Gandhinagar Institute of Science

Academic Regulation& Curriculum

for

Proposed Program of B.Sc.

In

Physics

B.Sc. (Hons.) PROGRAMME

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

Preamble

Physics is one of the fundamental sciences that seeks to understand the laws governing nature, matter, energy, space, and time. The discipline forms the basis of modern scientific and technological advancement and plays a vital role in shaping innovations in engineering, electronics, communication, energy, materials science, medical instrumentation, and computational technologies. The study of physics cultivates analytical thinking, quantitative reasoning, experimental skills, and scientific temper, which are essential for addressing contemporary scientific and societal challenges.

The B.Sc. (Honours) Programme in Physics is designed to provide students with a strong foundation in classical and modern physics, mathematical methods, computational techniques, and experimental practices. The curriculum integrates theoretical concepts with laboratory training and project-based learning to develop conceptual clarity, problem-solving ability, and research aptitude. The programme emphasizes interdisciplinary learning and encourages students to explore emerging areas such as quantum mechanics, condensed matter physics, astrophysics, electronics, photonics, renewable energy, nanoscience, and computational physics.

Aligned with the principles of the National Education Policy (NEP) 2020 and outcome-based education, the programme aims to nurture scientifically competent, ethically responsible, and socially aware graduates capable of pursuing higher studies, research, teaching, entrepreneurship, and careers in industry and technology-driven sectors. The curriculum also promotes critical thinking, innovation, communication skills, teamwork, environmental consciousness, and lifelong learning.

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

The curriculum and syllabi are continuously updated through a structured feedback mechanism involving stakeholders such as faculty members, experts, industry experts, alumni and parents. This ensures that the program remains relevant, practical, and future-oriented.

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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 Department of Physics is to provide students with a fundamental understanding of the physical cosmos, its origins, and structure, so that they can exploit unknown and unidentified species in basic research and technology in the future. Through teaching and research in Physics at all levels, the department creates a platform for the distribution and development of information, and it assists students in creating a scientific society that supports rational thinking.

2.2 MISSION

(1) To awaken young minds and find their potential in both theoretical and practical Physics via devotion to teaching, commitment to students, and creative instructional methods such as PPT and Visual Aids.

(2) To support the College's developmental initiatives and to make the Department lively.

(3) To make significant contributions in areas such as faculty and contemporary labs, as well as to exhibit a high level of expertise in the study of Engineering Physics.

(4) To organize and preserve effective operational processes in the Department in order to achieve our goals as an eminent institution with international standards.

(5) To provide cutting-edge academic programs in Physics and multidisciplinary fields, as well as to generate intellectual property through innovations, high-quality research papers, and patents.

(6) To establish cutting-edge research facilities that will benefit GIS scholars as well as those from other academic institutions.

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: Strong Foundation in Physics**
  "Graduates will acquire strong foundational knowledge in various branches of Physics to understand physical phenomena and solve scientific problems."
- **PEO2: Analytical and Experimental Skills**
  "Graduates will develop analytical thinking, laboratory competence, experimental design skills, data interpretation ability, and scientific reasoning required for higher studies, research, and industry applications."
- **PEO3: Scientific Temper and Research Orientation**
  "Graduates will cultivate scientific temper, curiosity, innovation, and research aptitude for pursuing advanced studies and contributing to scientific and technological development through startups and incubation activities."
- **PEO4: Professional and Employability Skills**
  "Graduates will gain communication skills, computational proficiency, teamwork, ethical values, and problem-solving abilities necessary for employment, entrepreneurship, and interdisciplinary careers."
- **PEO5: Social and Ethical Responsibility**

"Graduates will understand the societal relevance of physics and demonstrate ethical responsibility, environmental awareness, and commitment toward sustainable development and national progress."

- **PEO6: Higher Education and Lifelong Learning**
  "Graduates will engage in lifelong learning and adapt to emerging scientific advancements, technological changes, and professional challenges in academia, research, and industry."

5 Program Details

5.1 Program Structure & Duration

- Duration & Intake : 4 Years & 60 Seats
- Semesters: 8
- Mode: Full Time
- Credit Structure: As per NEP/University norms
- Medium of Instruction: English

5.2 Eligibility Criteria for Admission:

Students must have passed Class 12 (HSC/10+2) from a recognized board such as Gujarat Secondary and Higher Secondary Education Board, Central Board of Secondary Education, or Council for the Indian School Certificate Examinations in the Science stream with Mathematics subject.

5.3 Admission Procedure

- Students can apply offline based on merit directly. Candidates may also visit the campus, attend an interaction session, and receive approval from the Admission Committee.
- **Admission using GCAS Portal:**
  1. Quick Registration and login ID generation using Mobile number, Email ID and Aadhar details.
  2. Payment of Registration fees via online mode.
  3. Fill the profile details and upload the required documents.
  4. Select the preferences of universities and their affiliated colleges in best priority order.
  5. Final Submission of details.
  6. Merit List and Admission offers from the priority list of universities and their affiliated colleges.
  7. Acceptance of admission offer and confirmation by paying the whole semester fees after

verification of documents.

8. Student can further follow the same procedure for other admission rounds till he/she will not get proper admission offer.

The University reserves the right to revise admission procedures.

5.4 Credit Summary for B.Sc. Physics (Hons.) Course in Department of Physics with effect from academic year 2024

Course Type-wise Distribution for B.Sc. Physics (Hons.)

Sr. No.	Course Type	Abbreviation	Description
1	Major Course	MJ	Core Physics 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
1 Hour of Theory (Lecture) per week	1 Credit
2 Hours of Practical/Laboratory Work per week	1 Credit
2 Hours of Field Work/Internship per week	1 Credit=30 hours (4 credit=120 hrs)
2 Hours of Skill/Project Work per week	1 Credit

Range of Credits (as per NEP):

Qualification	Minimum Credits Required
UG Certificate (1 Year)	48 Credits (44+4 credits of Internship)
UG Diploma (2 Years)	92 Credits (88+4 credits of Internship)
UG Degree (3 Years)	132 Credits
UG Honors / Honors with Research (4 Years)	176 Credits

Semester-wise Credit Structure (B.Sc. Physics (Hons.))

Semester	Total Credits
Semester I	22
Semester II	22
Semester III	22
Semester IV	22
Semester V	22
Semester VI	22
Semester VII	22
Semester VIII	22
Grand Total	**176 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

First Year 1st Semester:

Sr. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10150101	Fundamental Physics-I	3	-	2	5	4
2	Major	10150102	Fundamental Physics-II	3	-	2	5	4
3	Minor	10160102	Calculus-I	3	-	2	5	4
4	Multi / Interdisciplinary	10170105	Astrology-I	4	-	-	4	4
5	Ability Enhancement Course	AEC016	Practical English	2	-	-	2	2
6	Skill Enhancement Course	SEC006	Data Analysis using a spreadsheet	2	-	-	2	2
7	Value Added Course	VAC004	Basic Life Support	2	-	-	2	2
Total				**19**	**0**	**06**	**25**	**22**

First Year 2nd Semester:

Sr. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10150201	Fundamental Physics-III	3	-	2	5	4
2	Major	10150202	Fundamental Physics-IV	3	-	2	5	4
3	Minor	10160202	Calculus-II	3	-	2	5	4
4	Multi / Interdisciplinary	10170205	Agriculture Business Management	4	-	-	4	4
5	Ability Enhancement Course	AEC015	Personality Development for effective leadership	2	-	-	2	2
6	Skill Enhancement Course	SEC019	Social Media and Management	2	-	-	2	2
7	IKS	IKS0201	Indian Ancient History and Cultural Heritage	2	-	-	2	2
Total				**19**	**0**	**06**	**25**	**22**

NCrF Credit Level	Semester	Major (core)	Minor (Elective)	Multi/Inter-disciplinary	AEC	SEC/ Internship	VAC/ IKS	RP/ OJT	Total Credit per sem.	Qualification/ Certificate
First Year	I	8	4	4	2	2 (SEC)	2 (IKS)	-	22	UG Certificate
	II	8	4	4	2	2 (SEC)	2 (VAC)	-	22	
1st Year Total Credits		16	8	8	4	4	4	-	44	

Exit 1: Award of UG certificate in Major course with 44 credits with additional 4 credits of summer Internship in core specific NSQF defined course or continue with major and minor course for next NCrF credit level.

Second Year 3rd Semester:

Sr.No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10150301	Advance Physics-I	3	-	2	5	4
2	Major	10150302	Advance Physics-II	3	-	2	5	4
3	Major	10150303	Advance Physics-III	3	-	2	5	4
4	Multi / Interdisciplinary	10170308	Astrology-II	4	-	-	4	4
5	Ability Enhancement Course	AEC010	Functional Grammar and Composition	2	-	-	2	2
6	Skill Enhancement Course	SEC021	Visual Arts	-	-	4	4	2
7	Value Added Course	VAC024	Yoga and Meditation for Wellness	2	-	-	2	2
Total				**17**	**0**	**10**	**27**	**22**

Second Year 4th Semester:

Sr.No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10150401	Advance Physics-IV	3	-	2	5	4

2	Major	10150402	Advance Physics-V	3	-	2	5	4
3	Major	10150403	Advance Physics-VI	3	-	2	5	4
4	Minor	10160402	Group Theory-II	3	-	2	5	4
5	Ability Enhancement Course	AEC008	Freelancing and content writing	2	-	-	2	2
6	Skill Enhancement Course	SEC023	Organic Farming	2	-	-	2	2
7	IKS	IKS0401	Indian Ancient Science and Philosophy	1	-	2	3	2
Total				**17**	**0**	**10**	**27**	**22**

NCrF Credit Level	**Semester**	**Major (core)**	**Minor (Elective)**	**Multi/Inter-disciplinary**	**AEC**	**SEC/ Internship**	**VAC/ IKS**	**RP/ OJT**	**Total Credit per sem.**	**Qualification/ Certificate**
Second Year	**III**	**12**	**-**	**4**	**2**	**2 (SEC)**	**2 (IKS)**	**-**	**22**	**UG Diploma**
	IV	**12**	**4**	**-**	**2**	**2 (SEC)**	**2 (VAC)**	**-**	**22**	
2nd Year Total Credits		**40**	**12**	**12**	**8**	**8**	**8**	**-**	**88**	
Exit 2: Award of UG diploma in Major course with 88 credits with additional 4 credits of summer Internship in core specific NSQF defined course or continue with major and minor course for next NCrF credit level.										

Third Year 5th Semester:

Sr.No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Major	10150501	Quantum and Statistical Mechanics	3	-	2	5	4
2	Major	10150502	Molecular Spectroscopy	3	-	2	5	4
3	Major	10150503	Semiconductor Devices and Digital Electronics	3	-	2	5	4

4	Minor	10150504	Physics of Nanoscience and Nanotechnology	3	-	2	5	4
5	Minor	10150505	Mathematical Physics	3	-	2	5	4
6	Skill Enhancement Course	SEC022	Public Speaking	2	-	-	2	2
Total				**17**	**0**	**10**	**27**	**22**

Third Year 6th Semester:

Sr.No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Major	10150601	Solid State Physics	3	-	2	5	4
2	Major	10150602	Operational Amplifier	3	-	2	5	4
3	Major	10150603	Particle Physics	3	-	2	5	4
4	Minor	10150604	Computational Physics: FORTRAN	3	-	2	5	4
5	Ability Enhancement Course	AEC021	Digital Privacy: Understanding and Operational Framework	2	-	-	2	2
6	Internship	10150605	Internship in Major specific course	-	-	8	8	4
Total				**14**	**0**	**16**	**30**	**22**

NCrF Credit Level	**Semester**	**Major (core)**	**Minor (Elective)**	**Multi/Inter-disciplinary**	**AEC**	**SEC/ Internship**	**VAC/ IKS**	**RP/ OJT**	**Total Credit per sem.**	**Qualification/ Certificate**
Third Year	**V**	**12**	**8**	**-**	**-**	**2 (SEC)**	**-**	**-**	**22**	**UG Degree**
	VI	**12**	**4**	**-**	**2**	**4 (Internship)**	**-**	**-**	**22**	
3rd Year Total Credits		**64**	**24**	**12**	**10**	**14**	**8**	**-**	**132**	
Award of UG degree in Major course with 132 credits and Internship in core discipline or continue with major and minor course for next NCrF credit level.										

Fourth Year 7th Semester:

Sr. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
1	Major	10150701	Mathematical Physics-I	4	-	-	4	4
2	Major	10150702	Classical Mechanics	4	-	-	4	4
3	Major	10150703	Advanced Quantum Mechanics	4	-	-	4	4
4	Minor	10150704	Physics Laboratory Practicals-I	-	-	8	8	4
5	Research Project/On-the-Job Training	10150705	On Job Training (OJT) (For UG Honors Degree) / Research Project (For UG Honors with Research Degree)	-	-	12	12	6
Total				**12**	**0**	**20**	**32**	**22**

Fourth Year 8th Semester:

Sr. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	**T**	**P**	**Total**	
1	Major	10150801	Advanced Quantum Mechanics-II and Statistical Mechanics	4	-	-	4	4
2	Major	10150802	Classical Mechanics-II and Solid-State Properties	4	-	-	4	4
3	Major	10150803	Analog Electronics	4	-	-	4	4
4	Minor	10150804	Physics Laboratory Practical-II	-	-	8	8	4
5	Research Project/On-the-Job Training	10150805	On Job Training (OJT) (For UG Honors Degree) / Research Project (For UG Honors with Research Degree)	-	-	12	12	6
Total				**12**	**0**	**20**	**32**	**22**

NCrF Credit Level	Semester	Major (core)	Minor (Elective)	Multi/Inter-disciplinary	AEC	SEC/ Internship	VAC/ IKS	RP/ OJT	Total Credit per sem.	Qualification/ Certificate
Fourth Year	VII	12	4	-	-	-	-	6 (OJT)	22	UG Honors Degree
	VIII	12	4	-	-	-	-	6 (OJT)	22	
4th Year Total Credits		88	32	12	10	14	8	12	176	
Award of UG Honors degree in Major course with total 176 credits										

7 Teaching, Learning & Evaluation

7.1 Teaching Methodology

The program shall adopt:

- Classroom Teaching
- Case Studies
- Industry Interaction
- Site Visits
- Workshops
- GIS/Software Training
- Field Surveys
- Research Projects
- Internships
- AI-based Learning Tools
- Blended and Digital Learning

7.2 Attendance Rules

- Minimum 75% attendance shall be mandatory in each course.
- Students below prescribed attendance may not be permitted to appear in examination.
- Additional attendance requirements may apply for practical, internships, and field work.

