RAJEEV GANDHI GOVT. POST GRADUATE COLLEGE,

AMBIKAPUR, SURGUJA (CG), INDIA

Learning Outcomes based Curriculum Framework

FOR

FOUR YEAR UNDERGRADUATE PROGRAMME IN PHYSICS

UNDER COICE BASED CREDIT SYSTEM (CBCS) PATTERN

SESSION 2023-2024

DEPARTMENT OF PHYSICS

VISION

The vision of the Physics Department is to provide in proficiency both in depth understanding of principles and concept of Physics, theoretical and experimental Physics. The Department aims to enhance the students' knowledge in basic and applied physics. To inculcate aptitude for a research career in academia or industry by introducing advanced ideas and techniques that are applicable while emphasizing the underlying concepts of Physics.

MISSION

1. To impart quality education in Physics such that they aim to become Scientists in reputed Research Organisations. To make the students effectively disseminate their knowledge in Physics to coming generations..
2. Develop the capacity and know -how to apply principles/laws of Physics to solve the problems. The ability to do and interpret the data obtained in experiments. To become a center of excellence and extend research facilities.
3. Apply the Physics knowledge for sustainable development useful for society. Assume responsibility and always practice ethical principles. To function effectively as individual as well as in a team.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Professional Skill Development To provide professional training and skill development to students in physical sciences, related disciplines and nurture them to become responsible persons in the society.
PEO 2	Core Competency Development To augment their core-competencies and knowledge levels in science, humanities and inter-disciplinary areas by imparting education of high standards and advanced technological tools.
PEO 3	Innovative Curriculum of Global Relevance To upgrade the curriculum periodically based on scientific advancements, innovations and societal relevance, so as to cater to the shifting global demands.
PEO 4	Environmental Sensitivity and Sustainability To infuse environmental sensitivity in students through academic activities and hence equip them with technical skills and scientific knowledge required to protect and safeguard the environment for a sustainable future.
PEO 5	Ethical Principles and Holistic Development To promote ethical values and focus on the holistic development of students to become proficient, skilled, competent and socially responsible people.
PEO 6	Accessibility and Academic Excellence To provide an accessible learning environment of excellence and equal opportunity to students, enabling them to develop their creativity, critical thinking, and leadership and employability skills.

PROGRAMME OUTCOMES (POs)

PO 1	To understand concept and theory of their respective subject.
PO 2	To express thoughts and ideas effectively in writing and orally.
PO 3	To identify relationship within and across disciplines in the sciences.
PO 4	To cognitive and technical skills in their field and in multidisciplinary context.
PO 5	To select and use relevant methods and tools for problem
PO 6	To make judgment and take decisions based on analysis of data and evidence.
PO 7	To critically evaluate principles and theory of sciences.
PO 8	In digital literacy and data analysis.
PO 9	To find a job in their field, exercise responsibilities to job assigned and start-
PO 10	To develop a sense of respect and duty towards constitutional, human and
PO 11	To mitigating the effects of environmental degradations, climate change and pollution.

Graduate attributes in Physics

The graduates should be able to demonstrate the capability to:

Disciplinary Knowledge:

- comprehensive knowledge and understanding of their subject area, the ability to engage with different traditions of thought, and the ability to apply their knowledge in practice including in multi-disciplinary or multi-professional contexts.

Problem solving

- Solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.

Critical thinking:

- apply analytic thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well as evidence, arguments, claims, beliefs, and there liability and relevance of evidence,
- Identify relevant assumptions or implications; and formulate coherent arguments.

Creativity

- create, perform ,or think in different and diverse ways about the same objects or scenarios,
- deal with problems and situations that do not have simple solutions,
- innovate and perform tasks in a better manner,
- view a problem or a situation from multiple perspectives,
- Think 'out of the box' and generate solutions to complex problems in unfamiliar contexts, adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence.

Communication Skills:

- listen carefully, read texts and research papers analytically, and present complex in formation in a clear and concise manner to different groups/audiences,
- express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media,
- confidently share views and express herself/himself,
- construct logical arguments using correct technical language related to a field of

learning, work/vocation, or an area of professional practice,

convey ideas, thoughts ,and arguments using language that is respectful and sensitive to gender and other minority groups.

Analytical reasoning/thinking

- evaluate the liability and relevance of evidence;
- Identify logical flaws in the argument soothers;
- Analyze and synthesize data from a variety of sources;
- Draw valid conclusions and support them with evidence and examples, and addressing opposing view points

Research-related skills:

- A keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions
- The ability to problem arise, synthesize and articulate issues and design research proposals,
- The ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data,and predict cause-and-effect relationships,
- The capacity to develop appropriate methodology and tools of data collection,
- The appropriate use of statistical and other analytical tools and techniques,
- The ability to plan, execute and report the result so fan experiment or investigation,
- The ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/in personal research work, regardless of the funding authority or field of study.

