- Computational Physics and Scientific Computing (Python, MATLAB, Mathematica)
- Data Analysis, Machine Learning, and Artificial Intelligence Applications in Physics
- Semiconductor Physics and Electronic Device Technologies
- Nanotechnology and Advanced Materials Research

- Photonics, Optoelectronics, and Laser Technology
- Plasma Physics and Fusion Research
- Instrumentation and Measurement Systems
- Renewable Energy and Energy Storage Technologies
- Simulation and Modeling of Physical Systems
- Scientific Writing, Technical Documentation, and Science Communication
- Teaching and Academic Training in Educational Institutions
- Research and Development Organizations such as IISc, ISRO, PRL, IUCAA, IPR, BARC, TIFR, SAC, ARCI, NPL, and related laboratories

8.3.2 Students shall submit:

- Internship/Training Report
- Work Diary/Logbook
- Completion Certificate
- Presentation and Viva Voce

8.4 Discipline Rules

Students shall maintain discipline, professional ethics, and appropriate conduct within the institution and during laboratory work, research activities, internships, industrial visits, seminars, conferences, examinations, and all academic engagements.

Students are expected to:

- Attend classes, laboratories, seminars, and research activities regularly.
- Follow institutional rules and regulations.
- Respect faculty members, staff, fellow students, and institutional property.
- Maintain academic honesty and integrity in assignments, projects, publications, dissertations, and examinations.
- Follow laboratory safety protocols and ethical research practices.

Any form of misconduct, ragging, plagiarism, research malpractice, use of unfair means in examinations, damage to institutional property, harassment, or behavior adversely affecting the academic environment shall invite disciplinary action as per University and UGC regulations.

8.5 Anti-Ragging Policy

The program shall strictly comply with:

- UGC Anti-Ragging Regulations
- Anti-Ragging Affidavit Requirements
- Institutional Disciplinary Procedures
- Government Guidelines on Prevention of Ragging

Ragging in any form is strictly prohibited and punishable under applicable laws and regulations.

8.6 Ethical Use of Technology and AI Tools

Students are encouraged to utilize:

- Scientific Computing Software
- Simulation and Modeling Tools
- Artificial Intelligence and Machine Learning Platforms
- Data Analytics and Visualization Tools
- Research Databases and Digital Libraries
- Computational Physics and Mathematical Software

The use of such tools shall be ethical, transparent, and consistent with academic integrity, research ethics, and University policies.

9. Student Support

9.1 Industry and Research Collaboration

The department shall actively promote collaboration with industries, national laboratories, and research organizations working in areas such as semiconductors, photonics, quantum technologies, nanotechnology, advanced materials, renewable energy, plasma science, instrumentation, data science, healthcare technology, and space science.

Such collaborations may include:

- Internships and Research Training
- Joint Research Projects
- Expert Lectures and Workshops
- Industrial and Laboratory Visits
- Consultancy and Sponsored Projects
- Skill Development Programs
- Placement and Career Support
- Collaborative Academic Activities

The institution may establish MoUs with industries, research laboratories, universities, and professional bodies to enhance academic quality, research output, innovation, entrepreneurship, and employability.

9.2 Research and Consultancy

The department shall encourage faculty members and students to actively engage in:

- Fundamental and Applied Physics Research
- Nanomaterials and Advanced Materials Research
- Semiconductor and Electronic Device Studies
- Photonics and Laser Applications
- Quantum Technologies
- Computational and Data-Driven Physics
- Renewable Energy Research
- Scientific Instrumentation Development
- Space Science and Nuclear Science Research

Students shall be encouraged to participate in:

- Research Projects
- Publications in Journals
- Patent Development
- Conferences and Seminars
- Workshops and Training Programs
- Funded Research Activities
- Collaborative Research Initiatives

The institution may also undertake consultancy assignments for industries, government agencies, research organizations, educational institutions, and technology-based enterprises.

9.3 Library and Laboratory Facilities

Adequate library, laboratory, computational, and digital learning facilities shall be provided to support advanced teaching, practical training, research, and skill development under the M.Sc. Physics program.

Facilities may include:

- Well-equipped Physics Laboratories
- Advanced Experimental Setups
- Computing and Simulation Facilities
- High-Speed Internet Access
- E-Journals and Research Databases
- Scientific Software and Data Analysis Tools
- Digital Learning Platforms
- Reference Books, Journals, and Research Publications

These facilities shall support coursework, project work, dissertation research, and interdisciplinary learning.

9.4 Student Support and Mentoring

A structured system of academic mentoring and professional guidance shall be implemented for M.Sc. Physics students.

The department shall provide:

- Academic Counseling
- Research Guidance
- Career Counseling
- Competitive Examination Support
- Higher Education Guidance
- Entrepreneurship and Innovation Support
- Skill Development Programs

Students shall also be encouraged to participate in:

- Workshops and Conferences
- Research Seminars
- Scientific Competitions
- Professional Society Activities
- Industrial and Research Laboratory Visits

Appropriate mechanisms shall be available for addressing academic, professional, and personal concerns in accordance with institutional policies.

9.5 Placement and Career Development

The department shall facilitate placement assistance and career development activities through collaboration with industries, research organizations, universities, and technology-driven enterprises.

Efforts shall be made to establish linkages with organizations such as:

- Indian Space Research Organisation
- Physical Research Laboratory
- Indian Institute of Science
- Institute for Plasma Research
- Tata Institute of Fundamental Research
- Bhabha Atomic Research Centre

- Inter-University Centre for Astronomy and Astrophysics

Career development activities may include:

- Placement Training
- Aptitude and Technical Skill Development
- Resume and CV Preparation
- Interview Preparation
- Research Career Guidance
- Entrepreneurship Development
- Certification Programs
- Soft Skills and Communication Training
- Expert Lectures and Placement-Oriented Workshops

These initiatives shall aim to enhance employability, research competence, professional skills, and lifelong learning among students of the M.Sc. Physics program.

10. Program Credibility

10.1 Executive Summary

The **M.Sc. Physics** program is designed to provide advanced knowledge, research competence, and professional skills in contemporary areas of physical sciences. The program emphasizes a strong foundation in theoretical physics, experimental techniques, computational methods, and interdisciplinary research to address scientific and technological challenges of the modern world.

Through advanced coursework, laboratory training, computational modeling, seminars, research projects, and dissertation work, the program develops highly skilled graduates capable of contributing to academia, research institutions, industries, and government organizations.

The program integrates fundamental principles with emerging fields such as nanoscience and nanotechnology, advanced materials, photonics, quantum technologies, semiconductor science, data analytics, artificial intelligence applications in physics, renewable energy, and space science. It promotes critical thinking, scientific innovation, problem-solving ability, research ethics, and lifelong learning.

By nurturing scientifically competent, technologically proficient, and socially responsible professionals, the M.Sc. Physics program contributes significantly to scientific advancement, technological innovation, and national development.

10.2 Scope and Career Opportunities

Graduates of the M.Sc. Physics program may find opportunities in:

- Research and Development Organizations
- Universities and Higher Educational Institutions
- Semiconductor and Electronics Industries
- Nanotechnology and Advanced Materials Industries
- Photonics and Optoelectronics Industries
- Renewable Energy Sector
- Scientific Instrumentation Industries
- Aerospace and Space Research Organizations
- Nuclear Science and Atomic Energy Establishments
- Defense Research Organizations
- Data Science and Computational Research Sectors
- Healthcare Technology and Medical Physics Applications
- Artificial Intelligence and Scientific Computing Industries
- Quality Assurance and Testing Laboratories
- Government Scientific Departments and Laboratories

10.3 Potential Job Roles

Graduates may pursue careers as:

- Assistant Professor/Lecturer (subject to regulatory requirements)
- Research Scientist
- Junior Research Fellow (JRF)
- Senior Research Fellow (SRF)
- Project Associate/Project Scientist

- Scientific Officer
- Physicist
- Data Analyst
- Computational Scientist
- Semiconductor Process Engineer
- Materials Scientist
- Instrumentation Scientist
- Photonics and Optoelectronics Engineer
- Radiation Safety Officer (subject to certification requirements)
- Scientific Content Developer
- Science Communicator
- Technical Consultant
- Quality Control and Testing Officer
- Research and Development Executive
- Scientific Officer in Defense, Space, and Atomic Energy Organizations
- Civil Services Officer (IAS, IPS, IFS, etc.) through competitive examinations

10.4 Higher Studies and Professional Opportunities

Students may pursue:

- Ph.D. in Physics
- Ph.D. in Applied Physics
- Ph.D. in Materials Science and Engineering
- Ph.D. in Nanoscience and Nanotechnology
- Ph.D. in Photonics and Optoelectronics
- Ph.D. in Semiconductor Science and Technology
- Ph.D. in Quantum Science and Technology
- Ph.D. in Energy Science
- Ph.D. in Computational Physics
- Ph.D. in Atmospheric and Space Physics
- Ph.D. in Medical Physics
- Interdisciplinary Doctoral Programs

- National and International Research Fellowships
- Postdoctoral Research Programs
- Professional Certification Programs in Data Science, Artificial Intelligence, Semiconductor Technology, Scientific Computing, and Advanced Instrumentation

11. Collaborative Research and Experimental Work

Collaborative research and experimental activities constitute an integral component of the M.Sc. Physics program. These activities enable students to engage in advanced scientific investigations, interdisciplinary research, and real-world problem-solving while developing research, analytical, and technical skills.

Objectives

- To develop advanced experimental and research skills.
- To strengthen scientific inquiry and critical thinking.
- To provide exposure to modern research methodologies and instrumentation.
- To promote interdisciplinary collaboration and innovation.
- To develop scientific communication and project management abilities.
- To encourage independent and collaborative research.

Areas of Collaborative Research and Experimental Activities

1. Advanced Physics Laboratory and Research Projects

Students may undertake collaborative projects in:

- Advanced Mechanics
- Condensed Matter Physics
- Solid State Physics
- Quantum Mechanics
- Atomic and Molecular Physics
- Nuclear Physics
- Electronics and Instrumentation
- Photonics and Laser Physics

- Materials Science
- Nanoscience and Nanotechnology

2. Materials Science and Nanotechnology Research

Research activities may include:

- Synthesis and Characterization of Nanomaterials
- Carbon Nanotubes and Graphene-Based Materials
- Thin Film Deposition and Characterization
- Functional Materials and Sensors
- Energy Storage Materials
- Smart and Multifunctional Materials
- Surface and Interface Studies

3. Computational Physics and Scientific Computing

Students may collaborate on:

- Numerical Simulations
- Computational Modeling
- Scientific Programming
- Machine Learning Applications in Physics
- Data Analytics and Visualization
- Artificial Intelligence-Based Scientific Research
- High-Performance Computing Applications

4. Photonics, Optics, and Laser Technology

Research activities may include:

- Optical Characterization Techniques
- Fiber Optics and Communication Systems
- Laser Applications
- Photonic Devices

- Optical Sensors
- Spectroscopy and Imaging Techniques

5. Semiconductor and Electronic Device Studies

Collaborative projects may involve:

- Semiconductor Material Characterization
- Electronic Device Fabrication and Testing
- Sensor Technologies
- Microelectronics and Nanoelectronics
- Instrumentation Systems
- Embedded Systems Applications

6. Environmental, Atmospheric, and Energy Studies

Students may undertake investigations in:

- Renewable Energy Systems
- Solar Energy Assessment
- Environmental Monitoring
- Atmospheric Physics
- Climate and Weather Data Analysis
- Sustainable Energy Technologies

7. Astronomy and Space Science Activities

Activities may include:

- Astronomical Observations
- Telescope Operations
- Space Science Projects
- Astrophysical Data Analysis
- Citizen Science Programs
- Space Research Awareness Activities

8. Research Collaborations with National Laboratories and Industries

Students may undertake collaborative work with organizations such as:

- Physical Research Laboratory
- Indian Space Research Organisation
- Institute for Plasma Research
- Indian Institute of Science
- Inter-University Centre for Astronomy and Astrophysics
- Tata Institute of Fundamental Research
- Bhabha Atomic Research Centre

9. Dissertation and Research Mini-Projects

Students shall undertake supervised research involving:

- Literature Survey
- Research Problem Identification
- Experimental or Computational Investigation
- Data Analysis and Interpretation
- Dissertation Writing
- Seminar Presentation
- Viva Voce Examination

Expected Learning Outcomes

Upon successful completion of collaborative research and experimental activities, students shall be able to:

- Design and execute advanced scientific investigations.
- Apply theoretical concepts to research and technological applications.
- Operate sophisticated scientific instruments and computational tools.
- Analyze, interpret, and communicate scientific data effectively.
- Conduct independent and collaborative research.
- Demonstrate scientific ethics and professional responsibility.