7.3 Examination and Evaluation System

7.3.1 Evaluation Components:

The evaluation may consist of Continuous Internal Evaluation (CIE) and End Semester Examination (ESE)

- Continuous Internal Evaluation (CIE) may include:

- Mid-Semester Examination
- Assignments
- Presentations
- Field work
- Class Test
- AI Quiz & Viva Voce
- Dissertation
- Project work

7.2 Suggested Weightage

- Continuous Internal Evaluation: 50%
- End Semester Examination: 50%

7.3 Passing Standards

- Minimum 40% marks in each component where applicable.
- Minimum 45% aggregate for passing the course/program.
- Separate passing may be required in theory and practical examinations.

7.4 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 / Project Work

Students shall undertake Research Project OR Industry-Based Dissertation.

Requirements may include:

- Proposal Presentation
- Periodic Review
- Final Report Submission
- Viva Voce Examination

The dissertation shall be evaluated by internal and external examiners.

8 Rules and Regulations

8.1 Rules for Promotion

A student shall be promoted to the next semester as per Gandhinagar University rules subject to fulfilment of academic requirements, minimum attendance and Completion of required credits.

8.2 Maximum Duration for Completion

The maximum duration for completing the program shall be 4 years from the date of admission (or as prescribed by the University.)

8.3 Internship Guidelines

8.3.1 Students shall undergo mandatory internship/field training in:

- Data Analysis, Machine Learning and Scientific Computing (Python, MATLAB)
- Industries involving in Plasma Induction, Electronics and Instrumentation
- Scientific Content Writing
- Quantitative Analysis
- Simulation and Modeling
- Educational institutes and Coaching centers
- Research and development organizations like IISc., IUCAA, ISRO, PRL, IUAC etc.

8.3.2 Students must submit:

- Internship Report
- Work-Diary/Logbook
- Completion Certificate
- Presentation

8.4 Discipline Rules

Students shall maintain discipline, professional ethics, and proper conduct within the institution, during field visits, internships, industry interactions, examinations, and all academic activities. Students are expected to attend classes regularly, follow institutional rules and regulations, respect faculty members, staff, fellow students, and institutional property, and maintain academic integrity in assignments, projects, and examinations. Any form of misconduct, ragging, indiscipline, use of unfair means in examinations, damage to institutional property, harassment, or behavior affecting the academic environment shall be treated seriously and may result in disciplinary action including

warning, suspension, cancellation of examination, withholding of results, or expulsion from the program as per University rules and UGC regulations. Students shall also comply with all safety, ethical, and professional standards prescribed by the institution from time to time.

8.5 Anti-Ragging Policy

The program shall strictly follow:

- UGC Anti-Ragging Regulations
- Anti-Ragging Affidavit requirements
- Institutional disciplinary procedures
- Ragging in any form is strictly prohibited.

8.6 Ethical use of Technology and AI Tools

Students are encouraged to use:

- Various Software and AI Tools
- Data Analytics Tools
- AI-based Learning Platforms
- Computational Mathematical Tools

Use of AI tools shall be ethical and academic integrity must be maintained.

9 Student Support

9.1 Industry Collaboration

The department shall actively promote collaboration with industries in areas such as semiconductors, photonics, quantum technologies, renewable energy, instrumentation, data science, materials science, healthcare technology and space research organizations to enhance practical exposure and industry relevance of the program. Such collaborations may include internships, field training, live projects, expert lectures, workshops, industrial visits, consultancy assignments, joint research activities, skill development programs, and placement support. The institution may also establish Memoranda of Understanding (MoUs) with industry partners and professional bodies for academic enrichment, technology support, certification programs, and collaborative initiatives aimed at improving employability, entrepreneurship, innovation, and professional competency among students.

9.2 Research and Consultancy

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

consultancy, innovation, and applied studies related to semiconductors, photonics, quantum technologies, renewable energy, instrumentation, data science, materials science, healthcare technology, and space research. Students may undertake research projects, market surveys, valuation studies, policy analysis, urban development assessments, and data-driven studies as part of their academic and professional training. The institution may also undertake consultancy assignments for government agencies, local authorities, industries, financial institutions, developers, and other organizations in areas such as Semiconductor and Electronics, Optics and Laser Technology, Energy Storage, Quantum technology, scientific instrumentation, Space and nuclear research studies. Participation in seminars, conferences, workshops, publications, funded projects, and collaborative research activities shall be encouraged to promote academic excellence, innovation, and industry- oriented learning.

9.3 Library and Laboratory Facilities

Adequate library, laboratory, and digital learning facilities shall be made available to support effective teaching, practical training, research, and skill development under the Bachelor of Science in Physics program. The department shall facilitate access to relevant books, journals, research publications, e-resources, and digital learning platforms related to all relevant branches of Physical Sciences. Necessary computing facilities, data analytics tools, internet access, and other technical resources required for practical and project-based learning shall also be provided to enhance industry-oriented education, research capability, and professional competency among students.

9.4 Student Support and Mentoring

A structured system for student support, academic mentoring, and professional guidance shall be implemented for students enrolled in the B.Sc. Physics program. The department shall facilitate academic counselling, mentoring, career guidance, research support, and skill development activities to assist students in their academic progression and professional growth. Students may also be provided opportunities for interaction with industry experts, participation in workshops, seminars, field visits, training programs, and extracurricular activities aimed at enhancing employability, leadership qualities, communication skills, and overall personality development. Necessary support mechanisms for addressing academic and personal concerns shall also be made available as per institutional policies.

9.5 Placement and Career Development

The department shall promote placement assistance and career development activities for students through industry interaction, professional networking, training programs, internships, and campus engagement initiatives. Efforts shall be made to establish linkages with electronics and scientific instrumentation companies, Community science centers, research oriented government organizations such as IISc., IPR, ISRO, PRL etc., higher educational institutions, private materials science and space research organizations as TIFR, BARC etc., and other related industries to facilitate internships, live projects, industrial exposure, and employment opportunities for students. Career development activities such as aptitude training, resume preparation, soft skill development, entrepreneurship guidance, certification programs, expert sessions, and placement-oriented workshops may also be organized to enhance professional competency and employability of students.

10.Program Credibility

10.1 Executive Summary

"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."

10.2 Scope and Career Opportunities

Graduates of the program may work in:

- Research Organizations
- Electronics and Semiconductor Industries
- Renewable Energy Sector
- Telecommunications
- Manufacturing and Instrumentation
- Aerospace and Defense
- Automation and Robotics
- Scientific Instrumentation
- Quality Assurance and Testing

10.3 Potential Job Roles

- School Teacher
- Lecturer/ Professor
- Academic Counselor
- Science Educator
- Educational Content Developer
- Scientific officer in Defense and Space Research organizations
- Public Sector Undertakings (PSUs)
- Researcher in various sectors like aerospace, defense, materials science and Quantum computing etc.
- IAS, IPS and IFS Civil Services
- Quality controller and analyzing officer in scientific instrumentation industries

10.4 Higher Study & Professional Opportunities

Students may pursue:

- M.Sc. Physics
- M.Sc. Applied Physics
- M.Sc. Astrophysics
- M.Sc. Electronics
- M.Sc. Nuclear Physics

- M.Sc. Medical Physics
- M.Sc. Data Science
- M.Sc. Materials Science
- Ph.D. in Physics and interdisciplinary sciences

11 Collaborative Field Work / Experimental Work

Collaborative field work and experimental activities are integral components of a B.Sc. Physics program, enabling students to apply theoretical concepts, develop practical skills, and gain exposure to real-world scientific and technological applications. These activities promote teamwork, problem-solving, scientific inquiry, and interdisciplinary learning.

Objectives

- To provide hands-on experience in scientific experimentation and data analysis.
- To develop collaborative and interdisciplinary research skills.
- To enhance understanding of physical phenomena through observation and measurement.
- To familiarize students with modern scientific instruments and computational tools.
- To promote innovation, scientific communication, and project management skills.

Areas of Collaborative Field Work and Experimental Activities

1. **Physics Laboratory-Based Projects:-**

Students work in teams to design and perform experiments in:

- Mechanics and Properties of Matter
- Heat and Thermodynamics
- Optics and Photonics
- Electricity and Magnetism
- Electronics and Instrumentation
- Modern Physics
- Nuclear and Radiation Physics

2. **Environmental and Atmospheric Physics Studies: -**

Field-based investigations may include:

- Measurement of atmospheric parameters (temperature, humidity, pressure)
- Solar radiation and renewable energy assessment

- Air and noise pollution monitoring
- Weather data collection and analysis
- Environmental impact studies

3. Astronomy and Astrophysics Observations-

Collaborative observational activities include:

- Night sky observation programs
- Solar observation and sunspot studies
- Telescope handling and calibration
- Astronomical data analysis
- Participation in citizen science projects

4. Industrial and Institutional Visits-

Students may undertake field visits to:

- Research laboratories
- Manufacturing industries
- Renewable energy installations
- Telecommunication centers
- Scientific instrumentation facilities
- Space and atomic energy establishments

Such visits provide exposure to industrial practices, advanced instrumentation, and research methodologies.

5. Electronics and Instrumentation Projects:-

Collaborative activities may involve:

- Circuit design and testing
- Sensor-based measurement systems
- Microcontroller and embedded system applications
- Data acquisition systems
- Internet of Things (IoT) applications in physics

6. Computational Physics and Data Analysis:-

Students collaborate on:

- Numerical simulations

- Programming-based problem solving
- Statistical analysis of experimental data
- Scientific computing projects
- Machine learning applications in physical sciences

7. Interdisciplinary Projects: Physics students may collaborate with other departments such as:

- Mathematics
- Computer Science
- Chemistry
- Environmental Science
- Engineering

Projects can focus on:

- Materials characterization
- Renewable energy systems
- Computational modeling
- Data science applications
- Medical physics and imaging techniques

8. Research Mini-Projects

Students undertake supervised research projects involving:

- Literature review
- Experimental design
- Data collection and interpretation
- Report writing
- Presentation of findings

Expected Learning Outcomes

Upon completion of collaborative field work and experimental activities, students will be able to:

- Design and conduct scientific experiments.
- Operate laboratory and field instruments safely and effectively.
- Collect, analyze, and interpret experimental data.

- Work effectively in multidisciplinary teams.
- Communicate scientific findings through reports and presentations.
- Apply theoretical knowledge to practical and industrial problems.
- Demonstrate ethical and professional scientific practices.

12 Review and Revision of Regulation

The University reserves the right to interpret, modify, revise, amend, or update any provision, rule, regulation, curriculum structure, evaluation pattern, academic requirement, or operational guideline related to the program from time to time in accordance with University regulations, statutory requirements, industry developments, and academic needs.

In case of any ambiguity or dispute regarding interpretation of any provision of this manual, the decision of the University/Competent Authority shall be final and binding on all stakeholders. Any amendments, additions, or revisions approved by the appropriate academic or statutory bodies of the University shall automatically become applicable to the program.

Annexure I: Detail Syllabus

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

Subject Code: 10150101	**Subject Title: Fundamental Physics-I**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to higher secondary level.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human being and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit-1	**<u>Fundamentals of Classical Mechanics</u>** Classical mechanics, Newton's first law, mass, Weight, Force, Newton's second law, Newton's third law, Weight and mass, Applications of Newton's laws in one dimension, Motion in three dimensions with constant acceleration, Newton's laws in three dimensional vector form, Projectile motion, Drag forces and motion of projectile, Uniform circular motion, Relative motion, Collisions, Linear momentum, Impulse and momentum, Conservation of momentum, Two particle and many particle systems, System of variable mass, Rotational motion, The rotational variables, Rotational quantities as vectors, Relationships between linear and angular variables	15	34
Unit-2	**<u>Basic Mathematical Physics</u>** •Introduction, Applications of Vector Multiplication, Triple Scalar Product, Triple Vector Product, Differentiation of Vectors, Fields, Directional Derivative; Gradient, some other expressions involving del, Green's Theorem in the plane, The Divergence and the Divergence theorem. Gauss's law, The curl and Stoke's theorem.	15	33

Unit-3	**OPTICS:** Fermat's principle and its applications: Fermat's principle of least time, Laws at reflection and laws of refraction from Fermat's principle. Refraction at a single spherical surface, Reflection by a single spherical surface, Thin lens, the principle foci and the focal length of lens, Newton's formula and rings, Lateral magnification, Aplanatic points of a sphere, **Matrices and Matrix methods in Optics:** Matrix equations, Multiplication of a Matrix by a number, Multiplication of Matrices, Zero matrix, Identity Matrix or Unit Matrix, Applications of matrix Multiplication, Inverse of a Matrix, Rotation of Matrices. The Matrix method, Unit planes, Nodal planes, A system of two thin lenses, Huygens' theory, Rectilinear propagation, Superposition of two sinusoidal waves, Coherence and interference of light waves, Interference pattern, Intensity distribution	15	33

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
List of Experiments			100
1	**Newton's Ring:** To find the wavelength of light of given monochromatic source. To find the radius of curvature of given lens.	4	
2	**Cauchy's Constant:** To determine Cauchy's constant A and B using given formula and to find the wavelength of unknown line of a mercury spectrum.	4	
3	**Least Square Fitting (Linear Fitting)**	4	
4	**Characteristic of thermistor.**	4	
5	**Melde's Experiment:** To prove (i)P/L & (ii) T/L^2 constant	4	
6	**Resonator:** To test the accuracy of relation n2 (V + Kv) = constant and to determine the frequency of unknown fork.	4	
7	**Diagonalization of given matrix (2x2). Evaluate trace of a matrix.**	4	

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

- Apply knowledge of Newton's laws of motion and classical mechanics to explain natural physical processes and related technological advances.
- Prepare students to work with vectors in the following ways: triple product, Curl, gradient and divergence, vector differentiation and vector related theorems.
- Describe interference in a thin film caused by reflected and transmitted light, as well as the colors seen in reflection by thin films of oil, mica, and soap bubbles.
- Explain how Newton's rings develop and do a Newton's ring experiment to determine an unknown

wavelength of light and the refractive index of a liquid.

- Derive the laws of reflection and refraction (Snell's law), apply Fermat's concept of least time.
- Explain the matrix and their multiplication, zero matrix, inverse matrix etc. and the matrix methods to solve the problems of Optical systems.
- 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.
- Use a mechanical device to measure with a precision of 0.01 cm and 0.001 cm. They are also taught how to read and use a digital multi-meter.
- Learn how to use the least square method and analysis of error to define the error specification among experimental readings/observations.