Coordinating/collaborating with others:

- Work effectively and respectfully with diverse teams,
- Facilitate cooperative or coordinate effort on the part of a group,
- Act together as a group or at remain the interest so far common cause and work efficiently as a member of a team

Learning how to learn' skills:

- acquire new knowledge and skills, including 'learning how to learn' skills, that are necessary for pursuing learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social, and

cultural objectives, and adapting to changing trades and demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/skill development/re skilling,

- work independently, identify appropriate resources required for further learning,
- Acquire or generational skills and time management to set self-defined goals and targets with timelines.
- Inculcate a healthy attitude to be a lifelong learner

Digital and technological skills

- Use ICT in a variety of learning and work situations,
- access, evaluate, and use a variety of relevant information sources,

Use appropriate software for analysis of data

Multicultural competence and inclusive spirit

- the acquisition of knowledge of the values and belief so multiple cultures and a global perspective to honour diversity,
- capability to effectively engage in a multicultural group/society and interact respectfully with diverse groups,
- capability to lead diverse team to accomplish common group tasks and goals.

Gender sensitivity and adopt gender-neutral approach, as also empathy to the less advantaged and the differently-able including those with learning disabilities.

Value inculcation

- embrace and practice constitutional, humanistic ,ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, non-violence, scientific temper, citizenship values,
- practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies,
- identify ethical issues related to work, and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights,
- Recognize environmental and sustainability issues, and participate in actions to promote sustainable development.
- Adopt objective, unbiased, and truthful actions in all aspects of work,

Instill integrity and identify ethical issues related to work, and follow ethical practices

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1	Acquire scientific temper leading to critical thinking and research motivation in Physics and its allied areas.
PSO 2	Gain knowledge and the skills to measure some of the properties of solid materials and understand the underlying principles governing the dynamics of rigid bodies.
PSO 3	Appreciate the principles of optics, electricity and magnetism and their applications in daily life.
PSO 4	Design and construct electronic circuits with computer interfacing for sophisticated analysis of material behavior and properties.
PSO 5	Comprehend algebraic concepts and advanced mathematical tools involved in the interpretation of various physical properties of materials.
PSO 6	Attain the required skills to interpret the Physics behind the phenomena occurring in nature and surroundings and hence apply them to enhance our life style.
PSO 7	Develop essential logical and analytical skills to approach a problem both quantitatively and qualitatively.

Qualification descriptors for a UG programs in Physics

The qualification descriptors for a **Four year undergraduate programme in Physics** may include the following.

The graduates should be able to:

- Demonstrate

  (i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas like Astrophysics, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, Space science and applications, and its linkages with related disciplinary areas/subjects like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology;

  (ii) procedural knowledge that creates different types of professionals related to different areas of study in Physics outlined above, including research and development, teaching and government and public service;

  (iii) skills in areas related to specialization area relating the subfields and current developments in the academic field of Physics.

- Use knowledge, understanding and skills required for identifying problems and issues relating to Physics, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources from various Physics laboratories of the world, and their application, analysis and evaluation using methodologies as appropriate to Physics for formulating new theories and concepts.
- Communicate the results of studies undertaken accurately in a range of different contexts using the main concepts, constructs and techniques of Physics. Develop communication abilities to present these results in technical as well as popular science meetings organized in various universities and other private organizations.
- Ability to meet one's own learning needs, drawing on a range of current research and development work and professional materials, and interaction with other physicists around the world.
- Apply one's knowledge of Physics and theoretical and laboratory skills to new/unfamiliar contexts to identify and analyse problems and issues and solve complex problems in Physics and related areas with well-defined solutions.
- Demonstrate Physics-related technological skills that are relevant to Physics-related job trades and employment opportunities.

The Programme learning outcomes relating to undergraduate Course in Physics:

The student graduating with the Degree should be able to

- Acquire

(i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics like Astrophysics, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, Space science, and its linkages with related disciplinary areas / subjects like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology;

(ii)procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service;

(iii)skills in areas related to one's specialization area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.

- Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.
- Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.
- Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.
- Demonstrate relevant generic skills and global competencies such as (i) problem-solving skills that are required to solve different types of Physics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries; (ii) investigative skills, including skills of independent investigation of Physics-related issues and problems; (iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature; (iv)

analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics and ability to translate them with popular language when needed; (v) ICT skills; (vi) personal skills such as the ability to work both independently and in a group.