- Develop innovative solutions to contemporary scientific and technological challenges.
- Prepare for doctoral studies, research careers, and advanced professional roles.

12. Review and Revision of Regulations

The University reserves the right to interpret, modify, revise, amend, update, or restructure any provision, rule, regulation, curriculum framework, credit structure, course content, evaluation pattern, academic requirement, research component, internship guideline, dissertation requirement, or operational procedure related to the **M.Sc. Physics Program** from time to time in accordance with University regulations, UGC guidelines, NEP provisions, statutory requirements, scientific advancements, industry developments, and academic needs.

In the event of any ambiguity or dispute regarding the interpretation of any provision contained in this document, the decision of the University/Competent Authority shall be final and binding on all stakeholders.

Any amendments, additions, revisions, or modifications approved by the appropriate academic and statutory bodies of the University shall automatically become applicable to the M.Sc. Physics Program from the date notified by the University.

GANDHINAGAR UNIVERSITY

Annexure I: Detail Syllabus

Gandhinagar Institute of Science Master of Science- Physics Semester-1

Subject Code:	**Subject Title: Quantum Mechanics-I and Mathematical Physics-I**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:

(1) To comprehend and apply the conceptual structure of quantum mechanics.
(2) To improve problem-solving and critical thinking skills.
(3) To characterize the atomic and subatomic behaviour of matter and energy.
(4) To recognize and apply the conceptual structure of Mathematical Physics.
(5) The study of Quantum mechanics and mathematical physics help to understand almost all the modern branches of Physics.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
1.	**Approximation Methods for Stationary States & The variation method:** Approximation Methods for Stationary States: Perturbation theory for discrete levels, Equations in various orders of perturbation theory, Non - degenerate case, Degenerate case - removal of degeneracy, Effect of an electric field on the energy levels of an atom (Stark- effect), Two – electron atoms. Illustrative examples	15	25
	The variation method: Upper bound on ground state energy, Applications to excited states, Trial function linear in variational parameters, The Hydrogen molecule, Exchange interaction. Illustrative examples		
2.	**WKB Approximation & Evolution with time:** WKB Approximation: One - dimensional Schrodinger equation, Bohr - Sommerfeld quantum condition, WKB solution of the radial wave equation. Evolution with time: Exact formal solutions: Propagators, Schrodinger equation: general solution, Propagators, Alteration of Hamiltonian, Transitions and sudden approximation. Illustrative examples	15	25
3.	**Integral transform:** Introduction, Laplace transforms, Solution of differential equations by Laplace transform, Convolution, Inverse Laplace transforms, Applications of Laplace transform for different physical problems	15	25
4.	**Group theory & Tensor:** **Group theory:** Group, Subgroups and classes, Invariant sub groups, Factor groups, Homomorphism and Isomorphism, Group representation, Reducible and irreducible representation, Schur's Lemmas, Orthogonality theorem, Character of a representation, Character tables, Decomposing a reducible representations into irreducible ones, Construction of representation, Representations of groups and quantum mechanics. **Tensor:** Introduction, n - dimensional space, superscripts and subscripts, Coordinate transformations, Indicial summation conventions, Dummy and Real indices, Kronekar delta symbol, Scalars, Contravariant vectors and covariant vectors, Tensors of higher ranks, Algebraic operations, Symmetric and Antisymmetric tensors, Invariant tensors, Conjugate and reciprocal tensors, Relative and absolute tensors, Line element and matrix tensor, Fundamental tensors.	15	25

Course Outcome: After completion of this course, student will be able to

- Use the Laplace transform and its inverse to solve initial value and other related issues.
- Demonstrate a strong comprehension of basic principles in group theory; demonstrate a good understanding of various types of tensors; and acquire basic tensor algebra abilities.
- Determine if a given group is cyclic, and then determine a generator for a subgroup of a particular order given a finite cyclic group. Express a given finite cyclic group as the direct product of cyclic groups of prime power order, then evaluate whether or not two direct products of cyclic groups are isomorphic.
- Understand why tensor analysis is employed and explain how it might be beneficial.

- Describe nondegenerate energy levels and clarify the fundamental ideas of perturbation.
- Quantum mechanical principles and the matrix representation of it are used to solve basic problems using the variational principle and time-independent perturbation theory.

List of Text Books:

1. P.M. Mathews and K Venkatesan, A text book of Quantum Mechanics, Tata MC Graw - Hill publishing company Limited.

2. Mathematical methods for physical sciences by M. L. Boas, 3rd edition 2006, John Wiley and Sons, New York (2nd Ed. 1983).

List of Reference Books:

1. L. I. Schiff, Quantum mechanics, Tata McGraw - Hill publishing company Limited.
2. G. Aruldhas, Quantum mechanics, Prentice - Hall of India.
3. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and applications, Macmillan India Limited.
4. Mathematical physics P. K. Chattopadhyay: 1990, New age international publisher New Delhi.
5. G. Arfken, Mathematical methods for Physicists, Academic Press, 5th edition Academic press/Elsevier science, India 2000.
6. Elements of Group theory for physics A. W. Joshi, 4th edition reprint 2002. New age international publishers, New Delhi.

Open e-Resource:

1. Online course: “Mathematical Physics-1” by Dr. Saurabh Basu on NPTEL (URL link: https://nptel.ac.in/courses/115103036)
2. Online course: " Selected Topics in Mathematical Physics” by Prof. V. Balakrishnan on NPTEL. (URL link: https://nptel.ac.in/courses/115106086)
3. Online course “Quantum Mechanics and Applications”, by Prof. Ajoy Ghatak on NPTEL. (URL Link: https://nptel.ac.in/courses/115102023)

Gandhinagar Institute of Science
Master of Science- Physics
Semester-1

Subject Code:	**Subject Title: Classical Mechanics-I and Statistical Mechanics**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:

(1) To comprehend and be able to apply and solve the conceptual structure of classical mechanics and statistical mechanics to daily routine problems.

(2) To comprehend the numerous forms and techniques - Newtonian mechanics, Lagrangian Mechanics and Hamiltonian Mechanics which are utilized according to which provides the solution most easily and conveniently.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Fluctuations:** Brownian motion, Langevin theory of random motion, Time dependence of fluctuations, Power spectrum of fluctuation, Persistence and correlation of fluctuation, Wiener - Khinching theorem, Johnson noise - Nyquist theorem, Shot noise	15	25
2.	**Critical phenomena and phase transitions** Phase transitions, Condition for phase equilibrium, First order phase transition, Clausius – Clayperon equation, Second order phase transition, The Critical exponent, Co - operative processes, Curie - Weiss theory of Magnetic transition, Ising Model, Ising Model in zeroth approximation, Exact solution of one dimensional Ising Model, Order parameters Critical phenomena and	15	25

	phase transitions.		
3.	**Theory of small oscillations:** General case of coupled oscillations, Eigen vectors and eigen frequencies, Orthogonality of eigen vectors, Normal coordinates, Small oscillations of particles on string	15	25
4.	**Canonical Transformation:** Canonical transformation and Hamilton Jacobi theory: Gauge transformation, Canonical transformation, Condition for transformations to be Canonical. Poission bracket, Canonical equations in terms of Poisson bracket notation, Relation between infinitesimal transformation and Poisson brackets, The Hamilton Jacobi equations, Separation of variables, Action angle variables, Properties of action angle	15	25

Course Outcome: After completion of this course, student will be able to

- Understand the basic concepts of classical mechanics and nonequilibrium statistical mechanics.
- To describe most of the phenomena we come together in our daily activities.
- Learn the concepts of classical mechanics which plays a significant role in more sophisticated applications such as rocket and satellite launch.

- Get basic understanding to develop such laws of physics in quantum physics.
- Gain the knowledge of Hamiltonian formulations and its applications.
- Acquire the understanding and explanation of Canonical and Gauge transformation, Relation between infinitesimal transformation and Poisson brackets, The Hamilton Jacobi equations, Separation of variables and Action angle variables.

List of Text Books:

1. R. G. Takwale and P. S. Puranik, Introduction to Classical Mechanics, 1979, Tata Mc Graw-Hill Pub. Co. Ltd., New Delhi.
2. S.K. Sinha, Statistical Mechanics - Theory and Applications, Narosa Pub. House.

List of Reference Books:

1. Herbert Goldstein, Charles P. Poole & John Safko, Classical Mechanics, 3rd Edition, Pearson Education, Chennai.
2. G. Aruldas, Classical Mechanics, Prentice Hall of India, New Delhi.
3. N. C. Rana & P. S. Joag, Classical Mechanics,1st Edition, Tata McGraw Hill Publication, New Delhi.
4. S.N. Biswas, Classical Mechanics,1/e , Books& Allied (NCBA) Publisher, New Delhi.
5. L. D. Landau &E. M. Lifshitz, Statistical Mechanics, Pergamon Press, Oxford.
6. E.S. Raja Gopal, Statistical Mechanics, and Properties of Matter, McMillan Co. Limited.
7. Evelyn Guha, Statistical Mechanics - An Introduction, Narosa Publishing House.
8. R.K. Patharia Statistical Mechanics, Pergamon Press.

9. F. Reif, Fundamentals of Statistical Mechanics, McGraw Hill Companies.
10. R.K. Srivastava & J. Ashokan, Statistical Mechanics, Printice Hall of India.
11. John D. Walecka, Fundamentals of Statistical Mechanics, World Scientific.

Open e-Resource:

1. Online course: "Classical mechanics: from newtonian to lagrangian formulation", By Prof. Debamalya Banerjee on NPTEL (URL link: https://nptel.ac.in/courses/115105098).

2. Online course: "Nonequilibrium Statistical Mechanics" by Prof. V. Balakrishnan on NPTEL (URL link: https://nptel.ac.in/courses/115106091).

Gandhinagar Institute of Science
Master of Science- Physics
Semester-1

Subject Code:	**Subject Title: Electrodynamics-I and Programming in C-I**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:
(1) To solve and describe the problems and nature of electromagnetic wave and its propagation through different media and interfaces.
(2) To develop confidence for self-education and ability for life-long learning needed for Computer language.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Electromagnetic waves in Matter:** Propagation in linear media, Reflection and transmission of plane waves at normal incidence, Reflection and transmission at oblique incidence, Total internal reflection, Reflection from the surface of a metal, The frequency dependence of permittivity, Illustrative examples.	15	25
2.	**Waveguides:** Propagation of waves between conducting planes, Waves in guides of arbitrary cross-section, Waveguide of rectangular cross section, Co-axial waveguides, Resonant cavities, Dielectric waveguides, Illustrative examples.	15	25
3.	**Programming in C:** Keywords, Identifiers, Constants, Variables, Data Types, Operators, Expressions, Precedence and Associativity of operators, Type conversions, I/O	15	25

	operations, Branching: if, simple if, if- else, nesting of if-else, else if ladder, switch, Conditional operator, Looping: while, do while, for, continue and break, go to.		
4.	**Programming in C** Arrays: One dimensional arrays, Declaration and initialization of arrays, Two dimensional and multi-dimensional arrays, Character strings: Declaration and initialization of string variables, Reading and writing of strings, Arithmetic operations on characters, Concatenation, Comparing, Copying and finding length of strings, String handling functions, Table of strings	15	25

Course Outcome: After completion of this course, student will be able to

- Examine and study the boundary effects on the propagation of electromagnetic waves in matter.
- Learn the behavior of electromagnetic waves in the vicinity of the boundaries of the waveguides.
- Gain knowledge about the most efficient ways of transmitting energy over short distances using wave guides and their practical importance in electronic communication systems.
- Acquire understanding of control structures such as if, switch, while, for, continue and break, concepts of arrays and discuss the array handling techniques.
- Exposed to a number of programs using different logical operations like arithmetic, string handling functions etc. based on basic C-language concepts.