List of Textbooks: -Nil-

List of Reference Books:

1. Mathematical methods in Physical Sciences By M.L. Boas: Article no.: 6.1 to 6.11 and Chap. 3-section 6
2. Physics by Halliday, Resnick and Krane, Vol.1, 5th Edition, Wiley Publishing ,Articles: 3.1 to 3.8, 4.1 to 4.6, 6.1 to 6.5, 7.2 to 7.6, 8.1 to 8.6
3. Optics by Subramanyam and Brijlal: Articles: Article no: 2.1, 2.2, 2.5, 2.6, 15.1, 15.2, 15.3, 15.4, 15.5, 15.6 Article no: 5.1, 5.2, 5.3, 5.10
4. Optics by Ajoy Ghatak 6th Ed., McGraw Hill Education (India) Pvt. Ltd. New Delhi, 2017: Article no. : 3.1,3.2, 4.1 to 4.8, 5.2 to 5.5, 12.1 to 12.3
5. Mathematical Methods for Physics and Engineering by Riley, Hobson and Bence, Cambridge University Press, 1998.
6. Physics by Halliday, Resnick and Krane, Vol.1 and 2, 5th Edition, Wiley Publishing
7. Concepts of Physics, Volume 1 and 2 by H C Verma, Bharati Bhawan Pub. & Distributers.
8. B.L. Worsnop, H.T. Flint, “Advanced Practical Physics for Students”, Methuen & Co., Ltd., London, 1962.
9. S. Panigrahi, B. Mallick, “Engineering Practical Physics”, Cengage Learning India Pvt. Ltd.,2015.
10. S.L. Gupta, V. Kumar, “Practical Physics”, Pragati Prakashan, Meerut, 2014

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learnings-https://www.youtube.com/user/nptelhrd
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

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

Subject Code: 10150102	**Subject Title: Fundamental Physics-II**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to higher secondary level.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human beings and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit-1	**Elasticity I:** Load, Stress and strain, Hook's law, Ductility, Brittleness and Plasticity, Elastic behaviour of solids in general, Factors affecting elasticity, Three types of elasticity, Equivalence of a shear to a shear to a compression and an extension at right angles to each other, Deformation of a cube – Bulk modulus, Modulus of rigidity, Young's modulus, Relations connecting the elastic constants, Poisson's ratio, Relations for K and n in terms of Poisson's ratio, Limiting values of σ.	15	33
Unit-2	**Waves:** Traveling Waves: Speed of propagation of waves in a stretched string longitudinal waves in a bar, Plane waves in a fluid, transmission of energy by a traveling wave. Sound waves: Introduction, Intensity & intensity level, Loudness & pitch, Radiation from a piston, Diffraction, Radiation efficiency of a sound source, Sound absorption and reverberation, Sabine's formula and usage (including derivation), Acoustic of building.	15	34

	Ultrasonics: Magnetostriction method, Piezo-electric oscillator, Piezo-electric detectors, Measurement of velocity of ultrasonic waves, Diffraction effect & its application to determine the velocity of the waves, The ultrasonic waves & its applications.		
Unit-3	**<u>Basic Thermodynamics and Thermoelectric Effects</u>** Thermal Equilibrium and zeroth law. Concept of temperature, Thermometers, and measurement of temperature. Conversion of work into heat and vice versa. Mathematical formulation of first law. Heat engine; Kelvin-Plank statement of second law. Refrigerator; Clausius statement of second law. Carnot Cycle: Carnot's Theorem and Corollary. Thermodynamic temperature scale. Seeback effect, Peltier effect, Thomson effect, Total emf in a thermocouple.	15	33

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Vibrational Magnetometer:** To compare the magnetic moment of two bar magnets.	4	100
2	**Study of Transformer:** To determine (i) turn ratio (ii) percentage efficiency (iii) energy loss due to copper, for a given transformer.	4	
3	**Value of inductance:** For given two inductors determine the value of inductance for each of them. AND (i) by connecting them in series. (ii) by connecting them parallel.	4	
4	**Decay Constant:** To verify the exponential law for the decay of a charged capacitor and determine the decay constant of the capacitor.	4	
5	**Series & Parallel Resonance:** To determine the frequency of a.c. emf by series and parallel resonance circuit varying capacitor.	4	
6	**Half-Wave Rectifier:** Obtain load characteristic and %regulation for Half-wave rectifier with-out filter circuit and by using capacitor filter circuit. Determine ripple factor for Full wave rectifier without filter only.	4	
7	**Fly Wheel:** To find the moment of inertia of a fly wheel.	4	

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

- Analyze structural systems under the effect of different loads and forces.
- Exhibit a grasp of the fundamental concepts, characteristics, and applications of Sound Waves, it's Motion and Acoustics.
- Understand the properties of Ultrasonics, different Ultrasonic sound generating techniques, and their applications in NDT.
- Explain the fundamentals of Thermodynamics and temperature

measurement techniques.

- Describe and distinguish between thermoelectric electric effects such as Seeback, Peltier, and Thomson.
- 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.
- Use a mechanical device to measure with a precision of 0.01 cm and 0.001 cm. They are also taught how to read and use a digital multi-meter.
- Learn how to use the least square method and analysis of error to define the error specification among experimental readings/observations.

List of Textbooks: -

Nil-List of Reference

Books:

1. Properties of matter by D S Mathur, S. Chand & Co., 2009. Article No. : 8.1 to 8.18

2. A textbook on oscillations, waves & Acoustics by M. Ghosh, D. Bhattacharya (S. Chand) Chapter 23: Art 23.1 to 23.6

3. Heat and Thermodynamic by Zemansky and Dittman (7th Edition): article no: 1.4,1.5,1.6,1.7,4.4,6.1,6.6,6.7,7.4,7.5

4. University Physics by Young and Freedman, Pearson 13th Edition, 2013.

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

6. Concepts of Physics, Volume 1 and 2 by H C Verma, Bharati Bhawan Pub. & Distributers.

7. B.L. Worsnop, H.T. Flint, “Advanced Practical Physics for Students”, Methuen & Co., Ltd., London, 1962.

8. S. Panigrahi, B. Mallick, “Engineering Practical Physics”, Cengage Learning India Pvt. Ltd.,2015.

9. S.L. Gupta, V. Kumar, “Practical Physics”, Pragati Prakashan, Meerut, 2014

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learnings-https://www.youtube.com/user/nptelhrd
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

8

Gandhinagar Institute of Science
Bachelor of Science - Physics
SEMESTER - 1

Subject Code: 10160102-Minor	**Subject Title:** Calculus – I
Pre-requisite: To study this course, a student must have subject Mathematics in class XII.	

Course Objective:

(1) To gain proficiency in calculus computations and analyze the behavior of functions.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	-	02	04	50	50	25	25	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Indeterminate forms:** Various types of Indeterminate forms and L'Hospital's Rules. **Infinite sequence and series**: Monotonic increasing and Monotonic decreasing sequences, Telescoping series, Geometric series, Alternating series, Convergence and divergence of sequence and series, Divergent test, Comparison test, Integral test, Ratio test, Root test, Leibnitz's test, Test of convergent for power series, Test of Absolutely convergent and Conditional convergent.	15	34%
2	**Successive Derivatives**: Standard for n^{th} derivative, Leibniz's Theorem, Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorem (MVT) Taylor's and Maclaurin's Theorems, Series expansions of trigonometric functions, exponential functions, inverse trigonometric functions.	15	33%
3	**Integrals**: Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of Integration, Improper integrals, Classification and Convergence of Improper Integrals, Comparison test, p-test, Reduction Formulae	15	33%

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

- Develop proficiency in handling indeterminate forms, mastering convergence tests, and applying mathematical techniques to rigorously assess the behavior of functions, sequences, and series, fostering analytical thinking and problem-solving skills.
- Master successive derivatives and their applications.
- Gain proficiency in handling diverse integrals and understanding their convergence properties.

List of References:

1. G. B. Thomas and R. L. Finney, Calculus, Pearson Education, 2010.
2. Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas' Calculus, Pearson Education, Delhi.
3. Shanti Narayan, Differential Calculus, S. Chand & Co. Ltd,1996 .
4. Shanti Narayan, Integral Calculus, S. Chand & Co. Ltd, 1999.
5. T. M. Apostol, Calculus Vol.-I, John Wiley & Sons Inc., 1974.
6. T. M. Apostol, Calculus Vol.-II, John Wiley & Sons Inc., 1974.
7. B. S. Grewal, Higher Engineering Mathematics, Thirty-fifth edition, Khanna Publ.
8. Louis Leithod, The Calculus with Analytic Geometry, Harper-Collins Pub.

Open e-Resource:

1. National Programme on Technology Enhanced Learning (NPTEL) (https://nptel.ac.in/courses/122104017)
2. Massachusetts Institute of Technology (MIT) Open Learning. (https://ocw.mit.edu/search/?d=Mathematics)

List of Suggested Experiments

1. Indeterminate forms and L'Hospital's rule.
2. Test of Convergent and Divergent: Divergent test, Comparison test, Integral test, Ratio test, Root test, Leibnitz's test.
3. Test of Convergent and Divergent: Test of convergent for power series, Test of Absolutely convergent and Conditional convergent.
4. Successive Derivatives, Standard for n^{th} derivative, Leibniz's Theorem.
5. Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorem.
6. Concavity and Convexity, Maxima and Minima, Taylor's theorem and Maclaurin's theorem.
7. Riemann's integrals, Fundamental theorem of integral calculus, Mean Value Theorems of integral calculus.
8. Improper Integrals, Convergence of Improper Integrals.

GANDHINAGAR INSTITUTE OF SCIENCE

B.Sc.

Semester-1

Subject Code: 10170105	**Subject Title:** Astrology-1
Pre-requisite:	

Course Objective:

1. To introduce the basic principles, origin, development, and key texts of astrology.
2. To understand the astrological view of the universe and its applications in various fields.

Teaching Scheme (Hours per week)			**Credit**	**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**		**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	-	-	04	50	50	-	-	100

Subject Contents			
Sr. No	**Topics**	**Total Hours**	**Weight (%)**
1	**Astrology** Introduction Origin Development of Astrology	10	23%
2	**Elements of Astrology** Siddantha Samhitha Hora	11	27%
3	**Concept of Universe** Word Solar family Earth	11	27%
4	**Applications of Astrology** Social Environmental Health and Education	10	23%

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

1. Understand the origin, development, and core elements of astrology, including key texts like Siddantha, Samhitha, and Hora.
2. Describe the astrological universe and the roles of the solar family and Earth.
3. Identify and analyze essential astrology components and terminology.

4. Evaluate astrology’s applications in social, environmental, health, and education fields.

Textbooks

1. "Brihat Samhita" by Varahamihira
2. "Surya Siddhanta" (Translation by Ebenezer Burgess or modern Indian authors)
3. "Brihat Parashara Hora Shastra" by Maharishi Parashara
4. "Essentials of Astrology" by Komilla Sutton

Reference Books

1. "Light on Life: An Introduction to the Astrology of India" by Hart de Fouw & Robert Svoboda
2. "Astrology and Science" by B.V. Raman
3. "Phaladeepika" by Mantreswara
4. "Indian Astrology" by B.V. Raman

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

Subject Code: 10150201	**Subject Title: Fundamental Physics III**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to higher secondary level.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human being and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Basic Electric & Electronic Circuits:** **AC Bridges:** Condition for bridge balance, Maxwell bridge, Hay bridge, Schering bridge, Wein bridge **Diode circuits:** Load line analysis of a diode circuit, use of diode in rectifier, Half wave, full wave and bridge rectifier with their performance, Capacitor input filter, peak inverse voltage and surge current, clippers and limiters, clampers, the Zener diode, the loaded regulator, The unbiased transistor, the biased transistor, transistor currents, the CE connection, the base and collector curves.	15	34
2.	**Introduction to Electrostatics** Divergence and Curl of Electrostatic fields: Field lines, flux, and Gauss's Law, The Divergence of E, Applications of Gauss's Law, The Curl of E, Electric Potential: Introduction to potential, comments on potential, Poisson's equation and Laplace's Equation, The potential of a localized charge	15	33

	distribution, Summary: Electrostatics boundary conditions, Work and Energy in Electrostatics: The work done to move a charge, The energy of a point charge distribution, The energy of a continuous charge distribution, Comments on electrostatics Energy, Conductors: Basic Properties, Induced Charges, Surface charges and the force on a conductor, Capacitors.		
3.	**Basic Nuclear Physics** **Radioactivity and its applications:** The law of radioactive decay (review), Radioactive growth and decay, ideal equilibrium, Transient equilibrium and secular equilibrium, Radioactive series, Radioactive isotopes of lighter elements, Artificial radioactivity, Age of earth, Carbon dating (Archaeological time scale) **The Q Equation:** Types of Nuclear Reactions, The balance of mass and Energy in Nuclear reactions, The Q Equation, Solution of the Q Equation. Constituents of the nucleus properties: Measurement of Nuclear radius, Constituents of the nucleus and their properties, nuclear spin, moments and statistics. Methods of measurement of half-life, Numericals based on Q-equation.	15	33

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
List of Experiments			100
1	**Stefan Constant:** To verify the Stefan Boltzmann's fourth power law by using dc power source.	4	
2	**Radioactive decay:** Simulation of Nuclear Radioactive decay using random function of scientific Calculator.	4	
3	**Deflection Magnetometer:** To determine the magnetic moment (M) of given bar magnate using deflection magnetometer in Gauss A and B position.	4	
4	**Projection Method:** To find the value of a low resistance by the method of projection of potential.	4	
5	**Value of capacitance: For** given two capacitors determine the value of capacitance for each of them and (i) by connecting them in series (ii) by connecting them parallel.	4	
6	**Owen's Bridge:** To find the value of an inductance of an unknown inductor by using Owen's bridge circuit.	4	
7	**To Determine Wavelength of LASER light using Spectrometer.**	4	

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

- Describe and design HW, FW, and Bridge rectifiers, transistor circuits as well as different power supply filters.
- Describe Divergence and Curl of Electrostatic fields.
- Apply Gauss's law for spherical, cylindrical and plane symmetry. Discuss the electric potential and line integration of the electric field, as well as the relationship between the electric field and the potential gradient.
- **E**xplore the normal component of the electrostatic field by using the concepts of potential and electric field to develop Poisson's equation, Laplace's equation, and the boundary condition.
- Calculate the energy of a point charge as well as the energy of continuous charge distributions. Deduce the capacitance of a given electrostatic system by identifying the fundamental features of conductors, describing capacitors, and identifying the basic properties of conductors.
- Define a Nuclear reaction and understand its various varieties, know the difference between a Natural and Artificial radioactivity and the different kinematics associated with it.
- Apply the formulas in various applications in Geo sciences and Nuclear Physics.