- Demonstrate professional behavior such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism; (ii)the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment.

The Four year undergraduate programme in physics is divided into eight semesters. The syllabus and schemes of examination are detailed herewith.

Curricular framework and credit system for the four year undergraduate programme in Physics

semester	Code name	Paper name	Theory Credit	Practical Credit	Total Credit
B.Sc. (Physics) Sem.-I	VACPHY-01	Basic Physics of Nanotechnology-I	2	-	2
	SECPHY-01	Electronic Instrumentation-I	-	2	2
	DSCPHY-01	DSC-PHYSICS: **Mechanics**	3	-	4
		DSC-LAB-I: **Mechanics**	-	1	
	GECPHY-01	GEC-PHYSICS: **GENERAL PROPERIES OF MATTER**	3	-	4
		GEC-LAB-I: **GENERAL PROPERIES OF MATTER**	-	1	

semester	Code name	Paper name	Theory Credit	Practical Credit	Total Credit
B.Sc. (Physics) Sem.-II	VACPHY-02	Bas Basic Physics of Nanotechnology-II	2	-	2
	SECPHY-02	Electronic Instrumentation-II	2	-	2
	DSCPHY-02	DSC-PHYSICS: **ELECTRICITY AND MAGNETISM**	3	-	4
		DSC-LAB-II: **ELECTRICITY AND MAGNETISM**	-	1	
	GECPHY-02	GEC- **MATHEMATICAL PHYSICS**	3	-	4
		GEC-TUTORIAL-I: **MATHEMATICAL PHYSICS-I**	-	1	

semester	Code name	Paper name	Theory Credit	Practical Credit	Total Credit
B.Sc. (Physics) Sem.-III	VACPHY-03		2	-	2
	SECPHY-03		2	-	2
	DSCPHY-03	DSC-PHYSICS: **THERMAL PHYSICS**	3	-	4
		DSC-LAB-II: **THERMAL PHYSICS**	-	1	
	DSEPHY-01	DSEC- **DIGITAL SYSTEM AND APPLICATIONS**	3	-	4
		DSEC-TUTORIAL-: **DIGITAL SYSTEM AND APPLICATIONS**	-	1	

semester	Code name	Paper name	Theory Credit	Practical Credit	Total Credit
B.Sc. (Physics) Sem.-IV	VACPHY-04		2	-	2
	SECPHY-04		2	-	2
	DSPHYC-04	DSC-PHYSICS: **WAVES AND OPTICS**	3	-	4
		DSC-LAB-II: **WAVES AND OPTICS**	-	1	
	DSEPHY-02	DSEC- **MATHEMATICAL PHYSICS-II**	3	-	4
		GEC-TUTORIAL-: **MATHEMATICAL PHYSICS-II**	-	1	

semester	Code name	Paper name	Theory Credit	Practical Credit	Total Credit
B.Sc. (Physics) Sem.-V	VACPHY-05		2	-	2
	SECPHY-05		2	-	2
	DSCPHY-05	DSC-PHYSICS: **ELEMENTS OF MODERN PHYSICS**	3	-	4
		DSC-LAB-II: ELEMENTS OF MODERN PHYSICS	-	1	
	DSEPHY-03	DSEC- **QUANTUM MECHANICS**	3	-	4
		DSEC-TUTORIAL-I: **QUANTUM MECHANICS**	-	1	
	GECPHY-03	DEC- **QUANTUM MECHANICS**	3	-	4
		GEC-TUTORIAL-I: **QUANTUM MECHANICS**	-	1	

semester	Code name	Paper name	Theory Credit	Practical Credit	Total Credit
B.Sc. (Physics) Sem.-VI	SECPHY-06		2	-	2
	DSCPHY-06	DSC-PHYSICS: **SOLID STATE PHYSICS-I**	3	-	4
		DSC-LAB-II: **SOLID STATE PHYSICS-I**	-	1	
	DSEPHY-04	DSEC- **ANALOG SYSTEM AND APPLICATIONS**	3	-	4
		DSEC-LAB: **ANALOG SYSTEM AND APPLICATIONS**	-	1	
	GECPHY-04	GEC- **ANALOG SYSTEM AND APPLICATIONS**	3	-	4
		GEC-LAB: **ANALOG SYSTEM AND APPLICATIONS**	-	1	