List of Text Books:

1. D. J. Griffiths, Introduction to electrodynamics, Prentice Hall India Ltd. (2nd ed.)
2. E. Balagurusamy, Programminng in ANSI-C (IInd.Ed.), TMH Pub.

List of Reference Books:

1. B.B. Laud, Electromagnetics, Wiley Eastern, (2nd ed.).
2. E. C. Jordan and K. G. Balmain, Electromagnetic waves and radiating systems, Prentice Hall of India, New Delhi, 1976.
3. P.Day and M.Ghosh, Programming in C, Oxford University press, 2007.
4. B.S. Gottfried, Programming with C.
5. Y. Kenetker, Let us C, BPB Pub.
6. B W Kernighan and D.K. Ritchie, C programming language, PH pub.

Open e-Resource:

1. Online course: "Electrodynamics", by Prof. Amol Dighe on NPTEL.
(URL link: https://nptel.ac.in/courses/115101004).
2. Online course: Problem Solving through Programming in C", by Prof. Anupam Basu on NPTEL.
(URL link: https://nptel.ac.in/courses/106105171)
3. Online course: "Introduction to programming in C", by Prof. Satyadev Nandakumar on NPTEL.
(URL link: https://nptel.ac.in/courses/106104128).

Gandhinagar Institute of Science
Master of Science- Physics
Semester-1

Subject Code:	**Subject Title: Solid State Physics and Plasma Physics**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:

(1) To understand many phenomena of Physics, like crystal bonding, lattice vibration defects and superconductivity.

(2) The study of plasma physics helps to understand instability and the fission problem.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Energy Bands** Introduction, Nearly Free Electron Model, Origin of energy gap, Magnitude of the energy gap. Bloch Functions, Kronig-Penney Model, Wave Equation of Electron in a Periodic Potential, Restatement of the Bloch theorem, crystal momentum of an electron, solution of the central equation, empty lattice approximation, Approximate solution Near Zone Boundary, Number of orbitals in a band, Metals and Insulators.	15	25
2.	**Fermi Surfaces and Metals:** Introduction, Reduced zone scheme, Periodic zone scheme, construction of Fermi surfaces, electron orbits, hole orbits and open orbits, Calculations of energy bands, Tight binding method for energy bands, Wigner -Seitz method,	15	25

	cohesive energy, Pseudopotential method, Experimental methods in Fermi Surface studies, Quantization of orbits in a magnetic field, de - Haas - Van Alphen Effect, Extremal orbits, Magnetic breakdown.		
3.	**Scattering and Dispersion:** Scattering of radiation by a free charge, Scattering of radiation by a bound charge, Radiation damping, Dispersion in dilute gases, Dispersion in liquids and solids. Frequency dependence ε, μ, σ. Dispersion in non conductors, Free electrons in conductors and Plasma, Illustrative Examples.	15	25
4.	**Plasma Physics:** The moment equations, Derivation of the moment equations, Magnetohydrodynamic OR MHD, One fluid model, Two fluid model, Illustrative Examples. Collisions, Liouville equation, The system of B.B.G.K.Y. Equations, The B-V equation with self consistent field, Illustrative Examples. Controlled thermonuclear reaction, Lawson criterion, The Coulomb barrier, Heating and confinement of the plasma, Radiation loss of energy, Instability problem, Magnetohydrodynamic conversion of energy, Plasma propulsion, Other plasma devices, Illustrative Examples.	15	25

Course Outcome: After completion of this course, student will be able to

- Understand Bloch's theorem and what energy bands are and know the fundamental principles of semiconductors.
- Explain the formation of energy band and classify metals, semiconductors and insulators, understand different models and methods like the nearly hee electron model, Tight binding approximation, Wigner-Seitz cellular method and Pseudopotential method.
- Describe Fermi Surface, its construction and will be able to apply it to study the heat capacity, electrical conductivity and thermal conductivity of the material.
- Gain information about the Fundamentals of plasma physics describing variety of plasma occurring naturally/artificially.
- Explain the fluid and kinetic description of plasma state, plasma waves and its experimental aspects.
- This overall prepare students foundation for further advanced plasma course like magnetically confined thermonuclear fission and fusion reactor.

- **List of Text Books:**

1. C. Kittle, Introduction to Solid State Physics, 7th Ed., Wiley Eastern Limited, New Delhi.
2. S. N. Goswami, Elements of Plasma Physics, New Central book Agency Pvt. Ltd, Calcutta.

List of Reference Books:

1. J.P. Srivastava: Elements of solid state physics, PHI, India.
2. D. J. Griffiths, Introduction to Electrodynamics (2nd & 3rd Edition) Prentice Hall India Ltd.
3. B. B. Laud, Electromagnetics (2nd Edition), Wiley Eastern.
4. F.F. Chen, Introduction to Plasma Physics, Plenum Press.

Open e-Resource:

1. Online course: "Introduction to Solid State Physics" by Prof. Manoj K Harbola and Prof. Satyajit Banerjee on NPTEL. (URL link: https://nptel.ac.in/courses/115104109).

2. Online course: "Plasma Physics: Fundamentals and Applications" by Prof. V.K. Tripathi and Prof. Vijayshri on NPTEL. (URL link: https://nptel.ac.in/courses/115102020).

Gandhinagar Institute of Science
Master of Science- Physics
Semester-1

Subject Code:	**Subject Title: Physics Laboratory Practicals-I**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:
(1) To introduce the basic concepts of physics through hands on experience and impart experimental skill to students.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
-	**-**	**06**	**08**	**-**	**-**	**140**	**60**	**200**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
SET-A			
1	Ultrasonic Interferometer	3	
2	Phonon dispersion relation using Lattice dynamics kit	3	
3	Efficiency of a G.M. Counter	3	
4	Performance of a vacuum pump and verification of Gaede's equation	3	
5	OPAMP parameters	3	
6	OPAMP as an inverting / non-inverting amplifier	3	

7	Universal gates (NAND and NOR)	3	100
SET-B			
8	RC Phase shift oscillator	3	
9	Astable multivibrator	3	
10	Diagonalization of Symmetric matrix (3x3).	3	
11	Regulated Power Supply	3	
12	C- programming	3	
13	Characteristics of Optoelectronic devices	3	
14	Study of Electron Spin Resonance	3	

Course Outcome: After completion of this course, student will be able to

- Be capable of making observations, displaying data visually, performing calculations based on the data and graph, and determining the results/outcomes/conclusions of the experiment.
- Learn how to use the least square method and analysis of error to define the error specification among experimental readings/observations.
- Taught how to select, fabricate and develop the circuits using the various active and passive components through soldering technique.
- Understand the fundamental Physics behind many scientific discoveries through hands on experience.

List of Text Books: -Nil-

List of Reference Books:

1. Physics by Halliday, Resnick and Krane, Vol.1 and 2, 5th Edition, Wiley Publishing
2. B.L. Worsnop, H.T. Flint, “Advanced Practical Physics for Students”, Methuen & Co., Ltd., London, 1962.
3. R.A. Dunlap, Experimental Physics: Modern Methods, Oxford University Press, New Delhi (1988).
4. E.V. Smith, Manual for Experiments in Applied Physics, Butterworths (1970).
5. D. Malacara (ed.), Methods of Experimental Physics, Series of Volumes, Academic Press Inc. (1988).

Open e-Resource: -Nil-

Gandhinagar Institute of Science
Master of Science- Physics
Semester-2

Subject Code:	**Subject Title: Quantum Mechanics-II and Mathematical Physics-II**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:
(1) To comprehend and apply the conceptual structure of quantum mechanics.
(2) To improve problem-solving and critical thinking skills.
(3) To characterize the atomic and subatomic behaviour of matter and energy.
(4) To recognize and apply the conceptual structure of Mathematical Physics.
(5) The study of Quantum mechanics and mathematical physics help to understand almost all the modern branches of Physics.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Quantum dynamics, Atoms and Molecules** The equations of motion, The Schrödinger picture, The Heisenberg picture, Indistinguishable particles, Pauli principle, Inclusion of spin, Spin functions for two electrons, Spin functions for three electrons, The Helium Atom, Central field approximation, Thomas - Fermi Model of the atom, Hartree equation, Hartree Fock equations.	15	25

2.	**Quantum theory of E-M waves and Radiation** Time dependent perturbation theory, Electric dipole interaction, Quantum electrodynamics, Creation and annihilation operators, Fock states, Quantization of field, Zero-point energy, Coherent state, Description of the electromagnetic field, Interaction of radiation with matter.	15	25
3.	**Complex Variable** Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues. The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Argument principle Example, Additional illustrative examples, The point at infinity, residue at infinity, Mapping Examples, Conformal mapping, Some Application of conformal Mapping examples, Additional illustrative examples.	15	25
4.	**Integral equations and Green's functions** Introduction, Conversion of differential equation into an integral equation, Linear Harmonic oscillator, Liouville - Neumann series, Separation methods, Examples, Nonhomogeneous boundary value problems and Green's functions, Green's functions for one- dimensional problems, Eigen function expansion of Green's function, Fourier transform method of constructing the Green's function, Green's functions in higher dimensions.	15	25

Course Outcome: After completion of this course, student will be able to

- Understand the basic concepts of Quantum dynamics in terms of indistinguishable particles using Schrodinger and Heisenberg picture.
- Study and apply the time dependent perturbation theory and interaction of electromagnetic radiation with matter in terms of indistinguishable particles.
- Understand the basic concepts and general formalism of mathematical physical sciences.
- Learn about the physical interpretation of Complex Variable, Green’s Function and Integral Equations.
- Solve the problems and examples related to Complex Variable, Green’s functions and Integral Equation

List of Text Books:

1. Quantum Mechanics, V. K. Thankappen, Wiley eastern limited.

2. Quantum Mechanics, G. Aruldhas Prentice - Hall of India Private Limited

3. Mathematical Physics, P. K. Chattopadhyaya, Wiley Eastern Ltd.

List of Reference Books:

1. Lasers and non - linear optics, B. B. Laud, New Age International Ltd.
2. Mathematical methods in the Physical sciences, M.L Boas., John Willey, 1966
3. Quantum Mechanics, L. I. Schiff, McGraw - Hill
4. Quantum Mechanics: Theory and applications A. Ghatak and S. Lokanathan, Macmillan India Limited.
5. Mathematical methods for Physicists, G. Arfken, Academic Press, 1970
6. Mathematical Physics, S. Satyaprakash, Sultan Chand & Sons, 1990

Open e-Resource:

1. Online course: “Mathematical Physics-1” by Dr. Saurabh Basu on NPTEL (URL link: https://nptel.ac.in/courses/115103036)

2. Online course: " Selected Topics in Mathematical Physics” by Prof. V. Balakrishnan on NPTEL. (URL link: https://nptel.ac.in/courses/115106086)

3. Online course “Quantum Mechanics and Applications”, by Prof. Ajoy Ghatak on NPTEL. (URL Link: https://nptel.ac.in/courses/115102023)

Gandhinagar Institute of Science
Master of Science- Physics
Semester-2

Subject Code:	**Subject Title: Classical Mechanics-II and Solid State Properties**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:

(1) To comprehend and be able to apply and solve the conceptual structure of classical mechanics to daily routine problems.

(2) To comprehend the numerous forms and techniques - Newtonian mechanics, Lagrangian Mechanics and Hamiltonian Mechanics which are utilized according to which provides the solution most easily and conveniently.