List of Text Books:Nil

List of Reference Books:

1. Electronics Devices and Circuits, Allen Mottershead Articles: 2.1, 2.3, 2.8, 3.1, 3.4, 3.9, 3.10, 3.13, 4.1, 4.4, 4.6
2. Basic Electronics and Linear Circuits, N N Bhargava, D C Kulshreshtha, and S C Gupta, TMH Edition Articles: 4.6, 4.6.1, 4.6.2, 4.7.2, 4
3. Electronics Devices and Circuit Theory (7th Edition), Robert Boylstead Article: 2.9
4. Electronic Principles by A P Malvino, 6th Edition, Tata McGraw-Hill Ltd., 4.1 to 4.11, 5.1, 5.2, 6.1 to 6.6
5. Introduction to Electrodynamics: Third Edition David J Griffiths, Prentice – Hall of India Private Limited.
6. Electromagnetism by B.B. Laud, Wiley Eastern Limited
7. Physics by Halliday, Resnick and Krane, Vol.1 and 2, 5th Edition, Wiley Publishing Article No: 26.1 to 26.6, 27.1 to 27.6, 28.1 to 28.8 and 31.1 to 31.4.
8. Nuclear Physics By S.B. Patel; New Age International Limited. A: Article no: 2.6 to 2.13 & B: Article no: 3.1 to 3.5
9. Nuclear Physics by Kenneth Krane
10. Modern Physics by Aruldas
11. Physics by Halliday, Resnick and Krane, Vol.1 and 2, 5th Edition, Wiley Publishing
12. Concepts of Physics, Volume 1 and 2 by H C Verma, Bharati Bhawan Pub. & Distributers.
13. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962.
14. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd.,2015.
15. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr

3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

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

Subject Code: 10150202	**Subject Title: Fundamental Physics IV**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to higher secondary level.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human being and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**<u>Introduction to Magnetostatics</u>** A: The Lorentz force law, magnetic fields, magnetic forces, Cyclotron motion, Cycloid motion, Currents, continuity equation B: The Biot- Savart law, The magnetic field of a steady current C: The straight-line currents, The divergence and curl of B, Ampere's law, Comparison between Magnetostatic and Electrostatics D: Magnetic vector potential	15	34
2.	**Elasticity II:** Twisting couple on a cylinder, Torsional Pendulum, Determination of coefficient of rigidity for a wire, bending of a beam, The cantilever, Transverse vibrations of loaded cantilever, depression of a beam supported at the ends, Determination of Y by bending of beams, Determination of elastic constants by Searle's method	15	33

3.	**LASERS**: Introduction, Attenuation of light in an optical medium, Thermal equilibrium, Interaction of light with matter, Einstein coefficients and their relations, Light amplification, Meeting the three requirements, Components of Laser, Lasing action, Principal pumping schemes, Type of lasers, Semiconductor laser, Laser beam characteristics, Applications	15	33

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
List of Experiments			100
1	**LDR Characteristics:** Obtain IV characteristics of given LDR and calculate its resistance (for at least three different light levels).	4	
2	**I-V Diode characteristics of a PN-junction diode and its load line analysis.**	4	
3	**Bridge Rectifier:** Obtain load characteristic and regulation for Bridge rectifier without using filter circuit and by using capacitor filter circuit. Obtain ripple factor without filter circuit.	4	
4	**Full-wave Rectifier:** Obtain load characteristic and % regulation for Full-wave rectifier with-out filter circuit and by using capacitor filter circuit. Determine ripple factor for Full wave rectifier without filter only.	4	
5	**'g' by bar pendulum**	4	
6	**Universal Logic Gates AND, OR, NOT, NAND, NOR**	4	
7	**Activation energy of a semiconductor.**	4	

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

- Understand behavior of charge particles in magnetic field, Explain cycloid motion of charge particle.
- Analyze structural systems under the effect of forces.
- Gain knowledge of theoretical and mathematical concepts associated with mechanics of rigid and breakable bodies.
- Analyze the errors associated with experimentation.
- Exhibit knowledge of laser fundamentals, characteristics, types, and applications.

List of Text Books: -
Nil-List of Reference Books:

1. Introduction to Electrodynamics: Third Edition David J Griffiths, Prentice –Hall of India Private Limited.

2. Electromagnetism by B.B. Laud, Wiley Eastern Limited
3. Physics by Halliday, Resnick and Krane, Vol.1 and 2, 5th Edition, Wiley Publishing Article No: 32.1 to 32.6 and 34.1 to 34.5

4. Properties of matter by D S Mathur, S. Chand & Co., 2009. Article No.: 8.22 to 8.36

5. A text book of Optics by N. Subrahmanyam, Brijlal and M. N. Avadhanulu, S. Chand Publication: Chapter 22 (including all sub articles)
6. Fiber Optics and optoelectronics by R. P. Khare, Oxford University Press.
7. An introduction to LASERS- Theory and Applications by M. N. Avadhanulu, S. Chand & Comp. Ltd.

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

9. Concepts of Physics, Volume 1 and 2 by H C Verma, Bharati Bhawan Pub. & Distributers.

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

11. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd.,2015.

12. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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Gandhinagar Institute of Science
Bachelor of Science - Physics
SEMESTER - 2

Subject Code: 10160202-Minor	**Subject Title:** Calculus – II
Pre-requisite: To study this course, a student must have subject Mathematics in class XII.	

Course Objective:

(1) To gain proficiency in advanced calculus computations and analyze the behavior of functions.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	-	02	04	50	50	25	25	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Vector Differentiations:** Limit of a vector function, Derivation of a vector function, Geometrical and physical significance of vector differentiation, Gradient, Directional derivatives, Divergence and Curl Operators, Solenoidal and Irrotational Vectors. **Vector Integration:** Line integral, Conservative force field, Scalar potential, Work done by a force, Gauss divergence theorem, Verification of Gauss divergence theorem, Green's theorem, Verification of Green's theorem, Stoke's theorem, Verification of Stoke's theorem.	15	34%
2	**Partial Derivatives**: Limit and Continuity of a function of two variables, Partial Derivatives, Homogeneous functions of multi variable, functions, Total Differentiations, Differentiations of Composite functions, Implicit and Explicit functions, Application of Partial derivatives.	15	33%
3	**Multiple Integration:** Double integrals, Change of order of double integral, Double integral in polar coordinates, Area by double integral, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical coordinates, Jacobian, Change of variables in double integrals and triple integrals.	15	33%

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

- Know the geometrical and physical significance of vector differentiation and apply them.
- Apply vector integration to find the work done by a force.
- Obtain Gauss, Green's and Stoke's theorems and their application in real life problems.
- Understand the derivative in several variables.

- Apply Partial derivatives to find real applications.
- Evaluate the problems in double and triple integrations.
- Evaluate area and volume by multiple integrals.

List of References:

9. G. B. Thomas and R. L. Finney, Calculus, Pearson Education, 2010.
10. Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas' Calculus, Pearson Education, Delhi.
11. Shanti Narayan, Differential Calculus, S. Chand & Co. Ltd,1996 .
12. Shanti Narayan, Integral Calculus, S. Chand & Co. Ltd, 1999.
13. T. M. Apostol, Calculus Vol.-I, John Wiley & Sons Inc., 1974.
14. T. M. Apostol, Calculus Vol.-II, John Wiley & Sons Inc., 1974.
15. B. S. Grewal, Higher Engineering Mathematics, Thirty-fifth edition, Khanna Publ.
16. Louis Leithod, The Calculus with Analytic Geometry, Harper-Collins Pub.

Open e-Resource:

3. National Programme on Technology Enhanced Learning (NPTEL) (https://nptel.ac.in/courses/122104017)
4. Massachusetts Institute of Technology (MIT) Open Learning. (https://ocw.mit.edu/search/?d=Mathematics)

List of Suggested Experiments

1. Problems of direction derivatives, divergence, and curl.
2. Problems of line integral and Gauss theorem.
3. Problems of Green’s theorem.
4. Problems of Stoke’s theorem.
5. Problems of partial derivatives.
6. Problems of Application of partial derivatives.
7. Problems of double and triple integrals.
8. Problems of Application of multiple integrals.

GANDHINAGAR INSTITUTE OF SCIENCE

B.Sc. /B.A.

Semester-2

Subject Code: 10170205	**Subject Title: Agriculture Business Management**
Pre-requisite: Candidate must have achieved regular 10+2 degree from any recognized Board.	

Course Objective: (1) To expose learners to the environment in which the agri-business is conducted.

(2) Focus will be on understanding micro and macro environmental forces and their impact on agri-business.

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	50	50	-	-	100

Subject Contents			
Sr. No	**Topics**	**Total Hours**	**Weight (%)**
1	Agri-business: Meaning, definition, history and scope of agri-business (Input, Farm Product Sectors). Importance of agri-business in the Indian economy. Changing dimension of agricultural business. Agri-business Management-distinctive features, nature and components.	15	25%
2	Structure of Agriculture - Linkages among sub-sectors of the Agribusiness sector; economic reforms and Indian agriculture; impact of liberalization, privatization and Globalization on Agri business sector. Emerging trends in production, processing, marketing and exports; policy controls and Regulations relating to the industrial sector with specific reference to agro-industries.	15	25%
3	Role of agriculture in Indian economy; problems and policy changes relating to farm Supplies, farm production, agro processing, agricultural marketing, agricultural finance etc. in the country. Demand and Supply: Definition, Meaning, Laws, Factor affecting, Types, Determinants. Elasticity: Definition, Types Natural Resource Economics.	15	25%
4	Agricultural Economics: Meaning, Definition, Scope and Importance of Agricultural Economics Basic Concepts: Goods, Services, Utility, Value, Price, Wealth, and Welfare, Consumption Wants: Meaning, Characteristics, Classification of Wants, Importance.	15	25%

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

1. Understand the fundamentals of management with reference to agribusiness.
2. Acquaint with various functional areas of agribusiness.
3. Study the managerial functions and its applications with reference to agribusiness.
4. Learn the concepts and process of Planning and Organizing.
5. Provides knowledge about the Staffing, Directing and Control.

List of Reference Books:

1. Freddie L. Barnard, Jay T. Akridge, Frank J. Dooley, Agribusiness Management (Environmental and Agricultural Economics), 2010.
2. John B. Penson, Oral Capps, C. Parr Rosson, Richard T. Woodward, Introduction to Agricultural Economics, Pearson, 2019.
3. W.J. Obst, R. Graham & G. Christie, Financial Management in Agribusiness, Scientific Publishers, 2010.

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

Subject Code: 10150301	**Subject Title: Advance Physics I**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to first year of Bachelor of Science.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human beings and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit-1	**Inter Atomic Force and Bonding** Introduction, force between atoms, Cohesion of atoms and cohesive energy, Calculation of cohesive energy, Bonding in solids, Ionic bonding, Bonding energy of NaCl molecule, Calculation of lattice energy of ionic crystal, Calculation of Madelung constant of ionic crystal, Properties of ionic crystal, Covalent bond, Saturation in covalent bond, Hybridization, Properties of covalent bond, Metallic bond, Properties of metallic bond, Intermolecular bond, Dispersion bond, Dipole bond, Hydrogen bond	15	34
Unit-2	**Electronics** A:Basic characteristics of the Transistor: Basic Transistor amplifier, Two diode analogy for a transistor, Transistor input characteristics, Transistor collector characteristics, Collector cut off current I_{CEO}, Forward current transfer ratio CE , Permissible operating area of a transistor CE, The basic common base amplifier, CB, Forward current transfer ratio CB, Relation between α and β, Collector cut off current I_{CBO}, Physical explanation of CB	15	33

	and CE amplifying action, Reduction of CE leakage current to I_{CO}, Common collector amplifier, Identifying the transistor leads The common emitter amplifier: Graphical analysis of CE class A amplifier, Input and output resistance, Effect of adding a class A amplifier, Conversion efficiency of class A amplifier with a direct coupled resistive load, Phase relationship in CE amplifier, Input waveform consideration, Comparison of basic transistor amplifier B: Solid state electronics Devices: Tunnel diode, Application of tunnel diode, The silicon-controlled rectifier, Uni junction transistor Opto Electronic diodes: LED, Photo diodes, Opto Couplers.		
Unit-3	**Modern Physics and Elementary Quantum Mechanics** A: Historical origins of quantum theory, Difficulties with Classical: models, Black body radiation, Compton effect, Frank- Hertz experiment, Stationary states of atoms, The correspondence principle, Bohr atom, Spectroscopic series, Quantization of the orbits. The Elliptic Orbits, Particle in a box B: Harmonic oscillator, Short coming of an old quantum theory, Compton effect, Particle diffraction, Wave packets and Einstein De Broglie relation.	15	33

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
List of Experiments			100
1	Y-by Koening's method.	3	
2	Wavelength of prominent spectral lines by diffraction grating.	3	
3	Flatness of plate by Newton's ring.	3	
4	Resolving power of telescope.	3	
5	Numerical Study of Oscillatory Motion.	3	
6	Wavelength of light using Hartmann formula.	3	

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

- Understanding the crystalline, polycrystalline and glassy materials and study of unit cell structures and its operations.
- Study of classification of crystal types and the indices of a lattice direction and plane, understanding the common crystal structures.
- Understand the basic characteristics of the transistor and two diode analogy for a transistor with its input characteristics.
- Study of class A amplifier and its input and output resistance with input waveform consideration.

- Understand the Black body radiation, Compton effect and Frank-Hertz experiment.
- Understand the correspondence principle and Bohr atom and Quantization of the orbits.
- Calculate numericals based on the above concepts and theory.