(3) To study of the solid state physics helps to understand many phenomena of physics, like crystal bonding, lattice vibration defects and superconductivity.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Non Linear Oscillations and Chaos** Introduction, Singular Points of Trajectories, Nonlinear Oscillations, , Limit cycle, Chaos, Logistic Map, Poincare System, Strange attractors	15	25
2.	**Relativistic electrodynamics and classical field theory** Relativistic Mechanics, Proper time and proper velocity, Relativistic energy and momentum, Relativistic kinematics, Relativistic dynamics, Relativistic electro dynamics, How field transform. The field tensor, Electro dynamics in	15	25

	tensor notation, Relativistic potentials. The transition from a discrete to a continuous system., The Lagrangian formulation for continuous system, Sound vibrations in gases as an example of Lagrangian formulation, The Hamiltonian formulation for continuous system, Description of fields by variational principles.		
3.	**Magnetism** Diamagnetism, Paramagnetism, Electron Spin Resonance, Nuclear Magnetic Resonance, Spin Relaxation, Weiss theory of Ferro magnetism, the exchange interaction, The Heisenberg model, Ferromagnetic domains, The Bloch wall, Origin of domains, Neel model of Antiferromagnetism, Neel model of Ferrimagnetism, Spin waves, Magnons in Ferromagnets, The Bloch T3/2 law, Magnons in Antiferromagnets.	15	25
4.	**Superconductivity** Introduction, Meissner effect, Heat Capacity, Energy gap, Isotope effect, Thermodynamics of the superconducting transition, London equation, Coherence Length, BCS theory of superconductivity, BCS ground state, Flux quantization in a superconducting ring, Type - I and Type -II superconductors, Vortex state, Single particle tunneling, Josephson superconductor tunneling, DC Josephson effect, AC Josephson effect, Macroscopic quantum interference, Introduction to High Tc Superconductors	15	25

Course Outcome: After completion of this course, student will be able to

- Introduce and describe nonlinear phenomena in physical systems by using a basic background in Physics.
- Have an understanding of how and why a dynamical system becomes chaotic,
- Understand fundamental characteristics of chaotic systems and how they are modelled.
- Develop a basic concept on phase portraits, bifurcations, limit cycles, chaotic attractors, Poincare and Lorenz maps, multiscale, perturbation theory, Iterative maps, period doubling, chaos, scaling and universality and fractals with physical examples.
- Learn about the properties and characteristics of diamagnetic, paramagnetic and ferromagnetic behaviour of magnetic materials using several models and techniques.
- Demonstrate understanding of basic theory, properties and applications of Superconductivity.

List of Text Books:-Nil-

List of Reference Books:

1. Classical Mechanics, A. B. Bhatia, Narosa Publishing house.

2. Classical Mechanics (2nd Ed), Herbert Goldstein, Addison - Wesley Publishing Co.
3. Classical Mechanics, G. Aruldhas PHI Pvt. Ltd.
4. Classical Mechanics, J. C. Upadhyaya Himalaya Publishing House.
5. Classical Mechanics, S. N. Biswas Books and allied (P.) Ltd.
6. Classical Mechanics (3rd ed.), Goldstern, Poole and Safko, Pearson Education.
7. Introduction to Solid State Physics, C. Kittle, 7th Ed., Wiley Eastern Limited, New Delhi
8. Elements of solid state physics, J.P.Srivastava, PHI, India..

Open e-Resource:

1. Online course: "Classical mechanics: from newtonian to lagrangian formulation", By Prof. Debamalya Banerjee on NPTEL (URL link: https://nptel.ac.in/courses/115105098).

2. Online course: "Concepts in Magnetism and Superconductivity", by Prof. Arghya Taraphder on NPTEL (URL link: https://nptel.ac.in/courses/115105131).

3. Online course: "A brief course on Superconductivity", by Dr. Saurabh Basu on NPTEL (https://nptel.ac.in/courses/115103108).

Gandhinagar Institute of Science
Master of Science- Physics
Semester-2

Subject Code:	**Subject Title: Semiconductor Physics and Devices**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:
(1) To analyze the nature of various semiconducting material in variable conditions.
(2) To develop and study the working and applications of diodes, FETs, optoelectronic devices and detectors using the semiconducting material.
(3) To acquire the basic knowledge of digital logic levels i.e. TTL, NMOS and CMOS logic families and application of knowledge to understand digital integrated circuits.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Energy Bands and carrier concentration in Thermal Equilibrium** Energy Bands; Energy levels of isolated atoms, Energy momentum Diagram, Direct and Indirect band gap semiconductors; band diagrams of metals, semiconductors and insulators, Intrinsic carrier concentration, Concept of Fermi factor, Extrinsic semiconductors : Donors and Acceptors, Nondegenerate and Degenerate semiconductors, Carrier Drift : Mobility and its relation with resistivity and conductivity, The Hall effect.	15	25
2.	**p-n Junction** Band Diagram of p-n junction in thermal equilibrium; Equilibrium Fermi levels; Space Charge; Depletion region, Abrupt junction; Widths of the	15	25

	depletion region in abrupt junction; Depletion capacitance; Capacitance-voltage characteristics; Current voltage characteristics; Ideal diode equation.		
3.	**Field Effect transistors & Optoelectronic Devices** Field Effect transistors: JFET: Characteristic Parameters of FET, Effect of Temperature on FET Parameters, FET Amplifiers: Common Drain Amplifier, Common Gate Amplifier, MOSFET: Depletion MOSFET, Enhancement MOSFET, Differences between JFET and MOSFET, Handling precaution for MOSFET Optoelectronic Devices: Sources: LED: Introduction, Radiative transitions, Emission spectra, Methods of excitations, LED Structures; Materials for choice, Definition of efficiencies, Semiconductor Laser: Semiconductor laser structures & Materials, Advantages laser over Optical sources Detectors: Introduction, Photoconductor, Photodiodes, p-i-n & p-n photodiodes, Avalanche photodiode, Phototransistor, Photo voltaic effect and solar cells	15	25
4.	**Digital Integrated Circuits** Introduction, Level of Integration, Digital IC Families, TTL Logic Family: Introduction, NAND Gate with Totem-pole Output, Types of TTL, TTL parameters: floating inputs, worst-case input/output voltages, profile and windows, compatibility, sourcing and sinking, noise immunity, standard loading, loading rules. Three state TTL Devices. MOS Logic Family: Introduction, MOS Inverters, NMOS - NAND & NOR Gates. CMOS Logic Family : NAND & NOR Gates, Power Dissipation, CMOS characteristics: Floating inputs, Compatibility, Sourcing & Sinking, TTL to CMOS and CMOS to TTL interface, Comparison of Various Logic Families	15	25

Course Outcome: After completion of this course, student will be able to

- Demonstrate understanding of basic principles, properties and applications associated with semiconducting materials.
- Understand the basic concepts of semiconductor devices and digital integrated circuits.
- Learn about basics of field effect transistors and optoelectronic devices like LED, Semiconductor Laser, Photoconductor, Photodiode, Phototransistor and Photovoltaic cells.
- Implement semiconductor devices and semiconductor physics along with other systems involved in the manufacturing of integrated circuits and chip electronics in industry and material science research.

List of Text Books: -Nil-

List of Reference Books:

1. Semiconductor Devices : Physics and Technology (2nd Ed) by S.M. Sze, Wiely (India)
2. Physics of Semiconductor Devices (4th Ed), S. M. Sze and Kwok. K. Ng., John Wiely & Co.
3. Semiconductor Physics and Devices: Basic Principle (3rd Edition), Donald Neauman, Tata McGraw Hill.
4. Solid State Electronic Devices (6th Edition), Ben G. Streetman and S. Banerjee, PHI
5. Physics of Semiconductor Devices, Michael Shur, PHI Learning.
6. Electronic Devices and Circuits: An Introduction, Allen Motershead , PHI
7. Optoelectronic Devices and Circuits: A.K. Ganguly, (NAROSA)
8. Digital Principles and Applications, Albert Paul Malvino, Donald P.Leach & Goutam Saha, TMH, 7th Edition
9. Digital Circuits and Systems, C.B Agrawal, & M.K Garg., Umesh Publications.

Open e-Resource:

1. Online course: “Introduction to Semiconductor Devices” by Prof. Naresh Kumar Emani on NPTEL. (URL link: https://nptel.ac.in/courses/108106181).
2. Online course: “Semiconductor Devices and Circuits” by Prof. Sanjiv Sambandan on NPTEL. (URL link: https://nptel.ac.in/courses/108108112)
3. Online course: “Semiconductor Optoelectronics”, by Prof. M. R. Shenoy on NPTEL. (URL link: https://nptel.ac.in/courses/115102026).
4. Online course: “Digital Integrated Circuits”, by Prof. Amitava Dasgupta on NPTEL. (URL link: https://nptel.ac.in/courses/108106069).

Gandhinagar Institute of Science
Master of Science- Physics
Semester-2

Subject Code:	**Subject Title: Analog Electronics**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:
(1) To understand many phenomena of Physics, like crystal bonding, lattice vibration defects and superconductivity.
(2) The study of plasma Physics helps to understand instability and the fission problem.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Power Supply and Regulators** IC Regulators using 723, Positive, Negative, Low and High voltage regulators, current booster transistor, fold back current limiting circuit. The Operational Amplifier & Applications : active filters, low pass, high pass, band pass, band reject, notch, first and second order filters, comparators, sample and hold circuits, Logarithmic & antilogarithmic amplifiers	15	25
2.	**Tuned & Wide Band Amplifiers** The pole-zero diagram, single tuned amplifier-root locus, inductively coupled circuits, tuned primary amplifiers, tuned secondary FET amplifier, the double tuned transformer, stagger tuned amplifiers, response to pulses, bandwidth	15	25

	requirement for pulse amplification, rise time in pulse amplifier, sag of the pulse, shunt peak video amplifier. Rise time at the shunt peaked amplifier. PLL : Basic PLL operation, Lock range and capture range, PLL as AM and FM detector.		
3.	**Power Amplifiers & Multivibrators** Power Amplifiers: Class - A large signal amplifiers, transformer coupled Class - A amplifier, second harmonic distortion, push - pull Class - A amplifier, Class - B Push - Pull amplifiers. Multivibrators: Astable, Monostable, Bistable Multivibrators and Schmitt Trigger circuits using transistors. (With analysis)	15	25
4.	**Operational Amplifiers & Its Applications** Frequency compensation and slew rate, DC and AC amplifiers, Integrator and differentiator, Voltage to current and current to voltage converter, Bridge amplifier, electronic analog computation, sine, square, triangular and saw tooth wave generators, Schmitt trigger	15	25

Course Outcome: After completion of this course, student will be able to

- Understand the types of large signal power amplifiers and their merits and demerits.
- Learn to analyze the large tuned and wide band amplifiers and its applications.
- Give idea about the various types of filters, their working, characteristics, and applications.
- Make students familiar with the types of multivibrators, their working, and applications.
- Study the basic and advanced characteristics and applications of operational amplifiers.

- **List of Text Books:-Nil-**

List of Reference Books:

1. K.R. Botkar, Integrated circuits, Khanna Publishers
2. Electronic Devices and Circuit Theory, Robert Boylested and L. Nashelsky, PHI (3rd Ed.)
3. Electronic Fundamentals and Applications : Integrated and Discrete Systems, John D. Ryder, PHI, Fifth edition.
4. OPAMP & Linear Integrated Circuits, Ramakant Gaiekwad, PHI

Open e-Resource:

1. Online course: "Analog Electronic Circuits", by Dr. Shouribrata Chatterjee on NPTEL.
(URL link: https://nptel.ac.in/courses/108102112).
2. Online course: "Analog Circuits", by Prof. Jayanta Mukherjee on NPTEL.
(URL link: https://nptel.ac.in/courses/108101094).
3. Online course: **"**ANALOG ELECTRONIC CIRCUITS" ,by Prof. S.C. Dutta Roy on NPTEL.
(URL link: https://nptel.ac.in/courses/108102095).

Gandhinagar Institute of Science
Master of Science- Physics
Semester-2

Subject Code:	**Subject Title: Physics Laboratory Practicals-II**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Objective:
(1) To introduce the basic concepts of physics through hands on experience and impart experimental skill to students.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
-	**-**	**06**	**08**	**-**	**-**	**140**	**60**	**200**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
SET-A			100
1	Hall mobility and Hall angle	3	
2	Schmitt trigger	3	
3	SCR Characteristic	3	
4	Absorption coefficient of Beta particles of Aluminum	3	
5	Numerical Solution of a Polynomial	3	
6	Resistivity of a semiconductor by four probe method	3	
7	OPAMP as current/voltage and voltage/current converter	3	
8	OPAMP as Integrator and differentiator	3	

SET-B		
9	Calculation of Empty Lattice Energy Bands	3
10	C-programming	3
11	Random walk problem	3
12	Characteristics of Optoelectronics devices	3
13	Curie Temperature of a given material	3
14	Wavelength of a LASER source	3
15	Characteristics of a MOSEFET	3
16	Study of bending loss of an optical Fiber	3

Course Outcome: After completion of this course, student will be able to

- Be capable of making observations, displaying data visually, performing calculations based on the data and graph, and determining the results/outcomes/conclusions of the experiment.
- Learn how to use the least square method and analysis of error to define the error specification among experimental readings/observations.
- Taught how to select, fabricate and develop the circuits using the various active and passive components through soldering technique.
- Understand the fundamental Physics behind many scientific discoveries through hands on experience.