List of Textbooks:

1. Solid State Physics, by S O Pillai, New Age Publication. (6th Edition, Chapter 3: Articles no: I…IX, XII…XV, XVII…..XXIV)
2. Electronic Devices and Circuit by Allen Mottershead, PHI Publications (7th Edition, Article: 9.1 to 9.15, 9.18, 11.1 to 11.6, 11.9)
3. Quantum Mechanics by Powel and Crasemann, Addison and Wesley [Article Nos.: 1.1, 1.2, 1.3, 1.5, 1.7 to 1.12 to 1.17, 2.1, 2.2, 2.7]

List of Reference Books:

1. Quantum Mechanics by Mathews and Venkatesan
2. Modern Physics by Arthur Beiser by TMH Publications (article no: 2.2 to 2.7,4.3, 4.4, 4.6, 4.8, 3.6)
3. Electronic devices and circuits by Salivanhanan and N. Suresh Kumar
4. Quantum Mechanics by Aruldhas

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learnings-https://www.youtube.com/user/nptelhrd
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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

Subject Code: 10150302	**Subject Title: Advance Physics II**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to first year of Bachelor of Science.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human beings and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit-1	**<u>Crystal Physics</u>** A: Introduction, Lattice point and Space lattice, The basis and crystal structure, Unit cell and lattice parameter, Crystal system, crystal symmetry, The twenty three symmetry elements in cubic crystals, to show fivefold rotation axis is not compatible with a lattice, Combination of symmetry elements, Rotation inversion axis, Translational symmetry elements, Space group, The Bravais space lattice, Metallic crystal structure, Relation between the density of crystal material and lattice constant in a cubic lattice, other cubic structure, Direction, planes and Miller indices, Important features of Miller indices of crystal planes, Planes and directions in a cubic crystal, Distribution of atoms in the atomic planes of simple cubic structure, Separation between lattice planes in a cubic crystal	15	33
	B. Introduction, Crystal diffraction, Crystal grating, Bragg's law, Reciprocal lattice, Solution of Laue equations, Bragg's law in reciprocal lattice, Vector development of reciprocal lattice, Properties of reciprocal lattice vector		

Unit-2	**Wave Optics** Fresnel diffraction: Introduction, Huygens-Fresnel Theory, Fresnel's Assumptions, Rectilinear Propagation of light, Zone Plate, Difference between a zone plate and convex lens, Distinction between Interference and Diffraction, Fresnel and Fraunhoffer types of diffraction Fraunhoffer diffraction: Introduction, Fraunhoffer diffraction at a single slit, Fraunhoffer diffraction at double slit, Plane diffraction grating Resolving Power: Resolving Power, Rayleigh's Criterion, Limit of Resolution, Criterion for Resolution according to Lord Rayleigh, Resolving power of Telescope, Resolving power of plane transmission grating	15	34
Unit-3	**Dielectrics** 1. Polarization: Dielectrics, Induced dipoles, alignment of polar molecules, field of a polarized object, Physical interpretation of bound charges, The field inside a dielectric. 2. The Electric Displacement: A deceptive parallel, Boundary conditions. 3. Linear Dielectrics: Boundary value problems with linear dielectrics, Energy in dielectric systems. Forces on dielectric	15	33

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	Figure of Merit of a mirror galvanometer.	3	100
2	C1/C2 by Desauty's method.	3	
3	Zener diode as a voltage regulator.	3	
4	h-parameters of CE transistor.	3	
5	To study the variation of I_c & V_{CE} with temperature in fixed bias circuit & collector to base bias circuit for CE configuration.	3	
6	To study the variation of Ic & V_{CE} with temperature in fixed bias circuit & potential divider circuit for CE configuration.	3	

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

- Use of cohesion of atoms in the different types of bonds and its Madelung energy of ionic crystal.
- Understand the reciprocal lattice and crystal diffraction with its importance of Bragg Law and the construction of reciprocal lattice.
- Study diffraction of light with Fresnel's half period zones and difference between interference and diffraction.

- Understand and use of resolving power of optical instruments with Rayleigh's criterion of resolution and study of power grating with comparison of pate prism & grating spectra.
- Define a macroscopic and microscopic state and understand the equilibrium state, Describe Phase space and will be able to find phase space trajectory.
- Apply Liouville's theorem to find the rate of the change in density of phase points at the point of interest-Liouville's, Derive Maxwell and Boltzmann distribution from Gibb's Distribution, Apply the principle of Boltzmann distribution for describing the variation of pressure with altitude.
- Calculate numericals based on the above concepts and theory

List of Textbooks:

1. Solid State Physics, by S O Pillai, New Age Publication. (6th Edition, Chapter 4: Articles no: I…XXII)
2. Introduction to Solid State Physics, Arun Kumar, PHI, India. (Chapter 2: Articles no: 2.1 to 2.4, 2.7 to 2.11)
3. Optics & atomic physics by Singh, Agrawal. (Pragati Prakashan, Meerat) [Chapter 7. Article Nos.: 7.3 to 7.6, Chapter 8. Article Nos.: 8.6 to 8.8, 8.15,8.16 and Chapter 9. Article Nos.: 9.1 to 9.4, 9.8 to 9.10]
4. Introduction to Electrodynamics by Griffith. [3rd Edition, article no: 4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2, 4.2.1, 4.2.2, 4.2.3, 4.3, 4.3.1, 4.3.2, 4.3.3, 4.4, 4.4.1, 4.4.2, 4.4.3, 4.4.4]

List of Reference Books:

1. Electromagnetism by B.B. Laud

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learnings-https://www.youtube.com/user/nptelhrd
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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

Subject Code: 10150303	**Subject Title: Advance Physics III**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to first year of Bachelor of Science.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human beings and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Sound and Mathematical Physics** A: Sound: Architectural Acoustics, Sabine's formula, Reverberation time-theoretical treatment, Reverberation time of a live room, Reverberation time of a dead room, Optimum reverberation time. B: Fourier series: Introduction, Simple Harmonic motion & wave motion – Periodic functions, Applications of Fourier series, Average value of a function, Fourier co-efficient, Dirichlet conditions, complex form of Fourier series, other intervals, Even & odd functions, Parseval's theorem, Applications/Numericals on Fourier series.	15	34
2.	**Classical Mechanics** Motion in a Central force field: General features of the motion, Motion in an inverse square law force field, Kepler's laws of planetary motion, Collision of particles : Elastic & inelastic scattering, Elastic Scattering : Laboratory & Centre of mass system, Kinematics of elastic scattering in the laboratory system, Inelastic scattering, cross-section, The Rutherford formula, Moving	15	33

	Co-ordinate System: Rotating co-ordinate system, The Coriolis force, Motion on the earth, Effect of Coriolis force on freely falling particles		
3.	**<u>Nuclear Physics</u>** A: Physical tools: Introduction, Interaction between particles & Matter, brief survey, Detectors for Nuclear particles (i) Proportional counter (ii) The Geiger counter (iii) Scintillation counter (iv) Solid state or semi-conductor detectors (v) Cloud & Bubble chambers (vi) Spark chamber. Particle Accelerators: Need for an accelerator of charged particles, (i) Van de Graff Generator (ii) The cyclotron (iii) Synchrotron (iv) The Betatron; Beta ray spectrometer. B: Nuclear magnetic resonance (NMR), Introduction, The technique of NMR, Some experiments with NMR	15	33

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
List of Experiments			100
1	Absorption coefficient of liquid using photocell.	3	
2	Study of electron diffraction pattern.	3	
3	Resonance pendulum.	3	
4	Fourier Analysis.	3	
5	'L' by Maxwell's Bridge	3	
6	Thermocouple	3	

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

- To write Fourier series using sine cosine functions and in their complex form, find coefficients of various harmonics, sketch any given function and apply this knowledge in various fields associated with waves and oscillations.
- Calculate optimum reverberation time for any room and know whether it is a live room or dead room. This knowledge can be applied to day-to-day life in Architectural Acoustics.
- Apply knowledge of forces such as Coriolis force to explain natural physical processes such as the formation of cyclones and related technological advances.
- Use an understanding of elementary mathematics along with physical principles to effectively solve problems in collision encountered in everyday life, further study in science, and in the professional world.
- Design experiments and acquire data in order to explore physical principles, effectively communicate results, and critically evaluate related scientific studies.

- Define interaction of particles with matter which shall help him in the Study of various nuclear detectors.
- Analyze the working and construction of various nuclear accelerators used in the nuclear reaction.
- Calculate numericals based on the above concepts and theory.

List of Textbooks:

1. Oscillations, Waves and Acoustics by Ghosh and Bhattacharya. (S. Chand Publishers, article no. 24.1-24.6)
2. Mathematical Methods in Physical Science by M. L. Boas. (John Willey and Sons, Article Nos.: 7.1 to 7.8. 7.11, 10.8, 10.9)
3. Classical mechanics by R.G. Takwale & P.S. Puranik, Tata McGraw Hill. (Article Nos.: 5.2 to 5.6, 7.1 to 7.6, and 9.2 to 9.5)
4. Nuclear Physics by S.B. Patel. (New age International (P) Ltd., For A - Chapter 1: Article Nos.: 1.1.1 to 1.1.5 and For B - Chapter 9: Article Nos.: 9.1 to 9.3)

List of Reference Books:

1. Classical Mechanics by A. B. Bhatia, Narosa Publication.
2. Classical Mechanics by H. Goldstein, Addison Wesley.
3. Nuclear Physics by Kenneth Krane.
4. Modern Physics by Aruldhas.

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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GANDHINAGAR INSTITUTE OF SCIENCE

B.Sc.

Semester-III

Subject Code: 10170308	**Subject Title:** Astrology-II
Pre-requisite:	

Course Objective:

1. To study the traits and scientific aspects of planets, signs, houses, and aspects with critical thinking.
2. To build skills in natal chart reading using concepts from prediction, psychology, and neuroscience.

Teaching Scheme (Hours per week)			**Credit**	**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**		**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
04	-	-	04	50	50	-	-	100

Subject Contents			
Sr. No	**Topics**	**Total Hours**	**Weight (%)**
1	**Planets** Introduction Characteristics Scientific aspects	10	23%
2	**The Zodiac: Understanding the 12 Signs** Introduction Characteristics Relative analysis with Science	11	27%
3	**Houses and Aspects** Introduction Characteristics Critical Thinking & Skepticism	11	27%
4	**Reading a Natal Chart** Introduction Characteristics Prediction, Psychology and Neuroscience	10	23%

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

1. Understand the traits and scientific aspects of planets, signs, houses, and aspects.

2. Analyze zodiac signs from both traditional and scientific viewpoints.
3. Use critical thinking to evaluate houses and other astrological concepts.
4. Interpret natal charts using astrology, psychology, and neuroscience.

Textbooks

1. "Planets in Transit" by Robert Hand
2. "The Only Astrology Book You'll Ever Need" by Joanna Martine Woolfolk
3. "Astrology for the Soul" by Jan Spiller

Reference Books

1. "Cosmos and Psyche" by Richard Tarnas
2. "Aspects in Astrology" by Sue Tompkins
3. "The Inner Sky" by Steven Forrest
4. "Psychological Astrology: A Synthesis of Jungian Psychology and Astrology" by Karen Hamaker-Zondag
5. "Houses: Temples of the Sky" by Deborah Houlding

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

Subject Code: 10150401	**Subject Title: Advance Physics IV**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to first year of Bachelor of Science.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human beings and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Solid State Physics** **Lattice Vibration:** Introduction, Elastic vibration of one dimensional continuous homogenous medium, Vibration of one-dimensional mono-atomic linear lattice, Vibration of one dimensional Diatomic linear lattice, Phonon **Thermal Properties of Solids:** **a)** Introduction, Lattice specific heat, Classical theory (Dulong and Petit law), Einstein's theory, Debye's theory **b)** Anharmonicity, Thermal Expansion, Thermal conductivity of solids, Lattice thermal conductivity.	15	34
2.	**Heat and Thermodynamics** Entropy: Reversible part of the second law (Claussis theorem), Entropy, Entropy of the ideal gas, TS diagram, Application of the Entropy principle. Pure substances: Volume expansivity: Cubic Expansion coefficient, Compressibility. Mathematical methods in thermodynamics: Characteristics functions, Enthalpy, Helmholtz & Gibb's functions, Two mathematical theorems, Maxwell's relations, TdS equations, Internal energy equations, Heat	15	33

	Energy equations, Heat capacity equations. Open Systems: Joule-Thomson expansion, Liquefaction of gases by the Joule-Thomson expansion		
3.	**Electronics:** **Transistor Biasing:** Factors contributing to thermal stability, Effect of temperature increase, Stability factor S, Common base stability, Collector to base bias, Disadvantage of collector to base bias, Emitter bias, Voltage divider bias with emitter bias, Emitter bypass capacitor, Summary of stabilization circuit, Additional stability factors, Bias compensation **Hybrid equivalent circuit for a transistor:** Conversion of a transistor to a standard form, General Black box theory, Hybrid "h" parameters, Obtain the hybrid h parameters, Typical h parameter value, Amplifier equation, Voltage and current gains considering R_g of source, Dependence of amplifier characteristics on R_L and R_g, Comparison of CB, CC and CE	15	33

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
	List of Experiments		100
1	To study double refraction in calcite prism.	3	
2	Resolving power of grating.	3	
3	Diffraction by single slit.	3	
4	Wavelength of light by Biprism.	3	
5	Phonon dispersion relation of monoatomic lattice.	3	
6	Analysis of elliptical polarized light.	3	

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

- Describe Lattice vibration as elastic wave in crystal, the propagation of this wave in 1-dimensional monoatomic and diatomic crystal, Phonons and its characteristics.
- Describe specific heat using three models Dulong-Petit's model, Einstein's model and Debye's mode, and derive thermal conductivity and thermal expansion.
- Deduce the existence of Entropy, potential functions of thermodynamics and state their characteristics.
- Use Maxwell relations to establish relations among difficult to measure and easy to measure thermodynamic quantities and solve problems related with TdS equations, Internal energy equations and specific heats
- Describe liquefaction of gases by throttling process.
- Know the factor causes thermal instability of Bipolar transistor and design amplifier using BJT with different bias circuit, analyze transistor amplifier using h parameters.

List of Textbooks:

1. Introduction to Solid State Physics, Arun Kumar, PHI, India [Articles no: 5.1, 5.2 5.3, 5.3.2, 5.4 (excluding 5.4.1, 5.4.3), 5.5, 6.7, 6.8, 6.9, 6.10]
2. Solid State Physics, by S O Pillai, New Age Publication [6th Edition, Articles no: I, II, III, IV, V]
3. Heat & Thermodynamics by Zeemansky, McGraw Hill Int. Edition (7th edition) [Article Nos.: 8.1 to 8.5, 8.12, 9.6, 9.7, 10.1 to 10.8, 11.1, 11.2]
4. Electronics Devices and Circuits by Allen Mottershed, PHI [7th Edition, Article no. 12.1 to 12.12, 14.1 to 14.10]

List of Reference Books:

1. Modern Physics by Arthur Beiser
2. Modern Physics by Kenneth Krane
3. Electronic devices and circuits by Salivanhanan and N. Suresh Kumar

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

8

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

Subject Code: 10150402	**Subject Title: Advance Physics V**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to first year of Bachelor of Science.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human beings and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Atomic Spectroscopy** The vector atom model, Spin-orbit interaction and fine structure, Pauli's exclusion principle and electronic configuration, Total angular momentum in many electron atoms, L-S coupling, J-J coupling, Hund's rules, Energy levels and transitions of Helium, Alkali spectra, Shielding of core electrons, Spectral terms of equivalent electrons, Normal Zeeman effect-experimental arrangement and theory, Anomalous Zeeman effect, Paschen-Bach effect, Stark effect, Characteristics X-ray spectrum, Moseley's law, Width of spectral lines, Stern-Gerlach experiment.	15	34
2.	**Optics** Introduction: Polarization, Unpolarized and polarized light, Natural light is unpolarized light, Types of polarization, Production of plane polarized light, Polaroid sheets, Polarizer and Analyzer, Malus' Law, Anisotropic Crystals, Double refraction in calcite crystal, Nicol Prism, Effect of Polarizer on light of different Polarization, Huygen's construction of Wavefronts, Experimental Determination of Principle Refractive Indices, Phase difference between E-	15	33

	rays and O-Rays, Superposition of waves linearly polarized at right angles, Retarders, Production of Elliptically Polarized light, Production of Circularly Polarized light, Analysis of Polarized Light.		
3.	**Statistical Mechanics** **Macroscopic and microscopic states**: Macroscopic states, Microscopic states, Phase spaces, μ-space, Γ-space, Postulate of equal a priori probabilities, Ergodic hypothesis, Density distribution in phase space, Liouville's theorem, Principle of conservation of density in phase and principle of conservation of extension in phase, Condition for statistical equilibrium	15	33

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
	List of Experiments		100
1	FET Characteristics.	3	
2	'C' by ballistic galvanometer.	3	
3	Gray to Binary Conversions.	3	
4	Unijunction Transistor (UJT)	3	
5	High resistance by leakage method.	3	
6	Load line and determination of Q point for BJT.	3	

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

- Differentiate between the merits and demerits of various atomic models, with special thrust on vector model, utilize vector model to explain atomic spectra.
- Utilize atomic spectra in understanding the modification of atomic spectra under the influence of magnetic field and electric field.
- Able to differentiate between polarized and unpolarized light and explain pictorially the vibrations of E vectors in each case and demonstrate experiment to explain various optical phenomena.
- Explain the difference between Plane, Circularly and Elliptically polarized light and the methods to produce and detect them. The student will have an understanding about half wave plate and quarter wave plate and will be able to explain their applications.
- Describe geometry of calcite crystal and Nicol Prism and state their applications and able to demonstrate the difference between ordinary and extra ordinary rays. Explain construction and differentiate between different types of Polaroid's and will be able to relate this concept with sunglasses available in the market.
- Define a macroscopic and microscopic state and understand the equilibrium state, Describe Phase space and will be able to find phase space trajectory.

- Apply Liouville's theorem to find the rate of the change in density of phase points at the point of interest.

List of Textbooks:

1. Modern Physics by G. Aruldhas and P. Rajagopal, PHI Learning Pvt. Ltd. [Article Nos. : 7.1 to 7.19]
2. A Textbook of Optics by Dr N. Subrahmanyam, Brij Lal, Dr M N Avadhanulu. [Article No.:20.1 to 20.15, 20.17 to 20.22]
3. Fundamentals of Statistical Mechanics by B.B. Laud, New Age International Publishers. [Article Nos: 4.1 to 4.11]

List of Reference Books:

1. Modern Physics by Arthur Beiser.
2. Modern Physics by Kenneth Krane.
3. Physical Optics by A. K. Ghatak.
4. Statistical Mechanics An Introduction by Evelyn Guha, Narosa Publications.
5. Introduction to Statistical Mechanics by S.K. Sinha, Narosa Publication.
6. Fundamentals of Statistical and Thermal Physics by F. Reif, McGraw Hill Book Co.

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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Gandhinagar Institute of Science

Bachelor of Science

Semester-4

Subject Code: 10150403	**Subject Title: Advance Physics VI**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to first year of Bachelor of Science.	

Course Objective:

(1) To develop young Physics and Electronics scholars with a healthy mix of academic, emotional, and cultural development.

(2) Our first goal will be instilling a value system and cultivating sensitivity and tolerance for human beings and society.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1.	**Quantum Mechanics** A: Time dependent Schrodinger equation, Interpretation of the wave function, Expectation values, Ehrenfest's theorem, Admissibility conditions on the wave function, Stationary states: the time independent Schrodinger's equation. B: One dimensional problem, Particle in a box with rigid walls, Concept of a potential well, Wave functions and energies for the ground and excited states, Quantization of energy, Square well potential barrier.	15	34
2.	**Relativity** Galilean Transformation; Electromagnetism and Galilean Transformation; Michelson-Morley Experiment; The postulates of Special theory of relativity; Lorentz transformation; Velocity transformation; Length contraction; Time dilation; Simultaneity; Relativity of mass; Mass and energy; Space-Time diagrams; General Relativity; Principle of Equivalence; Some Predictions of General Relativity	15	33

3.	**Statistical Mechanics** **Statistical ensemble:** Micro canonical ensemble, Canonical ensemble, Mean value and fluctuations, Grand canonical ensemble, Fluctuations in the number of particles of a system in a grand canonical ensemble, Reduction of Gibb's distribution to Maxwell and Boltzmann distributions, Barometric formula.	15	33

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
	List of Experiments		100
1	Identification of elements in line spectra.	4	
2	e/m by Thomson's method.	4	
3	Analysis of elliptical polarized light using photocell.	4	
4	Wavelength of light by Adser's A pattern.	4	
5	L by Anderson's bridge.	4	
6	Shunt Regulator.	4	

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

- Derive the mass energy relation and will develop explicit problem-solving techniques to solve problems of the relativistic mechanics.
- Demonstrate an understanding of the basic principles of special theory of relativity of space, time and mass.
- Derive Maxwell and Boltzmann distribution from Gibb's Distribution.
- Apply the principle of Boltzmann distribution for describing the variation of pressure with altitude.

List of Textbooks:

1. Quantum Mechanics by G. Aruldhas [A: ARTICLE NO: 2.5 TO 2.10 B: ARTICLE NO: 4.1 TO 4.3]
2. Concept of Modern Physics BY ARTHUR BEISER (Tata McGraw Hill Edition Chapter 1 Article No. 1.1 to 1.10)
3. Fundamentals of Statistical Mechanics by B.B. Laud, New Age International Publishers. [Article Nos: 5.1, 5.2, 5.4, 5.5, 5.7, 5.8, 5.8.1, 5.8.2, 5.9]

List of Reference Books:

1. A TEXTBOOK OF QUANTUM MECHANICS BY P.M Mathews & K. Vankatesan.
2. Atomic & Nuclear Physics by Sharma, Publisher: Pearson education and Modern Physics by Gurbinder Kaur.
3. Statistical Mechanics An Introduction by Evelyn Guha, Narosa Publication.
4. Introduction to Statistical Mechanics by S.K. Sinha, Narosa Publication.
5. Fundamentals of Statistical and Thermal Physics by F. Reif, McGraw Hill Book Co.

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/ 8

GANDHINAGAR UNIVERSITY

GANDHINAGAR INSTITUTE OF SCIENCE
BACHELOR OF SCIENCE – Physics/ Mathematics
SEMESTER - 4

Subject Code: 10160402	**Subject Title:** Group Theory-II
Pre-requisite: To study this course, a student must have knowledge of Group Theory-I.	

Course Objective:

To provide students with a comprehensive understanding of key concepts in group theory, including normal subgroups, quotient groups, cyclic groups, homomorphisms, isomorphisms, and Cayley's theorem, with an emphasis on practical problem-solving through examples and applications in abstract algebra.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	-	02	04	50	50	25	25	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
1	**Normal Subgroups:** Definition and Examples, Quotients group, Solved Examples. **Isomorphism of Group:** Definition and Examples.	15	34%
2	**Cyclic Groups:** Properties of cyclic groups, Isomorphisms of cyclic groups, Subgroups of a cyclic group, Generator of a cyclic group, Solved examples.	15	33%
3	**Homomorphism-1:** Definition and Examples, Kernal of Homomorphism, Cayley's theorem, Isomorphism of groups, Groups of order four and six, Solved examples.	15	33%

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

- define and apply normal subgroups, quotient groups, and solve related examples.
- understand group isomorphisms and homomorphisms, including Cayley's theorem and examples of groups of order four and six.
- explore properties, subgroups, and isomorphisms of cyclic groups, and solve related examples.

List of Textbooks:

1. Abstract Algebra - I. H. Sheth, PHI, New Delhi, 2nd edition-2009.

List of References:

2. Topics in Algebra - I. N. Herstein, Vikas Publishing, New Delhi.
3. A First Course in Abstract Algebra - J. B. Fraleigh, Narosa Publishing, New Delhi.
4. Basic Abstract Algebra - P.B. Bhattacharya, S.K. Jain and S. R. Nagpal, Foundation Books, New Delhi.
5. Abstract Algebra - Dipak Chatterajee, PHI Learing Pvt. Ltd, New Delhi.
6. Algebra - Michael Artin, PHI.
7. A survey of Modern - G. Birkhoff & S. Maclane, Algebra Univ. Press.
8. A first course in Abstract Algebra (Rings, Groups & fields) - Marlow Anderson & Todd Fel, Chrpman & Halilereivy.
9. Contemporary Abstract Algebra, Joseph A. Gallian, 7th EDITION, Cengage learning.

Open e-Resource:

1. National Programme on Technology Enhanced Learning (NPTEL) (https://nptel.ac.in/courses)
2. Massachusetts Institute of Technology (MIT) Open Learning. (https://ocw.mit.edu/search/?d=Mathematics)

List of Suggested Experiments

1. Examples of Normal subgroups.
2. Examples on Quotients groups.
3. Examples of Isomorphism groups
4. Examples of cyclic groups.
5. Examples of Isomorphisms of cyclic groups.
6. Experiment of Subgroups of a cyclic group.
7. Experiment of Generator of a cyclic group.
8. Experiment of Kernal of Homomorphism.
9. Examples of Groups of order four and six.

GANDHINAGAR UNIVERSITY

UG Syllabus

IKS

SEMESTER 4

Subject Code: IKS0401	Subject Title: Indian ancient Science and Philosophy

Course Objective:

- Foster an appreciation for the composite nature of Indian history, culture and heritage.
- Instill a sense of love and belonging among learners, contributing to nation-building efforts.
- Provide an overview of various components of cultural heritage, including fairs, festivals, dances, art, architecture, and historical landmarks, which are crucial for a deeper understanding of history.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory		Practical		
Lecture	Tutorial	Practical	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total
02	-	-	02	-	-	25/ Project	25/ Project	50

Subject Contents			
Sr. No	**Topics**	**Total Hours**	**Credit**
1	**Ancient Science And Technology In India:** Development of science in ancient India (Astronomy, Mathematics, Medicine, Metallurgy, Chemistry) **Scientists of Ancient India and their contribution:** Mathematics & astronomy (Baudhayan, Aryabhatta, Brahmgupta, Bhaskaracharya, Mahaviracharya) Science (Kanad, Varahamihira, Nagarjuna) Medical science in ancient india (Susruta, Charak, Yoga & Patanjali)	15	1
2	**Indian Philosophical Systems:** Characteristics of Indian Philosophy, Pramanas, General Introduction to Indian Philosophical systems, i.e. Orthodox and Heterodox. Tenet of Nyaya philosophy, Principles of Vaisesika. Indian preaching on dharma, artha and Society- Bhagavadgita, Arthasastra, Gurukula systems, Nalanda, Takṣasila,	15	1

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

- Develop the ability to critically examine ancient sciences of India and narratives to understand the science and technology in ancient India.
- Develop a comprehensive understanding of the key characteristics of Indian philosophical systems.

List of Text Books:

1. An advanced history of India by B.C Majumdar & others, 1967, Macmillan
2. Ancient India by R.C. Majumdar, 1977, Motilal Banarsidas
3. History of Ancient India by Ram Shankar Tripati, 1942, Motilal Banarsidas
4. History and culture of India to 1000 A.D. by H.V. Srinivasamurthy, 1980, S.Chand & Co.
5. Advance history of India by K.A. NIlakanta Sastry & C.S. Srinivasachari, 1980, Allied Publications.
6. Ashoka, V.A. Smith, 1970, Oxford University Press.
7. Society, Religion & Art of Kushana India, Kanchan Chakraberti, 1930, Bagchi & Co.,
8. Ancient India by Romila Thapar, 2002, Oxford University Press, Delhi
9. Understanding Harappan civilization by Shereen Ratnagarh, Tulika Publication, Delhi

Gandhinagar Institute of Science
Bachelor of Science-Physics
Semester-5

Subject Code: 10150501	**Subject Title: Quantum & Statistical Mechanics**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to Second year of Bachelor of Science.	

Course Objective:

(1) Explain quantum tunneling, step potential, and barrier penetration, and compute transmission coefficients.
(2) Derive and apply Bose-Einstein and Fermi-Dirac distribution functions and their classical limits.
(3) Apply quantum statistical concepts to physical problems like ideal gas equations and paramagnetic susceptibility.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**(03+01)04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit- 1	**Operator Method:** Simple Harmonic Oscillator (1D and 3D), creation – anhilation operators, ladder operators, eigen function and eigen values of the ground state and excited states, zero-point energy, step potential, penetration through rectangular barrier, transmission coefficient, quantum tunneling, degeneracy and related problems	15	34
Unit- 2	**Angular Momentum:** Orbital angular momentum, operators for cartesian components, commutation relations (between Lx, Ly, Lz and L^2), operators L+ and L-, their interpretation as step operators, eigenvalues of Lz and L^2, angular momentum operator in spherical polar coordinates, their degeneracy, spherical harmonics, Schrodinger equation for Hydrogen atom in spherical-polar coordinates, separation into radial and angular variables.	15	33
	Formulation of Quantum Statistics: Density matrix, Liovilles theorem in Quantum Statistical Mechanics, Condition for Statistical equilibrium, Ensemble in Quantum Mechanics, Problems		

Unit- 3	**Bose Einstein and Fermi Dirac Distributions:** Symmetry of wave functions, the Quantum Distribution functions, the Boltzmann limit of Boson and Fermions Gases, Evaluation of the Partition function, Partition function for Diatomic Molecules (a) translation partition function (b) rotational partition function (c) vibration partition function (d)electronic partition function Equation of state for an Ideal gas, The quantum mechanical Para magnetic susceptibility, problems	15	33

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
	List of Experiments		100
1	Verification of Uncertainty Principle using diffraction.	3	
2	Zeeman Effect Experiment: Study splitting of spectral lines in magnetic fields.	3	
3	Measurement of Planck's constant using Photoelectric Effect.	3	
4	Tunneling Effect using Tunnel Diode or Zener Diode: Observation of quantum tunneling.	3	
5	Measurement of magnetic susceptibility of paramagnetic solution using Quincke's method.	3	
6	Specific heat of solids at low temperature using Debye model approximation.	3	

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

- Understanding the quantum tunnelling, step potential, barrier penetration, and compute transmission coefficients.
- Study of classification of operators in Quantum Mechanics and their physical interpretation.
- Understand the Bose-Einstein and Fermi-Dirac Statistics and distributions.
- Understand the quantum statistical concepts to various physical problem.