List of Text Books: -Nil-

List of Reference Books:

1. Physics by Halliday, Resnick and Krane, Vol.1 and 2, 5th Edition, Wiley Publishing

2. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962.

3. R.A. Dunlap, Experimental Physics: Modern Methods, Oxford University Press, New Delhi (1988).

4. E.V. Smith, Manual for Experiments in Applied Physics, Butterworths (1970).

5. D. Malacara (ed.), Methods of Experimental Physics, Series of Volumes, Academic Press Inc. (1988).

Open e-Resource: -Nil-

Gandhinagar Institute of Science
Master of Science- Physics
Semester-3

Course Objective:

1) To comprehend and apply the conceptual structure of Nuclear Physics, quantum mechanics and Instrumentation

2) To improve problem-solving and critical thinking skills.
3) To characterize the atomic and subatomic behaviour of matter and energy.
4) To recognize and apply the conceptual structure of Nuclear Physics.

Subject Code:	**Subject Title: Nuclear Physics-I, Advanced Quantum Mechanics-I and Instrumentation**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

5) The study of Advanced Quantum mechanics and Nuclear physics help to understand almost all the modern branches of Physics.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Nuclear Properties:** Nuclear spin, electric moments, magnetic moments, a brief description of hyperfine structure of atomic spectra, effect of an external magnetic field on the hyperfine structure, determination of I from molecular band spectra, molecular beam resonance method – experiments on hydrogen and deuteron.	15	25
2.	**Two-body forces:** Deuteron. Excited states of the deuteron, neutron proton scattering at low energies, scattering length, spin dependence of neutron proton scattering, singlet state in n-p system, effective range theory in n-p scattering, tensor forces, magnetic moment and electric quadrupole moment of the deuteron, proton scattering at low energy, exchange forces, meson theory of nuclear forces.	15	25
3.	**Scattering theory:** Kinematics of the scattering process: differential and total cross sections elastic and inelastic scattering, wave mechanical picture of scattering: the scattering amplitude, Green's functions: formal expression for scattering amplitude. The Born approximation, validity of the Born approximation, The Born series, The Eikonal approximation, Asymptotic behaviour of partial waves: phase shifts, The scattering amplitude in terms of phase shift, The differential and total cross sections: optical theorem, Phase shifts: Relation to the potential, Potentials of finite range, Low energy scattering, scattering by a square well potential, scattering by a hard sphere, scattering by a coulomb potential, Complex potential and absorption.	15	25
4.	**Transducers, Measurement and control:** Transducers: Desired characteristics of transducer, Different transducers: Temperature, Capacitive, Magnetic field, LVDT, Optical, Piezoelectric, Pyrometer. Measurement and control: Types of noises in electrical systems, Signal to noise ratio, Enhancement of signal to noise ratio, Signal conditioning and recovery, Impedance matching, filtering and noise reduction, shielding and grounding, Phase sensitive detector and lock-in amplifier.	15	25

Course Outcome: After completion of this course, students will be able to

- Understand Nuclear properties, like electric moments, magnetic moments and hyperfine structure etc.
- Understand and solve Two body problems of deuteron.
- Study Born approximation and complex potential and absorption in scattering theory.

Subject Code:	**Subject Title: Numerical Methods and Digital Electronics**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

- Understand the essential experimental techniques based on different transducers for Physical sciences.

List of Text Books:

1. P.M. Mathews and K Venkatesan, A text book of Quantum Mechanics, Tata MC Graw - Hill publishing company Limited.
2. M M. Sayer & A Mansingh., Measurement, Instrumentation and experimental design for Physicists and Engineers: Prentice Hall of India
3. D. C. Tayal, Nuclear Physics, Himalaya Publishing House Ltd. (ISBN: 978-93-5097-830-6, Revised and Enlarged Edition).
4. D. J. Griffiths and D. F. Schroeter, Introduction to Quantum Mechanics, 3rd Ed., Cambridge University Press India Pvt Ltd (2019).

List of Reference Books:

1. H. A. Enge, Introduction to Nuclear Physics, Addison-Wesley Publishing Company (1966).
2. R. R. Roy and B. P. Nigam, Nuclear Physics Theory and Experiments, 2nd Ed., New Age International Pvt. Ltd. New Delhi (2014).
3. S. B. Patel, Nuclear Physics: An Introduction, New Age Int. Pub., New Delhi (2021).
4. J. Singh, Fundamentals of Nuclear Physics, Pragati Prakashan, Meerut (2021).
5. K. S. Krane, Introductory Nuclear Physics, John Willey & Sons, New York (1988).
6. V. K. Thankappan , Quantum Mechanics, New Age International Publishers, 5th Ed., New Delhi (2020).
7. G. Aruldhas, Quantum Mechanics, 2nd Ed. PHI Learning Pvt. Ltd., Delhi (2017).
8. A. Ghatak and S. Loknathan, Quantum Mechanics, 6th Ed., Trinity Press, New Delhi (2019).
9. L. I. Schiff, Quantum Mechanics, 4th Ed., Tata McGraw Hill Edu., New Delhi (2017).
10. Khanna M. P., Introduction to particle physics, PHI Publications.
11. T. P. Holmann., Experimental systems, Applications and Design : TMH publication.

Open e-Resource:

Gandhinagar Institute of Science
Master of Science- Physics
Semester-3

Course Objective:

(1) To comprehend and be able to apply and solve Mathematical problems using the various Numerical Methods.
(2) To comprehend the numerous forms and techniques of Digital Electronics which are utilized according to which provides the solution most easily and conveniently.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Numerical Solution of Ordinary Differential Equations**: Introduction, Picard's method, Taylor's series method, Euler's method, Modified Euler's method, Runge's method, Runga-Kutta method, Predictor-corrector method, Milne's method, Adams-Bashforth method.	15	25
2.	**Numerical Solution of Partial Differential Equations: Introduction, Classification of second order equations, Elliptical equations, Solution of Laplace equation, Solution of Poisson's equation, Parabolic equations, Solution of one-dimensional heat equation, Solution of two dimensional heat equation, Hyperbolic equations, Solution of wave equation.**	15	25
3.	**Digital Electronics:** Parity generators and checkers, read only memory, programmable array logic. Clocks & Timers: Clock waveform, TTL clock, 555 Timer (internal block diagram) as Monostable Multivibrator and as Astable Multivibrator. Shift Registers: Types of registers, serial in - serial out, serial in - parallel out, parallel in - serial out, parallel in - parallel out, ring counter. Counters: Concept of asynchronous counters (IC 7493 Binary counter, IC 7490 Decade counter), Concept of synchronous counters (IC 74193-4-bit up-down counter) Digital clock.	15	25
4.	**D/A and A/D Conversion:** Variable register network, Binary ladder, D/A converter, D/A accuracy and resolution, A/D converter - simultaneous conversion, counter method, continuous A/D conversion, A/D techniques, Dual slope A/D conversion, A/D accuracy and resolution, application of DAC & ADC, Displays: LED (seven segment), dot matrix, plasma, LCD.	15	25

Course Outcome: After completion of this course, students will be able to

- Understand the basic concepts of numerical techniques to solve ordinary differential and partial differential equations.
- Learn the numerical techniques to solve the essential problems of physical systems.
- Get basic understanding to develop the Digital circuits, memories, clocks, timers and counters in detail.
- Gain the knowledge of Digital Electronics and its applications in routine life.
- Acquire the understanding and explanation of ADC and DAC techniques for digitization of signals.

List of Text Books:

. Numerical Methods in Engineering and Science, B.S. Grewal and J. S. Grewal, Khanna Publishers, New Delhi (2002)

. Digital Principles and Applications, Albert Paul Malvino , Donald P. Leach and Saha, Tata McGraw-Hill Publishing Company Limited, New Delhi.

List of Reference Books:

. Numerical Methods, Balgurusamy, Tata McGraw-Hill Pub. Co. Ltd, New Delhi (2000)

. Numerical Methods with Computer Programs in C++, Pallab Ghosh, Prentice-Hall of India Private Limited, New Delhi (2006)

. Fundamentals of Digital Circuits, Anand Kumar, PHI Private Limited, New Delhi (2006)

. Digital Logic and Computer Design, Morris Mano, PHI Private Limited, New Delhi (2006)

Open e-Resource:

1. Online course:

Subject Code:	**Subject Title:** Satellite communications, Fibre optics and Microprocessor-I
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Gandhinagar Institute of Science
Master of Science- Physics
Semester-3

Course Objective:

1) To solve and describe the problems and nature of electronic communication techniques and its propagation through different media and interfaces.
2) To gain the knowledge of Fundamentals of Microprocessors & Microcomputers.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Radio Wave Propagation and Satellite communication:** Radio Wave Propagation: Propagation in free space - mode of propagation, microwave systems. Tropospheric Propagation - mode of propagation, radio horizon, super and sub refractions, attenuation in atmosphere, VHF/UHF radio system. Ionospheric propagation - ionospheric layers, effect of ionosphere on wave propagation, plasma frequency and critical frequency, secant law skip distance and MUF, optimum working frequency, virtual height, effect of earth's magnetic field, service range, ionospheric irregularities and disturbances, HF radio systems. Surface wave – mode of propagation,	15	25

	ground wave. Satellite communication: Kepler's laws, orbits, geostationary orbit, power systems, attitude control, station keeping, antenna look angles, limits of visibility, frequency plan and polarization, satellite antenna radiation pattern, transponders, uplink and downlink power budget calculations, overall budget calculations, multiple access methods, applications of satellite communication, satellite radio navigation, Indian communication satellites.		
2.	**Fiber optic Communication:** Principle of light transmission in a fiber - propagation with in a fiber, fiber index profiles, Modes of propagation - overview of modes, key modal concepts, Maxwell's equations, waveguide equations for cylindrical fiber, wave equations for step index fiber, modal equation, modes in step index fiber, single mode fiber. Losses in fibers - absorption losses, leaky modes, mode coupling losses, bending losses, combined fiber losses. Dispersion - effect of dispersion on pulse transmission, intermodal dispersion, material (chromatic) dispersion, total dispersion and maximum transmission rates. Light sources and detectors for fiber optics. optical receiver circuit. Connectors and splices - losses in connectors and splices, connectors, fiber splices. Fiber optic communication link.	15	25
3.	**Microprocessor- based systems: Hardware and interfacing:** A programmable machine: device, Memory, Input/output, CPU. Block diagram of a Microcontroller, Advances in semiconductor Technology, Organization of Microprocessor-Based system. Microprocessor Instruction set and computer languages: Machine Language: 8085 Machine language, 8085 Assembly language. ASCII code, writing and Executing Assembly language program, High level languages, Block diagram of Translation High level language into Machine code, operating system. From large computer to Single chip Microcontrollers: Large Computers, Medium size computers, Microcomputers, personal computers, workstations, single board Microcomputers, Single chip Microcomputers (Microcontrollers) Application: Microprocessor controlled Temperature system (MCTS): System hardware, Microprocessor-controlled Temperature system (MCTS) block diagram, Microprocessor, Memory, input (A/D converter) Temperature sensor, output including Fan, Header, LCDs, system software (Programs). Introduction to 8085 Assembly Language Programming: The 8085 Programming Model Hardware Model, Programming model: Registers, Accumulator, Flags, Program Counter (PC) and Stack Pointer (SP); Instruction classification: The 8085instruction set, Data transfer operations, Arithmetic operations, logical operations, Branching Operations, Machine control operations and Review. Instruction, Data format and Storage: Instruction Work size: one byte, two byte, Three byte, Opcode format, Data format: ASCII Code, BCD code, Signed integer, Unsigned integers, Instruction and data storage: Memory. How to write Assemble and execute a simple program: Illustrative program: Addition of two hexadecimal numbers, including Flow chart, Manual assembly process and executing a program. Writing and hand assembling a program: Illustrative program: Subtracting two hexadecimal numbers and storing the result in Memory, writing Mnemonics, and Assembling Hex code, common errors.	15	25
4.	**Microprocessor Architecture and Microcomputer Systems:** Microprocessor Architecture and Its Operations, Memory: Flip-Flop or Latch as a storage Element, Memory Map and Addresses, Examples, Memory Address Range of a 1K Memory chip, Memory Address Lines, Memory work	15	25

	size, Memory and Instruction Fetch, Memory classification: From static Memory to Flash Memory, Advances in Memory technology. Input and output (I/O) devices: I/Os with 8-bit Addresses (Peripheral-Mapped I/O), I/O with 16-bit Addresses (Memory-Mapped I/O) Logic devices for interfacing: Tri-state devices, Buffer, Examples of Tri-state buffer. Bidirectional buffer, octal buffer, Logic diagram and Function Table, Decoder, (2 to 4), (3 to 8), Examples of Decoders, Encoder (8 to3), D-Flip-Flops: Latch and clocked; Examples of Latches (Registers), Logic diagram and Function Table. 8085 Microprocessor, Architecture and Memory interfacing: The 8085 MPU : The 8085 Microprocessor, Address bus, The 8085 Microprocessor pin out and signals, Multiplexed Address/data bus, Control and status signals, power supply and clock frequency, Externally initiated signals, Microprocessor communication and Bus timings, Examples of Data flow from Memory to MPU, Timing diagram, De-multiplexing the bus AD7-AD0, Generating control signals, A detail look at the 8085 MPU and its Architecture, The 8085A Microprocessor: Functional block diagram Example of Instruction decoding and execution, Example of an 8085-based Microcomputer: 8085 single-Board Microcomputer system, The 8085 Machine cycles and Bus timing, Op-code Fetch Machine cycle, Memory read Machine cycle with example and Timing diagram, How to recognize machine cycle.		