List of Textbooks:

1. Quantum Mechanics by Powel and Crasemann, Addison and Wesley [Article Nos.: 1.1, 1.2, 1.3, 1.5, 1.7 to 1.12 to 1.17, 2.1, 2.2, 2.7]
2. Quantum Physics by H. C. Verma
3. Quantum Mechanics by Zettillee
4. Statistical Mechanics by R. K. Patharia

List of Reference Books:

1. Quantum Mechanics by G. Aruldhas
2. Concept of Modern Physics BY ARTHUR BEISER (Tata McGraw Hill Edition)
3. Fundamentals of Statistical Mechanics by B.B. Laud, New Age International Publishers. [Article Nos: 5.1, 5.2, 5.4, 5.5, 5.7, 5.8, 5.8.1, 5.8.2, 5.9]
4. A TEXTBOOK OF QUANTUM MECHANICS BY P.M Mathews & K. Vankatesan.

5. Statistical Mechanics An Introduction by Evelyn Guha, Narosa Publication.
6. Introduction to Statistical Mechanics by S.K. Sinha, Narosa Publication.

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/ 8

Gandhinagar Institute of Science
Bachelor of Science-Physics
Semester-5

Subject Code: 10150502	**Subject Title: Molecular Spectroscopy**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to Second year of Bachelor of Science.	

Course Objective:

(1) To introduce the principles of molecular spectroscopy and quantum models of molecular energy levels.

(2) To develop analytical skills for interpreting rotational, vibrational, and electronic spectra of molecules.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**(03+01) 04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit- 1	**Types of Molecular Spectra and Molecular Energy States:** Separation of electronic and nuclear motion - The Born, Oppenheimer approximation, types of molecular spectra. **Pure Rotational Spectra:** Salient features of Rotational spectra, Molecular requirement for rotation spectra, experimental arrangement, Molecule as a rigid rotator, explanation of rotational spectra (without the process of solving Schrodinger equation to get energy formula), the non-rigid rotator, Isotope effect on rotational spectrum, tunable laser and pulse laser – introduction.	15	34
Unit- 2	**Vibrational - Rotational Spectra: S**alient features of vibrational Rotational spectra, Molecule as a harmonic oscillator, Molecule as anharmonic oscillator, Vibrational frequency and force constant for anharmonic oscillator, Fine structure of Infrared bands: Molecule as	15	33

	vibrating rotator, Diatomic molecule as symmetric top, Thermal distribution of vibrational and rotational levels.		
Unit- 3	**Raman Spectra:** Nature of the Raman spectra, experimental arrangement for Raman spectra, Classical theory of Raman effect, Quantum theory of Raman effect, Raman spectra and Molecular structure, Infrared spectra versus Raman spectra, Laser as intense source. **Classification of Molecular Electronic States:** Molecular electronic states, Symmetry properties of electronic eigenfunctions (symmetry classification of electronic states) Fluorescence and Phosphorescence: Luminescence, Mechanism of fluorescent emission, Mechanism of phosphorescent emission, Fluorescence spectrum compared with Raman spectrum	15	33

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
List of Experiments			100
1	Rotational Spectra Analysis of Diatomic Molecules	3	
2	Infrared Spectra Recording of Polyatomic Molecules (e.g., CO_2, HCl)	3	
3	Vibrational-Rotational Spectrum Analysis of HCl or CO	3	
4	Raman Spectra Recording of Liquids (e.g., CCl_4, Benzene)	3	
5	Demonstration of Raman Effect Using a Laser Source	3	
6	Fluorescence and Phosphorescence Spectra Observation	3	

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

- Gain basic knowledge about the types of Molecular Spectra and Born-Oppenheimer Approximation.
- Study of classification of Molecular Electronic States and Raman Spectra.
- Understand the Vibrational - Rotational Spectra and their salient features.
- Get the fundamental idea about the quantum models of molecular energy levels.

List of Reference Books:

1. B. H. Bransden and C. J. Jochain, Physics of Atoms and Molecules, (2nd Ed., Pearson Education, 2003)
2. G. Herzberg, Atomic Spectra and Atomic Structure, (Dover Publications, 2003)
3. G. Herzberg, Molecular Spectra and Molecular Structure, (Van Nostrand, 1950)
4. W. Demtroder, Atoms, Molecules and Photons, (Springer, 2006)
5. C. N. Banwell, Fundamentals of Molecular Spectroscopy, (McGraw Hill, 1983)
6. J. M. Hollas, Basic atomic & Molecular Spectroscopy, (Royal Society of Chemistry, 2002)
7. O. Svelto, Principles of Lasers, (5th Ed., Springer, 2010)
8. I. N. Levine, Quantum Chemistry, (7th Ed., Pearson, 2016)

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/

2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel,
https://www.swayamprabha.gov.in/index.php/program/current_he/
8

Gandhinagar Institute of Science
Bachelor of Science-Physics
Semester-5

Subject Code: 10150503	**Subject Title: Semiconductor Devices and Digital Electronics**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to Second year of Bachelor of Science.	

Course Objective:

(1) To provide a foundational understanding of semiconductor devices and their applications in electronic circuits.

(2) To develop the ability to analyze and design basic digital electronic systems using logic gates and combinational/sequential circuits.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**(03+01) 04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit- 1	**Semiconductor Devices:** Metal – semiconductor junction, p-n junction, majority and minority carriers, diodes, Zener diode, voltage stabilization, photo diode, tunnel diode, light emitting diode, varactor diode, transistor, solar cell, half-wave and full-wave rectifier. Field effect transistors, JFET VI characteristics, biasing JFET, MOSFET, biasing MOSFET, FET as variable voltage resister.	15	34
Unit- 2	**Amplifiers:** General principles of operation, classification, RC couple amplifier, gain frequency response, input and output impedance, multistage amplifier, transformer coupled amplifier, equivalent circuit at low, medium and high frequencies, noise in electrical circuits.	15	33
Unit- 3	**Digital Electronics:** Boolean Algebra, De-Morgan's theorem, Logic Gates, Universal Gates, Boolean expression and its solution, TTL logic families, JK and SR flip – flops, counters, multi-channel analyzer. A/D and D/A converters, Binary, Octal, Decimal and Hexadecimal number system and their mutual conversions, Illustrative examples.	15	33

		15	33

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
List of Experiments			100
1	I-V Characteristics of a Zener Diode and Its Use as a Voltage Regulator	3	
2	Half-Wave and Full-Wave Rectifier with and without Filter	3	
3	I-V Characteristics of a JFET and Determination of Pinch-off Voltage	3	
4	Frequency Response of a Single Stage RC Coupled Amplifier.	3	
5	Verification of Logic Gates and Realization of Universal Gates	3	
6	Design and Study of a 4-bit Binary Counter Using JK Flip-Flops	3	

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

- Understand the working principles and characteristics of semiconductor devices like diodes, transistors, and operational amplifiers.
- Analyze and design analog circuits using semiconductor components.
- Understand the fundamentals of digital logic, number systems, and Boolean algebra.
- Design and analyze combinational and sequential digital circuits.
- Use semiconductor and digital electronic principles in practical applications and problem-solving.

List of Reference Books:

1. P. Horowitz and W. Hill, The Art of Electronics, Cambridge University Press
2. J. Millman and A. Grabel, Microelectronics, McGraw-Hill
3. J.J. Cathey, Schaum's Outline of Electronic Devices and Circuits, McGraw-Hill
4. M. Forrest, Electronic Sensor Circuits and Projects, Master Publishing Inc
5. W. Kleitz, Digital Electronics: A Practical Approach, Prentice Hall
6. J.H. Moore, C.C. Davis and M.A. Coplan, Building Scientific Apparatus, Cambridge University Press
7. B.G. Streetman, Solid State Electronic Devices, (7th Ed., Pearson, 2015)
8. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, (1st Ed., Wiley, 2012)

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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Gandhinagar Institute of Science
Bachelor of Science-Physics
Semester-5

Subject Code: 10150504	**Subject Title: Nanoscience and Nanotechnology**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to Second year of Bachelor of Science.	

Course Objective:

(1) To introduce the fundamental principles of nanoscience and the unique physical properties of materials at the nanoscale.

(2) To explore synthesis techniques, characterization methods, and applications of nanomaterials in modern technology.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**(03+01) 04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit- 1	**Nanoparticles – Synthesis and Properties:** Method of Synthesis: RF Plasma Chemical Methods, Thermolysis, Pulsed Laser Methods, Biological Methods: Synthesis using micro-organisms, Synthesis using Plant Extract, Metal Nanoclusters, Magic Numbers, Modeling of Nanoparticles, Bulk to Nano Transitions.	15	34
Unit- 2	**Quantum Wells, Wires and Dots:** Preparation of Quantum Nanostructures, Size Effects, Conduction Electrons and Dimensionality, Properties Dependent on Density of States.	15	33
Unit- 3	**Characterization Techniques** Scanning Probe Microscopes (SPM), Diffraction Techniques, Spectroscopic Techniques, Magnetic Measurements, FT – IR, RAMAN, UV – Visible, NMR, XRD, SEM, TEM	15	33
Subject Contents			

Sr. No	Topic	Total Hours	Weight (%)
List of Experiments			100
1	Green Synthesis of Silver Nanoparticles using Plant Extract	3	
2	Biosynthesis of Zinc Oxide Nanoparticles using Microorganisms	3	
3	Thermal Decomposition (Thermolysis) for Metal Oxide Nanoparticles	3	
4	**Measurement of Optical Band Gap using UV-Visible Spectroscopy-** Determine the band gap of ZnO nanoparticles using Tauc plot method.	3	
5	**X-Ray Diffraction (XRD) Analysis of Nanoparticles-** Analyze given XRD pattern to determine crystallite size using Debye-Scherer formula.	3	
6	**Bulk to Nano Transition Study (Density, Melting Point, etc.)** Compare theoretical trends of density and melting point for bulk vs. nano materials.	3	

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

- Understand the fundamental principles and concepts of nanoscience, including the origin of nanoscale properties and the transition from bulk to nano materials.
- Describe various physical and chemical methods for synthesizing nanoparticles, including green and biological techniques.
- Explain the quantum effects in low-dimensional systems such as quantum wells, wires, and dots, and analyze how size influences electronic and optical properties.
- Identify and interpret the structure and morphology of nanomaterials using techniques such as SEM, TEM, XRD, and AFM.
- Apply spectroscopic methods (UV-Vis, FTIR, Raman, NMR) for the characterization of nanoparticles and infer material properties from spectral data.
- Demonstrate hands-on or simulated experience in nanoparticle synthesis, size estimation, and basic data interpretation relevant to nanotechnology applications.

List of Textbooks:

1. Introduction to Nanoscience and Nanotechnology by K.K. Chattopadhyay and A.N. Banerjee, Publisher: PHI Learning.
2. Nano: The Essentials—Understanding Nanoscience and Nanotechnology by T. Pradeep, Publisher: Tata McGraw-Hill.
3. Nanotechnology: Principles and Practices by Sulabha K. Kulkarni, Springer publications.

List of Reference Books:

1. Introduction to Nanotechnology by Charles P. Poole Jr. and Frank J. Owens, Wiley India Publications.
2. Characterization of Nanomaterials by K. Sharma, Wiley India Publications.

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/ 8

Gandhinagar Institute of Science
Bachelor of Science-Physics
Semester-6

Subject Code: 10150601	**Subject Title: Solid State Physics**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to Second year of Bachelor of Science.	

Course Objective:

(1) To introduce the fundamental concepts of crystal structure, bonding, and lattice dynamics in solids.

(2) To explore the electrical, magnetic, and thermal properties of materials based on quantum and classical models.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**(03+01)04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit- 1	**Bonding and Metals:** Types of boding in solids, covalent bonding and its origin, ionic bonding, energy of bonding, transition between covalent and ionic bonding, metallic bonding, Van der Waals bonding, hydrogen bonding, Drude's theory, DC conductivity, Hall effect and magnetoresistance, AC conductivity, plasma frequency, thermal conductivity of metals, Feri-Dirac distribution, thermal properties of free electron gas, Sommerfeld's theory of conduction in metals	15	33
Unit- 2	**Conduction in Semiconductors:** Bands in solids, metals, insulators and semiconductors, motion of free electrons, reduced mass, electrons and holes, donor and acceptor impurities, donor impurity levels, thermal excitation of carriers, electrical conductivity, Hall effect.	15	33
Unit- 3	**Magnetism and Superconductivity:** Diamagnetism, Paramagnetism due to free ions and conduction electrons, Curie's law, ferromagnetism, domains, hysteresis loop, outline of antiferro- and ferrimagnetism. Superconductor and superconductivity, zero resistivity, critical temperature, critical magnetic field, Meissner effect, types of superconductors, specific heat and thermal conductivity.	15	34

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
List of Experiments			100
1	**Measurement of Resistivity and Conductivity of a Metal Wire-** Using a four-probe or two-probe method (copper/nichrome wire).	3	
2	**Verification of Ohm's Law and Calculation of Conductivity in Metals-**Basic experiment to study current-voltage relationships and calculate resistance and conductivity.	3	
3	**Study of the Hall Effect in a Semiconductor-** Determination of Hall voltage, Hall-coefficient, and type (n or p) of semiconductor material.	3	
4	Study of Hysteresis Loop of a Ferromagnetic Material using a B-H Curve Tracer- Determine coercivity, retentivity, and saturation magnetization.	3	
5	**Demonstration of the Meissner Effect and Zero Resistance in a Superconductor-** Using a YBCO pellet with liquid nitrogen or via video simulation.	3	

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

- Provide a comprehensive understanding of different types of bonding in solids and their effect on material properties.
- Explain classical and quantum models of electrical conductivity in metals, including the Drude and Sommerfeld theories.
- Introduce the physics of semiconductors, their charge carriers, and transport properties.
- Explore magnetic behavior of materials and the fundamental concepts of superconductivity and related phenomena.