Course Outcome: After completion of this course, students will be able to

- Gain knowledge about different aspects of digital communication in electronic communication systems.
- Learn the different modes of radio wave propagation.
- Acquire understanding of Satellite communication and optical fibre communication.
- Exposed to architecture, instruction sets including classification, buses, machine cycles, writing and executing of simple programs as well as pin and functional block diagrams of 8-bit 8085 Microprocessor.
- Get some information about ASCII, and BCD codes and understand the details of Microcomputer systems along with logic devices, and memory interfacing.

List of Text Books:

. Roddy D. and Cooln J., Electronic communications, PHI, 2006

. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar, Penram International Publishing India Private LTD. (5^{th} edition)

List of Reference Books:

. Kennedy G and Davis B. Electronic Communication systems, TMH 1999.
. Tosmasi W., Advanced Electronic Communication system, PHI.
. Keiser G, Optical fiber communications, MGH Publications, 2000.
. Senior J.M., Optical Fiber Communications – Principles and practice, Pearson, 2007.
. M.L. Gupta, Electronic and Radio engineering Dhanpat Rai & Sons, 1991.
. Microprocessor, Microcomputer & their Applications, A.K Mukhopadhaya, NAROSA Publisher.
. Fundamentals of Microprocessors & Microcomputers B. Ram, Dhanpat Rai & Sons.

Open e-Resource:

. Online course:

Course Objective:

1) To understand the transmission line theory that bridges the gap between field analysis and basic circuit theory. The phenomenon of wave propagation on transmission lines is approached from an extension of circuit theory as well as from a specialization of Maxwell's equations.

Subject Code:	**Subject Title: Electronics Communication-I**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

2) The study of Elements of analogue and digital communication systems.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Transmission Line Theory:** Lumped element circuit model for a transmission line, Field analysis of transmission lines, The terminated lossless transmission line, Smith chart. The quarter wave transformer, Generator and load mismatches, Lossy transmission lines.	15	25
2.	**Antenna:** Basic antenna parameters (radiation pattern, radiation resistance, directivity and gain), Half-wave dipole antenna, effect of ground on the radiation pattern of ungrounded antenna, antenna arrays, Yagi antenna, antenna system employing parabolic reflectors, frequency independent log-parabolic antenna.	15	25
3.	**Analog Modulation:** Amplitude modulation: Theory of amplitude modulation, Frequency spectrum of AM wave, AM modulator and detector. Single side band modulation: Single sideband principle, FET balanced modulator, SSB generation: Filter method, Phasing method and Third method. Angle Modulation: Theory of frequency and phase modulation, frequency spectrum of FM wave. Reactance FM Modulator, Armstrong method of frequency modulation. Slope detector, Stagger tuned detector, Foster-Seeley discriminator, Ratio detector.	15	25
4.	**Pulse Modulation and Digital Communication:** Pulse Modulation: Pulse amplitude modulation, Pulse code modulation, PCM Receiver, Pulse time modulation, Pulse position modulation, Pulse width modulation. Synchronization, Probability of bit error in baseband transmission, matched filter, Bit-timing recovery, carrier recovery systems. Digital carrier systems: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Continuous	15	25

	Phase Frequency Shift Keying (CPFSK), Minimum Shift Keying (MSK), Phase Shift Keying (PSK).		

Course Outcome: After completion of this course, students will be able to

- Gain knowledge about Various techniques of modulation [FM, AM, PAM, PPM, PFM] and different aspects of transmission lines in electronic communication systems.
- Understand the difference between lossy, lossless, short circuit, open circuit and quarter wave lines.
- Acquire the knowledge about the various antenna parameters and the basic operating principles of antennas used in communication systems.
- Learn about the different types of the antennas that are commonly used in day-to-day life for analogue and digital communication systems.

Subject Code:	**Subject Title: Physics Laboratory Practicals-III**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

List of Text Books:

. David M. Pozar, Microwave Engineering (Third Edition), Wiley- India.
. J. D. Ryder, Networks, Lines and Fields, PHI Pvt. Ltd. New Delhi, 1991.
. Roddy D. and Coolen J., Electronic communications, PHI, 2006.

List of Reference Books:

. G. P. Srivastava, V. L. Gupta, Microwave Devices and Circuit Design, PHI.
. G. S. Raghuvanshi, Microwave Engineering, CENGAGE Learning.
. E. C. Jordan and K. G. Balman, Electromagnetic waves and radiating systems, PHI
. Kennedy G and Davis B. Electronic Communication systems, TMH 1999.
. Tosmasi W., Advanced Electronic Communication system, PHI.

Open e-Resource:

. Online course:

Gandhinagar Institute of Science
Master of Science- Physics
Semester-3

Course Objective:

1) To introduce the basic concepts of physics through hands on experience and impart experimental skill to students.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**		
Lecture	**Tutorial**	**Practical**	**Credit**	**Theory**	**Practical**	**Total**

				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
-	-	06	08	-	-	140	60	200

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
SET-A			100
1	Design and Study of Astable Multivibrator using IC 741	3	
2	Design and Study of Phase Shift Oscillator using IC 741	3	
3	Design and Study of Voltage Regulated Power Supply using IC 723	3	
4	Design and Study of Schmitt Trigger using IC 741.	3	
5	Design and Study of Astable & Monostable Multivibrator using IC 555.	3	
6	Design and Study of Two Stage Amplifier using ICs 741.	3	
7	Numerical study of Chaos	3	
SET-B			
8	Design and Study of different types of Flip-Flops using IC 7400,7402 & 7473.	3	
9	Study of different types of Shift Registers using IC 7493.	3	
10	Design and study of decade counter and divide by six counter using IC 7490.	3	
11	Determination of Guide Wavelength of a rectangular wave guide.	3	
12	Study of PLL characteristics using IC 565.	3	
13	ExpEyes based Experiments - I	3	
14	ExpEyes based Experiments - II	3	

Course Outcome: After completion of this course, student will be able to

- Be capable of making observations, displaying data visually, performing calculations based on the data and graph, and determining the results/outcomes/conclusions of the experiment.
- Learn how to use the least square method and analysis of error to define the error specification among experimental readings/observations.
- Understand the fundamental Physics behind many scientific discoveries through hands on experience.

List of Text Books: -Nil-

List of Reference Books:

1.Physics by Halliday, Resnick and Krane, Vol.1 and 2, 5th Edition, Wiley Publishing.
2.B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962.
3.R.A. Dunlap, Experimental Physics: Modern Methods, Oxford University Press, New Delhi (1988).
4.E.V. Smith, Manual for Experiments in Applied Physics, Butterworths (1970).
5.D. Malacara (ed.), Methods of Experimental Physics, Series of Volumes, Academic Press Inc. (1988).

Open e-Resource: -Nil-

Subject Code:	Subject Title: Nuclear Physics-II and Advanced Quantum mechanics-II
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Gandhinagar Institute of Science
Master of Science- Physics
Semester-4

Course Objective:

1) To comprehend and apply the conceptual structure of advanced quantum mechanics.
2) To improve problem-solving and critical thinking skills.
3) To understand the behaviour of non-relativistic and relativistic wave equations in terms of atoms and elementary particles.
4) The study of Quantum mechanics and Nuclear physics helps us to understand different types of nuclear reactions and basic particle Physics.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory		Practical		
Lecture	Tutorial	Practical	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total
04	-	-	04	70	30	-	-	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Nuclear reactions:** Nuclear reactions and cross sections, Resonance: Breit Wigner dispersion formula for 1=0, the compound nucleus, continuum theory of nuclear reaction, Direct reactions, theory of stripping reactions - semi classical description and wave mechanical description. Model: Single particle shell model, spin-orbit potential, analysis of shell model predictions –spins and parities of nuclear ground states, magnetic moments, electric quadrupole moment, nuclear isomerism, stripping reactions and shell model, Collective nuclear model – rotational states and vibrational states, a brief description of Nilson model.	15	25
2.	**Particle Physics:** Classification of elementary particles, types of interaction, Baryon number, lepton number, parity, charge conjugation and Time reversal, CPT theorem, charge independence of nuclear forces, Isospin, consequences of isospin invariance. G-parity, strange particles, associated production, strangeness, Gell Mann-Nishijima scheme. Neutral K-meson, strangeness oscillations. CP-violation in K^o decay. Isospin and Su(2), Su(3), Baryon and meson multiplets, Gell Mann Okabo mass formula, quark model, flavor and color.	15	25
3.	**Angular Momentum:** Eigen value spectrum, Matrix representation of J in the |jm> basis, Spin angular momentum, Non relativistic Hamiltonian with spin, addition of angular momenta, Clebsch-Gordan Coefficients, Spin wave functions for a system of two spin 1/2 particles, Identical particles with spin, addition of spin and orbital angular momenta, Spherical tensors; Tensor operators, Wigner Eckart theorem, Projection theorem for a first rank tensor.	15	25
4.	**Relativistic wave Equations:** Generalization of Schrodinger equation - Klein - Gordan equation: Plane wave solutions; - Charge and Current densities - Interaction with electromagnetic fields; Hydrogen-like atom, -Non relativistic limit - The Dirac equation: Dirac's Relativistic Hamiltonian – Position Probability density; expectation values - Dirac matrices - Plane wave solution: Energy spectrum - The Spin of the Dirac particle - Significance of negative energystates. – Relativistic electron in a central potential: Total angular momentum - Radial wave equation – Series solutions of the radial equation: asymptotic behavior - Determination of the energy levels –Spin magnetic moment - Spin-orbit energy.	15	25

Course Outcome: After completion of this course, student will be able to

- Gain knowledge about various types of Nuclear reactions and elementary particle models based on variety of states.
- Acquire the knowledge about the classification of elementary particles and their interactions.
- Understand the basic concepts of Baryon number, lepton number, parity, charge conjugation, parity, strangeness and Time reversal in elementary particles.
- Learn about the Non-relativistic and relativistic quantum mechanical phenomenon of atoms and particles.

List of Text Books:

1. P.M. Mathews and K Venkatesan, A text book of Quantum Mechanics, Tata MC Graw - Hill publishing company Limited, New Delhi (2011).
2. D. C. Tayal, Nuclear Physics, Himalaya Publishing House Ltd. (ISBN: 978-93-5097-830-6, Revised and Enlarged Edition).
3. D. J. Griffiths and D. F. Schroeter, Introduction to Quantum Mechanics, 3rd Ed., Cambridge University Press India Pvt Ltd (2019).
4. M. Sayer and A. Mansingh, Measurement, Instrumentation and Experimental Design for Physicists and Engineers, PHI, New Delhi (1999).
5. J. P. Holman, Experimental Systems, Applications and Design, TMH.

List of Reference Books:

1. V. K. Thankappan , Quantum Mechanics, New Age International Publishers, 5th Ed., New Delhi (2020).
2. G. Aruldhas, Quantum Mechanics, 2nd Ed. PHI Learning Pvt. Ltd., Delhi (2017).
3. A. Ghatak and S. Loknathan, Quantum Mechanics, 6th Ed., Trinity Press, New Delhi (2019).
4. L. I. Schiff, Quantum Mechanics, 4th Ed., Tata McGraw Hill Edu., New Delhi (2017).
5. H. A. Enge, Introduction to Nuclear Physics, Addison-Wesley Publishing Company (1966).
6. R. R. Roy and B. P. Nigam, Nuclear Physics Theory and Experiments, 2nd Ed., New Age International Pvt. Ltd. New Delhi (2014).
7. S. B. Patel, Nuclear Physics: An Introduction, New Age Int. Pub., New Delhi (2021).
8. J. Singh, Fundamentals of Nuclear Physics, Pragati Prakashan, Meerut (2021).
9. K. S. Krane, Introductory Nuclear Physics, John Willey & Sons, New York (1988).

Open e-Resource:

Subject Code:	Subject Title: Numerical Techniques and Programming in C - II
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Gandhinagar Institute of Science
Master of Science- Physics
Semester-4

Course Objective:
1) To comprehend and be able to apply and solve the Physical systems using Numerical techniques.
2) To learn the numerous forms and techniques of writing the coding and programming using C-language.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory		Practical		
Lecture	Tutorial	Practical	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total
04	-	-	04	70	30	-	-	100

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Solution of Simultaneous equations:** Consistency of a system of linear equations, System of linear homogeneous equations, Solution of linear simultaneous equations, Matrix inversion method, Gauss elimination method, Gauss-Jordan method, Factorization method, Jacobi's iterative method, Gauss-Seidel iterative method, Relaxation method, Ill conditioned equation, Iterative method to improve accuracy of an ill-conditioned system, Solution of nonlinear simultaneous equations by Newton-Raphson method.	15	25
2.	**Empirical laws and Curve fitting: Introduction, Graphical method, Laws reducible to the linear law, Method of group averages, Laws containing three constants, Principle of least squares, Method of least squares, Fitting of other curves, Method of moments.**	15	25
3.	**C- Programming language:** Functions: Need for user defined functions, the form of C functions, return values and their types, calling a function, category of functions, non-integer functions, nesting of functions, recursion, functions with arrays, scope and lifetime of variables, ANSI C functions. Structures and Unions: Structure definition, giving values to members, structure initialization, arrays of structures, arrays within structures, structures within structures, structures and functions, Unions, size of structures. Pointers: Concept, accessing the address of variables, declaring and initializing pointers, accessing variables through pointers, pointer expressions, pointer increments and scale factor,	15	25

	pointers and arrays, pointer and character strings, pointers and functions, pointers and structures File management in C: Defining, opening and closing a file, I/O operations on files, error handling during I/O operations, random access to files.		
4.	**Programming of Numerical methods:** Solution of polynomial equations: Bisection method, Newton Raphson Method. Numerical Integration: Trapezoidal method, Simpson's method, Monte Carlo method. Solutions of simultaneous algebraic equations: Gauss Seidal method. Solution of ordinary differential equations: Ranga-Kutta method.	15	25

Course Outcome: After completion of this course, student will be able

- To familiarize coding of various numerical methods commonly used in Physics problems.
- To apply the empirical laws and curve fittings techniques for analysing experimental observations.
- To gain knowledge about the concepts on advanced topics of C-programming such as functions, structures, pointers and file management.
- To train how to write programs with various logics using the C-language concepts.

List of Text Books:-

. Numerical Methods in Engineering and Science, S. Grewal and J. S. Grewal, Khanna Publishers, New Delhi (2002).
. Numerical Methods, E. Balgurusamy, Tata McGraw Hill Pub. Co. Ltd, New Delhi (2000).
. Numerical Methods with Computer Programs in C++, Pallab Ghosh, PHI, New Delhi (2006).
. Programming in ANSI C (8th edition), E. Balgurusamy, Tata McGraw Hill Pub. Co. Ltd., New Delhi (2019).

List of Reference Books:

1. Programming in C, P. Day and M. Ghosh, Oxford Univ. Press, New Delhi (2011).
2. Programming with C, B. S. Gottfried and Chhabra, TMGH Pub. Co. Ltd, New Delhi (2005).
3. Let us C, Y. Kenetker, BPB Pub., (17th edition) New Delhi (2020).
4. C Programming language, B. W. Kernighan and D. K. Ritchie, PHI, New Delhi (1999).
5. Computer Oriented Numerical Methods, V. Rajaraman, PHI, New Delhi.

Open e-Resource:

Course Objective:

1) To familiarization with 8085 MPU instructions, programming techniques, and debugging programs using static and dynamic techniques.

2) To learn about the basics of numerous Microwave Devices, Microwave passive circuit components and measurement techniques.

Subject Code:	**Subject Title: Microprocessor-II and Microwaves**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	**-**	**-**	**04**	**70**	**30**	**-**	**-**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Introduction to 8085 instructions:** Data transfer (copy) operations, Examples, Addressing Modes, Illustrative program: Data transfer-From Register to Output Port, How to enter and execute a program, Illustrative program: Data transfer to control output devices, Arithmetic Operations. Addition, subtraction, Examples, Flag concepts and cautions, subtraction of two unsigned numbers, Review of important concepts, Logical operations; OR, Exclusive-OR and NOT, Data Masking with logic AND, Examples, ORing data from two input ports, Branch Operations, Unconditional jump, Unconditional jump to set up a continuous loop conditional jumps, Testing of a Carry flag Writing Assembly language program: Microprocessor controlled Manufacture Process. **Programming Techniques with Additional Instructions:** Programming Techniques; Looping, Counting and Indexing, conditional loop, counter, Examples, Additional Data transfer and 16-bit Arithmetic instructions, 16-bit data transfer to Registers pairs (LXI), Data transfer from Memory to Microprocessor, Examples, Data transfer from the Microprocessor to Memory or directly into Memory, Arithmetic operations related to 16-bits (Register Pairs), Illustrative program: Block transfer of Data bytes, Arithmetic Operations related to Memory, Examples, Illustrative program: Addition with Carry, Logic operations: Rotate-Left, Right with and without carry, Applications of Rotate instructions, Illustrative program: Checking sign with Rotate instructions.	15	25
2.	**Counters and Time delay:** Counter, Time delay- using one Register, a Register pair, a loop within loop technique, Delay calculations, Additional techniques, Counter design with time delay, Hexadecimal zero to nine (Modulo ten_ Counters, Illustrative program: Generating pulse wave forms, Debugging counter and time delay programs.	15	25

	Stack and Subroutine: Concepts of Stack and Subroutine, Examples, Illustrative programs: Resetting and displaying flags, Traffic Signal Controller, Multiple calling of a subroutine Restart, Conditional call and Return instructions, Advance subroutine concepts: Nesting, Multiple ending subroutines, Similarities and differences between CALL-RET, PUSH-POP instructions. Code Conversion, BCD Arithmetic and 16-bit data operations: BCD to binary conversion, Illustrative program: 2-digit BCD to binary conversion, binary to BCD conversion, Illustrative program: binary to unpacked BCD conversion, BCD to seven segment LED code conversion, BCD to-common cathode- LED code conversion, Binary to ASCII Hex code conversion, ASCII Hex code to Binary conversion, BCD addition, Addition of Unsigned BXS numbers, BXD subtraction, subtraction of two packed BCD numbers, Advanced instructions, 16-bit data Transfer and Data exchange group, Example, Arithmetic group. Instructions related to the stack Pointer and program Counter, Miscellaneous instruction Multiplication: Multiplication of Two 8-bit unsigned numbers, Subtraction with Carry, 16-bit subtraction, Review of instructions and Applications.		
3.	**Microwave Devices:** Klystrons, Magnetrons and Traveling wave tubes, Velocity modulation, Basic principle of two cavity klystrons and Reflex Klystrons, principles of operation of magnetrons, helix traveling wave tube wave modes, transferred electron devices, Gunn effect, principle of operation, modes of operation of Gunn diode, Impatt diode.	15	25
4.	**Microwave Passive Circuit Components and Measurements:** Attenuators, E-plane tee, H-plane tee and hybrid tee, directional couplers, isolator and circulators, Detection of microwaves, microwave power measurement, measurement of impedance and frequency.	15	25

Course Outcome: After completion of this course, student will be able to

- To understand the basic concepts of 8085 MPU instructions, programming techniques, and debugging programs using static and dynamic techniques.
- To demonstrate microprocessor programming using MPU-8085 simulator with additional instructions.
- To develop a good understanding of the operation, properties and behaviour of some of the microwave active and passive components.
- To learn about the various microwave measurement techniques for the detection of microwave power, impedance and frequency.

List of Textbooks: -

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085 (fifth edition), Penram International Publishing (India) Private LTD.
2. D. Roddy and J. Coolen, Electronic Communication, Prentice Hall India Publications, 4th edition, 1995.
3. S. Y. Liao, Microwave devices and circuits, Prentice Hall India Publications, 1995.

List of Reference Books:

1. M. Kulkarni, Microwave and Radar Engineering, Umesh Publication Delhi, 1998.
2. K. C. Gupta, Microwave, Wiley Eastern Ltd. 1985.
3. D. C. Sarkar, Microwave propagation and techniques, S. Chand and Company, New Delhi.
4. G. Kennedy, Electronic Communication system Tata M. Graw Hill, 1996.

Open e-Resource:

Subject Code:	Subject Title: Remote Sensing and Electronic Communication-II
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Gandhinagar Institute of Science
Master of Science- Physics
Semester-4

Course Objective:

1) To introduce basic concepts of remote sensing in visible, IR and microwave bands.
2) To learn about the basics of various types of platforms and sensors used for remote sensing, and different interpolation techniques.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory		Practical		
Lecture	Tutorial	Practical	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total
04	-	-	04	70	30	-	-	100

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
1.	**Remote Sensing principles, platforms and sensors:** Remote Sensing principles: Electromagnetic remote sensing process, Radiation laws, Atmospheric interaction with electromagnetic radiation, Interaction with earth surface and spectral signatures Microwave remote sensing: The Radar principle, Factors affecting microwave measurements, Side looking airborne radar systems (SLAR), Synthetic aperture radar (SAR), Interaction between microwaves and earth surface, Geometrical Characteristics Remote Sensing platforms and Sensor: Satellite system parameters instrumental parameters, viewing parameters, Sensor parameters spatial resolution, spectral resolution, radiometric resolution, Imaging sensor systems- multispectral, thermal and microwave imaging, Earth Resource and meteorological satellites.	15	25
2.	**Image interpretation: Visual image interpretation: Basic elements of image interpretation, interpretation of satellite imagery, Application of aerial interpretation, Digital image processing: Basic character of digital image, Preprocessing geometric correction, radiometric correction, atmospheric correction, Image enhancement techniques contrast enhancement, Spatial filtering techniques different filters, filtering for edge enhancement, Image transformation NDVI transformation, PCA transformation, Image classification supervised and unsupervised classification.**	15	25
3.	**Radio receivers:** Superheterodyne AM receiver, block diagram, RF section, image frequency and its rejection, mixer & local oscillator section, IF section, detection and automatic gain control, Noise in AM receiver. FM receivers, Common circuits-comparison with AM receivers, Noise in FM receiver.	15	25
4.	**Radar:** Radar system, basic principles, fundamentals, radar performance factors, pulsed systems, Basic pulse Radar system, Antennas and scanning. Display methods, pulsed radar systems, Moving target indication (MTI), Radar Beacons, CW Doppler radar, FM CW radar.	15	25

Course Outcome: After completion of this course, student will be able to

- Learn and understand about the basic concepts of remote sensing in visible, IR and microwave bands, various types of platforms and sensors used for remote sensing, and different image interpolation techniques for satellite communications.
- Learn the basic super heterodyne system, which is the preferred design for most receivers.
- Acquaint with each block of the radio receivers, its functions and design limitations.
- Learn about the operation and properties of the various types of the radar systems which have a large number of civilian as well as military applications.