List of Textbooks:

1. Introduction to Solid State Physics, Arun Kumar, PHI, India [Articles no: 5.1-5.4 (excluding 5.4.1, 5.4.3), 5.5, 6.7, 6.8, 6.9, 6.10].
2. Introduction to Solid State Physics by Charles Kittel, Wiley India Publications.
3. Solid State Physics, by S O Pillai, New Age Publication [6th Edition, Articles no: I-V]
4. Heat & Thermodynamics by Zeemansky, McGraw Hill Int. (7th edition) [Article Nos.: 8.1 to 8.5, 8.12, 9.6, 9.7, 10.1 to 10.8, 11.1, 11.2]
5. Electronics Devices and Circuits by Allen Mottershed, PHI [7th Edition, Article no. 12.1 to 12.12, 14.1 to 14.10]

List of Reference Books:

1. Modern Physics by Arthur Beiser
2. Modern Physics by Kenneth Krane

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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Gandhinagar Institute of Science
Bachelor of Science-Physics
Semester-6

Subject Code: 10150602	**Subject Title: Operational Amplifier**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to Second year of Bachelor of Science.	

Course Objective:

(1) To introduce students to frequency response of amplifiers, operational amplifier fundamentals, and waveform generation techniques.

(2) To develop the ability to analyze and design analog circuits involving op-amps, oscillators, and waveform generators for practical applications.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**(03+01) 04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit- 1	**Introduction:** Frequency response of amplifier LC circuit, bandwidth and rise time, flat bandwidth equivalent circuit with and without input and output loading, cascade connections, decibel power, gain and loss, conversion to voltage and current gain, Bode's plots.	15	33
Unit- 2	**Operational Amplifier:** Basic components, differential amplifier, principle of operational amplifier, transfer characteristics, offset parameters, differential gain, inverting, non- inverting operational amplifiers, CMR, application of operational amplifier, linear circuits.	15	33
Unit- 3	**Oscillators and wave form generators:** Positive feedback, RC oscillator, Wien Bridge oscillator, phase shift oscillator, square wave generator, 555 timer for astable operation, calculation of frequency and amplitude of oscillator, unijunction oscillator.	15	34
Subject Contents			

Sr. No	Topic	Total Hours	Weight (%)
List of Experiments			100
1	**Study of Frequency Response of an RC-Coupled Amplifier-** To plot the gain vs. freq. curve and calculate the bandwidth and mid-band gain.	3	
2	**Verification of the Relationship between Bandwidth and Rise Time-** Using a simple RC circuit and oscilloscope to measure rise time and compare with theoretical bandwidth.	3	
3	**Gain and Decibel Conversion in Amplifier Circuits-**Measure voltage gain & express it in dB; convert power gain to current/voltage gain.	3	
4	**Design and Analysis of a Differential Amplifier-**Using matched transistor pairs or op-amp differential configuration.	3	
5	**Generation of Square Wave using Op-Amp as Comparator-** Construct a square wave generator and analyze waveform properties.	3	

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

- Analyze the frequency response of amplifiers using LC circuits and understand the concepts of bandwidth, rise time, and Bode plots.
- Understand the working principles, parameters, and characteristics of differential and operational amplifiers.
- Design and analyze inverting and non-inverting op-amp circuits with practical understanding of gain, CMRR, and offset.
- Explore the use of positive feedback in oscillator circuits and construct various oscillators like RC, Wien Bridge, and phase shift oscillators.
- Generate waveforms using 555 timer circuits and UJT based oscillators, and calculate their output parameters.
- Apply analog electronic principles to design and troubleshoot amplifier and waveform generator circuits in laboratory and real-life scenarios.

List of Reference Books:

1. P. Horowitz and W. Hill, The Art of Electronics, Cambridge University Press
2. J. Millman and A. Grabel, Microelectronics, McGraw-Hill
3. J.J. Cathey, Schaum's Outline of Electronic Devices and Circuits, McGraw-Hill
4. M. Forrest, Electronic Sensor Circuits and Projects, Master Publishing Inc
5. W. Kleitz, Digital Electronics: A Practical Approach, Prentice Hall
6. J.H. Moore, C.C. Davis and M.A. Coplan, Building Scientific Apparatus, Cambridge University Press
7. B.G. Streetman, Solid State Electronic Devices, (7th Ed., Pearson, 2015)
8. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, (1st Ed., Wiley, 2012)

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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Gandhinagar Institute of Science
Bachelor of Science-Physics
Semester-6

Subject Code: 10150603	**Subject Title: Particle Physics**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to Second year of Bachelor of Science.	

Course Objective:

(1) To introduce the fundamental particles, their interactions, and conservation laws governing particle physics through symmetries, quantum numbers and the Standard Model.

(2) To develop understanding of particle detection methods, accelerator technology, quark models, and recent discoveries in high-energy physics.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**(03+01) 04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit- 1	**Fundamental of Particle Physics:** Fundamental forces and fundamental particles, Symmetries and conservation laws, Space time symmetries, Space inversion, Charge conjugate and time reversal symmetries, CPT theorem and its consequences, Lepton and baryon numbers, Isospin, Strangeness and Charm, Gell-Mann and Nishima relation, Hadronic spectrum and Quark model, Concept of color and gluons	15	34
Unit- 2	**Elementary Particle:** Discovery of elementary particles in cosmic rays. Muon, meson and strange particles. Isospin and strangeness. Accelerators and detectors. Quark hypothesis, flavor and color. Meson and Baryon octets. Gellmann-Nishijima formula. Discovery of J/psi, charm quark. Families of leptons and quarks. Bottom and top quarks.	15	33
Unit- 3	**Interaction between Quarks:** Gauge symmetry and fundamental forces. Weak interaction, W and Z bosons, Higgs mechanism and spontaneous symmetry breaking. Higgs particle. Gluons and strong interaction. Neutrino oscillations, CP violation.	15	33
Subject Contents			

Sr. No	Topic	Total Hours	Weight (%)
List of Experiments			100
1	**Identification of Fundamental Particles using Simulated Particle Track Data-** Use simulated bubble chamber or cloud chamber images to recognize tracks of electrons, muons, and pions.	3	
2	**Decay Modes and Conservation Laws-** Analyze Feynman diagrams of simple particle decays and verify conservation of charge, baryon/lepton number, etc.	3	
3	**Decay Curve Analysis of Unstable Particles (Simulation/Spreadsheet)-** Use exponential decay models to understand particle lifetimes and decay modes.	3	

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

• Identify and classify fundamental particles and fundamental forces using the Standard Model framework.
• Explain conservation laws and discrete symmetries (C, P, T) and their combined implications via CPT theorem.
• Interpret quantum numbers like isospin, strangeness, charm, baryon and lepton numbers, and apply Gell-Mann–Nishijima formula.
• Describe the structure of hadrons using the quark model and understand the concept of color and gluons.
• Understand the working principles of particle accelerators and detectors, and the experimental discoveries of key particles.
• Explore advanced concepts such as neutrino oscillations, CP violation, Higgs mechanism, and gauge theories of fundamental interactions.

List of Reference Books:

1. B.L. Cohen, Concepts of Nuclear Physics, Tata McGraw Hill.
2. W.N. Cottingham and D.A. Greenwood, An introduction to Nuclear Physics, Cambridge University Press.
3. I. Kaplan, Nuclear Physics, Addison-Wesley Publications.
4. B.R. Martin, Nuclear and Particle Physics, Wiley India Publications.
5. A. Das and T. Ferbel, Introduction to Nuclear and Particle Physics, World Scientific.
6. B. Povh, K. Rith, C. Scholtz and F. Zetsche, Particles and Nuclei, Springer
7. G.D. Coughlan and J.E. Dodd, The Ideas of Particle Physics, Cambridge University Press
8. D. Griffiths, Introduction to Elementary Particles, Wiley India Publications.
9. D.H. Perkins, Introduction to High Energy Physics, Cambridge University Press.

Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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Gandhinagar Institute of Science
Bachelor of Science-Physics
Semester-6

Subject Code: 10150604	**Subject Title: FORTRAN**
Pre-requisite: Students must comprehend the fundamental ideas of essential topics such as Physics, and Mathematics up to Second year of Bachelor of Science.	

Course Objective:

(1) To introduce students to structured programming using FORTRAN and its application in scientific computing.
(2) To develop problem-solving skills through numerical methods such as root-finding, interpolation, and numerical integration.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory		**Practical**		
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total**
03	**-**	**02**	**(03+01) 04**	**50**	**50**	**25**	**25**	**150**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
Unit- 1	**Introduction:** Higher and lower-level languages, compilers, information storage and processing, algorithms programmes, floating point arithmetic, binary numbers. methods for determination of zeroes of linear and nonlinear equations and transcendental equations, convergence solution.	15	33
Unit- 2	**FORTRAN:** Fortran language, character set, structure of a Programme, types of variable names, real and integer constants, expression, types of Fortran statements, arithmetic replacement statements.	15	33
Unit- 3	**FORTRAN as a Tool:** Arrays and dimension statements, transfer control statements, IF, GO TO, loop structure under DO statement, logical expression and assignments, Simpsons' 1/3 and 3/8 rule, Newton - Raphson interpolation	15	34

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**

List of Experiments			
1	**Implement the Newton-Raphson Method in FORTRAN**- Calculate the root of a nonlinear function with convergence checking.	3	100
2	**Numerical Integration Using Simpson's 1/3 Rule- C**alculate definite integrals of given functions using FORTRAN.	3	
3	Numerical Analysis	3	
4	Matrix formulation	3	
5	Random number selection	3	
6	Program to Convert a Decimal Number to Binary and Vice Versa	3	

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

- Understand the difference between low-level and high-level programming languages, and basics of compilers and algorithms.
- Perform binary arithmetic, floating point operations, and analyze the convergence of numerical methods.
- Write and execute FORTRAN programs using appropriate syntax, variable types, and control structures.
- Implement root-finding methods like bisection, secant, and Newton-Raphson using FORTRAN.
- Solve interpolation problems and numerical integration using Simpson's 1/3 and 3/8 rules in FORTRAN.
- Apply FORTRAN programming to solve real-world physics and mathematical problems.

List of Reference Books:

1. V. Rajaraman, Computer Programming in FORTRAN 90 and 95, PHI Publications.
2. S. J. Chapman, Fortran 90/95 for Science and Engineering, McGraw Hill

Education. Open e-Resource:

1. MIT Open Learning - Massachusetts Institute of Technology**,** https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning- https://www.youtube.com/user/nptelhr
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/

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Gandhinagar Institute of Science
Bachelor of Science- Physics
Semester-7

Subject Code: 10150701	**Subject Title: Quantum Mechanics-I and Mathematical Physics-I**
Pre-requisite: Student must have achieved Graduate Degree Certificate 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**	**50**	**50**	**-**	**-**	**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. 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	15	25
2.	**WKB Approximation & Evolution with time:** WKB Approximation: One - dimensional Schrodinger equation, Bohr -Sommerfeld quantum condition, WKB solution of the radial wave equation.	15	25

	Evolution with time: Exact formal solutions: Propagators, Schrodinger equation: general solution, Propagators, Alteration of Hamiltonian, Transitions and sudden approximation. Illustrative examples		
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:** 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.	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.
- 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
Bachelor of Science- Physics
Semester-7

Subject Code: 10150702	**Subject Title: Classical Mechanics-I and Statistical Mechanics**
Pre-requisite: Student must have achieved Graduate Degree Certificate in Physics with minimum 45%. Students 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**	**50**	**50**	**-**	**-**	**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 phase transitions.	15	25
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	15	25

	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		

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

- Understand the basic concepts of classical mechanics and non-equilibrium 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
Bachelor of Science- Physics
Semester-7

Subject Code: 10150703	**Subject Title: Electrodynamics-I and Programming in C-I**
Pre-requisite: Student must have achieved Graduate Degree Certificate 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**	**50**	**50**	**-**	**-**	**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 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.	15	25
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
Bachelor of Science- Physics
Semester-7

Subject Code: 10150704 (Minor)	**Subject Title: Physics Laboratory Practicals-I**
Pre-requisite: Student must have achieved Graduate Degree Certificate 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**
-	-	**08**	**04**	**-**	**-**	**50**	**50**	**100**

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weight (%)**
SET-A			100
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	
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
Bachelor of Science- Physics
Semester-8

Subject Code: 10150801	**Subject Title: Quantum Mechanics-II and Mathematical Physics-II**
Pre-requisite: Student must have achieved Graduate Degree Certificate 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**	**50**	**50**	**-**	**-**	**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	15	25

	point at infinity, residue at infinity, Mapping Examples, Conformal mapping, Some Application of conformal Mapping examples, Additional illustrative examples.		
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
Bachelor of Science Physics (Hons.)
Semester-8

Subject Code: 10150802	**Subject Title: Classical Mechanics-II and Solid State Properties**
Pre-requisite: Student must have achieved Graduate Degree Certificate 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) Studying 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**	**50**	**50**	**-**	**-**	**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 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.	15	25

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, 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
Bachelor of Science- Physics
Semester-8

Subject Code: 10150803	**Subject Title: Analog Electronics**
Pre-requisite: Student must have achieved Graduate Degree Certificate 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**	**50**	**50**	**-**	**-**	**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 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.	15	25
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
Bachelor of Science-Physics
Semester-8

Subject Code: 10150804 (Minor)	**Subject Title: Physics Laboratory Practicals-II**
Pre-requisite: Student must have achieved Graduate Degree Certificate 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**
-	-	**08**	**08**	**-**	**-**	**50**	**50**	**100**

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
Bachelor of Science- Physics
Semester-7 & 8

Subject Code: 10150705 & 10150805	**Subject Title: PROJECT DISSERTATION (Credits:06)**
Pre-requisite: Student must have achieved Graduate degree Certificate in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

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 and give assignments according to it.
• 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 be 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 understanding, literature survey, experimental/ theoretical formulation, performance, interpretation of results and writing of Report and Dissertation.
• End-semester evaluation will be based on evaluation of report, dissertation, presentation and viva voce examination at the 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 Laboratories/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 from 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 the 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 supervisor will periodically interact with student and external supervisor. Supervisor will be responsible for internal assessment 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 documentation process at GU.
Students 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 least 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 skills and knowledge of the student based on the submitted hard copy of the dissertation and the oral presentation.

Gandhinagar Institute of Science
Bachelor of Science- Physics (Hons.)
Semester-7 & 8

Subject Code: 10150706 & 10150806	**Subject Title: SCIENTIFIC WRITING AND ON JOB TRANING (FIELD WORK) (Credits : 06)**
Pre-requisite: Student must have achieved Graduate Degree Certificate in Physics with minimum 45%. Student should have basic knowledge of technical terminology of Physical sciences.	

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.

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 or 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 Jockey	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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