List of Textbooks: -

. Fundamentals of remote sensing, George Joseph and Jaganathan, University press, 3rd edition, 2018.
. Lillesand T.M., Kiefer R.W. and Chipman, Remote sensing and image interpretation, John Wiley, th edition, 2015.
. D. Roddy and J. Coolen, Electronic Communication, Prentice Hall India Publications, 4th edition, 1995.

. M. Kulkarni, Microwave and Radar Engineering, Umesh Publication, Delhi.

List of Reference Books:

. Campbell J.B. and Wynne, Introduction to remote sensing, Taylor and Francis, 2011.
. Sabins F.F., Remote Sensing, Principles and Interpolation, W.H. Freeman and Co.

Subject Code:	**Subject Title: Physics Laboratory Practicals-IV**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

. Jenson J.R., Remote sensing environment: An earth resource perspective, PHI, 2000.
. M. L. Gupta, Electronic and Radio engineering, Dhanpat Rai & Sons, 1991.
. G. Kennedy, Electronic Communication system, Tata M. Graw Hill, 1996.
. N. D. Deshpande et al communication Electronics, Tata McGraw Hill, New Delhi.

Open e-Resource:

Gandhinagar Institute of Science
Master of Science- Physics
Semester-4

Course Objective:

1) To introduce the basic concepts of physics through hands on experience and impart experimental skill to students.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
-	**-**	**06**	**08**	**-**	**-**	**140**	**60**	**200**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
SET-A			100
1	Design and Study of Low pass filter Circuit using IC 741.	3	
2	Design and Study of high pass filter Circuit using IC 741.	3	
3	Study of Amplitude Modulation and Demodulation using Trainer kit.	3	
4	Study of Transmission Line characteristics using Trainer Kit.	3	
5	Study of ADC using IC 0800.	3	
6	Writing and Execution of simple Programs using Microprocessor 8085 Kit.	3	
7	Writing and Execution of advanced Programs using Microprocessor 8085 Kit.	3	
SET-B			

8	Determination of dielectric constant of a given sample at microwave frequency.	3	
9	ExpEyes based Experiments - III	3	
10	ExpEyes based Experiments - IV	3	
11	Experiments on optical fiber using kit	3	
12	I-V characteristics of a Gunn Diode	3	
13	Mode characteristics of klystron	3	
14	Solution of Ordinary Differential Equation by forth order Runge Kutta method - Programming	3	

Course Outcome: After completion of this course, student will be able to

- Be capable of making observations, displaying data visually, performing calculations based on the data and graph, and determining the results/outcomes/conclusions of the experiment.
- Learn how to use the least square method and analysis of error to define the error specification among experimental readings/observations.
- Taught how to select, fabricate and develop the circuits using the various active and passive components through soldering technique.
- Understand the fundamental Physics behind many scientific discoveries through hands on experience.

List of Text Books: -Nil-

List of Reference Books:

.Physics by Halliday, Resnick and Krane, Vol.1 and 2, 5th Edition, Wiley Publishing.
.B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962.
.R.A. Dunlap, Experimental Physics: Modern Methods, Oxford University Press, New Delhi (1988).
.E.V. Smith, Manual for Experiments in Applied Physics, Butterworths (1970).
.D. Malacara (ed.), Methods of Experimental Physics, Series of Volumes, Academic Press Inc. (1988).

Open e-Resource:

Subject Code:	Subject Title: PROJECT DISSERTATION
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Gandhinagar Institute of Science
Master of Science- Physics
Semester-4

Course Objective:

1) To make students familiar with approach to do literature survey
2) To make student capable of independent thinking and there by enable the student to develop aptitude to carry out research independently.
3) Students will learn basic techniques for carrying out research. To Acquire skills to plan and execute experiments individually as well as in groups.

Course Outcome: After completion of this project, students will be able to learn about:
Basic of literature review on relevant topic
Techniques used for performing research.
Analyse the results and tabulate them in a proper manner
How to write and dissertation, making presentation and viva etc.

Modalities of Major Project/Dissertation:

Every student shall work on a research project under a faculty member of the department.
Project work may be carried out within the department or in other department, or from other institution (if required).
Allotment of the supervisors shall be done by the Department. As far as possible, equal distribution of students should e maintained per faculty member, and the allotment may be done during the third semester.
The supervisor shall act as the instructor for this course on Dissertation and make continuous assessment based on the nderstanding, literature survey, experimental/ theoretical formulation, performance, interpretation of results and writing f Report and Dissertation.
End-semester evaluation will be based on evaluation of report, dissertation, presentation and viva voce examination at he end of the fourth semester by a panel of examiners.
Student should opt for full semester long dissertation work on the campus or outside the campus in some aboratories/Institutes/Universities / Industry/ organisation of National Importance.
For carrying out the dissertation work outside the campus, student will have to produce an invitation/acceptance letter rom external supervisor by the end of Semester III.
Permission from the Department is required for pursuing the project work outside the campus. Student may complete he dissertation project under the guidance of a supervisor of the Department.
Student who will pursue the project outside GU will have one internal supervisor and one external supervisor. Internal upervisor will periodically interact with student and external supervisor. Supervisor will be responsible for internal ssessment of the candidate from time to time.
Student will be allowed to work with external supervisor at other outside institutions only after completing all the ocumentation process at GU.
tudents must follow the timeline strictly issued by Department from time to time.

Department will have no financial obligation regarding the project work carried out by the student.
Student must abide by the attendance rules and regulations of the Gujarat University.
Two typed/computerised bound copies of the dissertation shall be submitted to the University during the final M.Sc. at east fifteen days before the commencement of the final examination.
Presentation and viva-voce: Student shall present and defend the report to examiners. Examiners will test the research kills and knowledge of the student based on the submitted hard copy of the dissertation and the oral presentation.

Gandhinagar Institute of Science
Master of Science- Physics
Semester-4

Course Objective:

1) To enable the student to learn the scientific writing, conference report writing by collecting, evaluating information that elaborates on a scientific topic using facts, charts, and graphs to support its arguments and findings.
2) To enable the student to present a scientific topic of subject relevance, thereby, developing oral presentation and oratory skills.

Subject Code:	**Subject Title: SCIENTIFIC WRITNIG AND FIELD WORK**
Pre-requisite: Student must have achieved Graduate degree in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

Course Outcome: After completion of this project, students will be able to learn about:

Field work/academic visits will let student to reflect the educational value of a trip, including any objectives the student might have and unexpected learning experiences.

Students will learn to highlight the impact of the field work on the student's chosen discipline and will serve to develop inspiration.

Modalities and general guidelines:

The candidate is required to show the scientific topic on which candidate want to write a detailed report to the supervisor before initiating the work and take necessary approval from the supervisor.

Student has to either choose to study Concepts in Research Methodology or undergo field work or attend a workshop/ seminar/ conference of state/ national/ international level and submit a report. Concepts in research methodology are the principles and techniques that guide the design and conduct of a research project. They include topics such as research paradigms, research questions, literature review, data collection methods, data analysis methods and ethical issues.

Students opting to study Concepts in Research Methodology must learn the following:

Searching interest of research, Defining the research question, Approaches and Methodology, objectives, significance and techniques of research.

Introduction to kinds of scientific documents: research paper, review paper, book reviews, theses, and project reports for the scientific community and for funding agencies).

Ethics in research: Honesty and integrity, Misconducts: Falsification, fabrication, plagiarism. Best/ standard practices of research.

Redundant publication: duplication and overlapping of publications, selective reporting and misinterpretation of data. Conflict of interest, Violation of publication ethics: authorship and contributorship.

Introduction to spreadsheet applications, features o Generating charts / graph and other features, Tools – Microsoft Excel or similar. o Using formulae and functions, Data storage, Standard deviation, standard error.

Web Search: Use of Publication search engines and libraries (PubMed, PubMed central, CrossRef, Google scholar).

Use of automated referencing softwares (Mendley, Zotero, EndNote, etc.)

Presentation tools: Introduction, features and functions, slide presentation. Key aspects of research presentations

Dully certified two typed/computerised bound copies of the scientific report and the details regarding the field work shall be submitted to the University for the end semester evaluation.

Report evaluation:

Dully certified report submitted by the candidate should be evaluated by the panel of examiners.

The supervisor shall act as the instructor for this course make continuous assessment based on the understanding, literature survey, experimental/ theoretical formulation, performance, interpretation of results and writing of Report.

End-semester evaluation will be based on evaluation of report, presentation and viva voce examination of the candidate at the end of the fourth semester by a panel of examiners.

Student has to give a seminar on the scientific report and conducted field work to an audience of peers and experts. It is usually accompanied by slides or other visual aids and followed by a question-and-answer session.

The purpose of presentation/seminar is to share the findings to demonstrate their conceptual understanding of the topic.

A. Ability Enhancement Courses (AEC)

Sl. No	Course Name	Tick (Any 05)
1	Business Communication – Blended with ICSI	AEC001
2	Communication and Presentation for Technical Professionals (IEEE)	AEC002
3	Conversational Hindi (Modern Indian Language)	AEC003
4	Corporate Grooming and Business Etiquettes	AEC004
5	Digital Privacy: Understanding and Operational Framework (IEEE)	AEC005
6	Digital Transformation: Game Changing Opportunities (IEEE)	AEC006
7	Economics & Business Environment Blended with ICSI	AEC007
8	Freelancing and Content Writing	AEC008
9	French	AEC009
10	Functional Grammar and Composition	AEC010
11	German	AEC011
12	Gujarati	AEC012
13	Marathi	AEC013
14	Mass Communication and Journalistic Writing	AEC014
15	Personality Development for Effective Leadership	AEC015
16	Practical English	AEC016
17	Punjabi	AEC017
18	Spanish	AEC018
19	Radio Jocky	AEC019

B. Skill Enhancement Courses (SEC)

Sl. No	Course Name	Tick (Any 05)
1	Animation & Graphics Design	SEC001
2	Aptitude and Logical Reasoning Blended with ICSI	SEC002
3	AutoCAD and Basic Drafting	SEC003
4	Business Administration	SEC004
5	Current Affairs and Quantitative Aptitude Blended with ICSI	SEC005
6	Data Analysis using Spreadsheet	SEC006
7	Digital Marketing	SEC007
8	Eco-Engineering: Designing for the Future	SEC008
9	Engineering Mastery: Tools and Techniques	SEC009
10	Event Management	SEC010
11	ICT Skills for Leadership	SEC011
12	Innovation & Entrepreneurship	SEC012
13	Interpersonal Skills – Blended with ICSI	SEC013
14	Introduction of Cyber Security (IEEE)	SEC014
15	Office Automation Tools	SEC015
16	Performing Arts (Dance, Music, Drama)	SEC016
17	Personal Financial Planning	SEC017
18	Practical Workshop Training	SEC018
19	Social Media Management	SEC019
20	Tally Accounting	SEC020
21	Visual Arts	SEC021
22	Public Speaking	SEC022
23	Organic Farming	SEC023

C. Value Addition Courses (VAC)

Sl. No.	Course Name	Tick (Any 05)
1	Anti-ragging – Blended with IEEE	VAC001
2	Art of Living for Wellness	VAC002
3	Awareness of Cyber Crime and Ethical Hacking	VAC003
4	Basic Life Support (BLS)	VAC004
5	Community Development	VAC005
6	Economics & Social Development	VAC006
7	Emotional Intelligence	VAC007
8	Environmental Studies	VAC008
9	Ethics and Values in Ancient Indian Tradition	VAC009
10	Gandhian Studies	VAC010
11	Indian Economy and Planning	VAC011
12	Indian Geography and Environmental Ecology	VAC012
13	Indian History and Cultural Heritage	VAC013
14	Integrated Personality Development Course	VAC014
15	Life Lessons from Bhagvad Gita	VAC015
16	Life Skills	VAC016
17	National Cadet Corps (NCC)	VAC017
18	National Service Scheme (NSS)	VAC018
19	Prevention of Sexual Harassment	VAC019
20	Psychology	VAC020
21	Stress and Time Management	VAC021
22	Sustainable Development and Environmental Studies	VAC022
23	Universal Human Values	VAC023
24	Yoga and Meditation for Wellness	VAC024

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