semester	Code name	Paper name	Theory Credit	Practical Credit	Total Credit
B.Sc. (Physics) Sem.-VII	DSCPHY-07	DSC-PHYSICS: **SOLID STATE PHYSICS-II**	3	-	4
		DSC-LAB: **SOLID STATE PHYSICS-II**	-	1	
	DSEPHY-05	DSEC- **ELECTROMAGNETIC THEORY**	3	-	4
		DSEC-LAB: **ELECTROMAGNETIC THEORY**	-	1	
	DSEPHY-06	DSEC- **NUCLEAR & PARTICLE PHYSICS-I**	3	-	4
		DSEC-LAB: **NUCLEAR & PARTICLE PHYSICS-I**	-	1	
	DSEPHY-07	DSEC- **STATISTICAL MECHANICS**	3	-	4
		DSEC-LAB: **STATISTICAL MECHANICS**	-	1	

semester	Code name	Paper name	Theory Credit	Practical Credit	Total Credit
B.Sc. (Physics) Sem.-VIII	DSCPHY-08	DSC-PHYSICS: **PHYSICS OF DEVICES AND INSTRUMENTS**	3	-	4
		DSC-LAB: **PHYSICS OF DEVICES AND INSTRUMENTS**	-	1	
	DSEPHY-08	DSEC- **NUCLEAR & PARTICLE PHYSICS-II**	3	-	4
		DSEC-LAB: **NUCLEAR & PARTICLE PHYSICS-II**	-	1	
	DSEPHY-09	DSEC- **ELECTRONICS**	3	-	4
		DSEC-LAB: **ELECTRONICS**	-	1	
	DSEPHY-10	DSEC- **APPLIED OPTICS**	3	-	4
		DSEC-LAB: **APPLIED OPTICS**	-	1	

Discipline Specific Core Course (DSCPHY-01)

Semester-I

Paper: Mechanics

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understand laws of motion and their application to various dynamical situations.

CO-02: Learn the concept of inertial reference frames and Galilean transformations. Also, the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.

CO-03: Understand translational and rotational dynamics of a system of particles.

CO-04: Apply Kepler's laws to describe the motion of planets and satellite in circular orbit.

CO-05: Understand concept of Geosynchronous orbits

CO-06: Explain the phenomenon of simple harmonic motion.

CO-07: Understand special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object.

CO-08: In the laboratory course, the student shall perform experiments related to mechanics: compound pendulum, rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity), fluid dynamics, estimation of random errors in the observations etc.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										
CO-02			✓					✓			
CO-03	✓									✓	
CO-04					✓	✓					
CO-05			✓					✓			
CO-06		✓			✓				✓		
CO-07	✓							✓			✓
CO-08			✓				✓		✓		

B.Sc.-I	FIRST SEMESTER	COURSE CODE: DSCPHY-01
PAPER CODE: PSCC-1T	**Credit: (Theory-03, Practical-1), Theory: 45 Hours, Practical: 30 Hours**	
PAPER TITLE: MECHANICS		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 11Hours	**Fundamentals of Dynamics:** Reference frames, Inertial frames, Non-inertial frames and their characteristic properties, fictitious forces. Uniformly rotating frame. Centrifugal force and its applications, Coriolis force and its applications. Galilean transformations, Galilean invariance, Impulse.	
UNIT-2 14 Hours	**Rotational Dynamics:** angular momentum of a rigid body, Angular momentum of a particle and system of particles. Physical significance of angular momentum, Relation between angular momentum and Torque, Relation between moment of inertia and angular momentum, Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of inertia, physical significance of moment of inertia, theorem of parallel and perpendicular axes related to moment of inertia, Kinetic energy of rotation.	
UNIT-3 10Hrs	**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy. Inertial mass, gravitational mass and their characteristic properties, Potential and field due to spherical shell and solid sphere **Motion of a particle under a central force field:** Central force and its characteristic properties, Two-body problem, its reduction to one- body problem. Kepler's Laws. Satellite in circular orbit,	
UNIT- 4 10 Hrs	**Oscillations:** Definition and characteristic properties of SHM, Types of Oscillation, Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values,	
SUGGESTED READINGS	1. An Introduction to Mechanics (2/e), Daniel Kleppner & Robert Kolenkow, 2014, Cambridge University Press. 2. Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education. 3. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education. 4. Intermediate Dynamics, Patrick Hamill, 2010, Jones and Bartlett Publishers. 5. Analytical Mechanics, G. R. Fowles and G. L. Cassiday, 2005, Cengage Learning.	

Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-I	FIRST SEMESTER	COURSE CODE: DSCPHY-1LAB
PAPER CODE: PSCC-1P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSC-LAB: MECHANICS		
PRACTICAL MARKS: 50		

CO: At the end of this course, the students will be able to

- ***To get the knowledge about use of various measuring instruments.***
- ***To get understand about the simple harmonic motion, elasticity, surface tension and viscosity.***

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours	1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope. 2. To determine the g with the help of Barton's Pendulum 3. Study of laws of parallel and perpendicular axes for moment of inertia. 4. Moment of inertia of Fly wheel. 5. Moment of inertia of irregular bodies by inertia table. 6. Study of conservation of momentum in two dimensional oscillations. 7. Study of a compound pendulum. 8. Study of damping of a bar pendulum under various mechanics. 9. Study of oscillations under a bifilar suspension. 10. Study of modulus of rigidity by Maxwell‟s needle. 11. Determination of Y, k, η by Searl‟s apparatus. 12. To study the oscillation of a rubber band and hence to draw a potential energy curve from it. 13. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g 14. Study of torsion of wire (static and dynamic method). 15. Poisson's ratio of rubber tube. 16. Study of bending of a cantilever or a beam. 17. Study of flow of liquids through capillaries. 18. Determination of surface tension of a liquid. 19. Study of viscosity of a fluid by different methods.
Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/

Generic Elective Course (GECPHY-01)

Semester-I

Paper: GENERAL PROPERTIES OF MATTERS

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Laws of motion and their application to various dynamical situations, and their applications to conservation of momentum, angular momentum and energy.
CO-02: Application of Kepler's laws to describe the motion of satellites in circular orbit.
CO-03: Concept of stress and strain and relation between elastic constants
CO-04: Postulates of Special Theory of Relativity, Lorentz transformation, relativistic effects on the mass and energy of a moving body.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓					✓					
CO-02			✓			✓			✓		
CO-03			✓		✓	✓					✓
CO-04									✓		

B.A/B.COM.-I	FIRST SEMESTER	COURSE CODE: GECPHY-01
PAPER CODE: PGEC-1T	Credit: (Theory-03, Practical-1),	Theory: 45 Hours, Practical: 30 Hours
PAPER TITLE: GENERAL PROPERTIES OF MATTERS		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) PRACTICAL MARKS: 50		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 11Hours	**Recapitulation of Vectors and Ordinary Differential Equation:** Vector algebra, scalar and vector product, gradient of a scalar field, divergence and curl of vectors field.	
UNIT-2 14 Hours	**Elasticity :** Concept of stress and strain, Hooke's law, twisting torque on a wire, tensile strength, relation between elastic constants, Poisson's ratio,	
UNIT-3 10Hrs	**Gravitation and Central Force Motion:** Law of gravitation. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere **Motion of a particle under a central force field:** Two-body problem, its reduction to one- body problem, Kepler's Laws. Satellite in circular orbit,	
UNIT- 4 10 Hrs	**Special Theory of Relativity:** Postulates of Special Theory of Relativity, Lorentz transformation, length contraction, time dilation, relativistic transformation of velocity, relativistic variation of mass, mass-energy equivalence	
SUGGESTED READINGS	1. An Introduction to Mechanics (2/e), Daniel Kleppner & Robert Kolenkow, 2014, Cambridge University Press. 2. Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education. 3. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education. 4. Intermediate Dynamics, Patrick Hamill, 2010, Jones and Bartlett Publishers. 5. Analytical Mechanics, G. R. Fowles and G. L. Cassiday, 2005, Cengage Learning.	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

B.A./B.COM-I	FIRST SEMESTER	COURSE CODE: GECPHY-1:LAB
PAPER CODE: PGEC-1P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: GEC-LAB: GENERAL PROPERTIES OF MATTERS		
PRACTICAL MARKS: 50		

CO: At the end of this course, the students will be able to

- ***To get the knowledge about use of various measuring instruments.***
- ***To get understand about the simple harmonic motion, elasticity, surface tension and viscosity.***

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours	1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope. 2. To determine the g with the help of Barton's Pendulum 3. Study of laws of parallel and perpendicular axes for moment of inertia. 4. Moment of inertia of Fly wheel. 5. Moment of inertia of irregular bodies by inertia table. 6. Study of conservation of momentum in two dimensional oscillations. 7. Study of a compound pendulum. 8. Study of damping of a bar pendulum under various mechanics. 9. Study of oscillations under a bifilar suspension. 10. Study of modulus of rigidity by Maxwell‟s needle. 11. Determination of Y, k, η by Searl‟s apparatus. 12. To study the oscillation of a rubber band and hence to draw a potential energy curve from it. 13. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g 14. Study of torsion of wire (static and dynamic method). 15. Poisson's ratio of rubber tube. 16. Study of bending of a cantilever or a beam. 17. Study of flow of liquids through capillaries. 18. Determination of surface tension of a liquid. 19. Study of viscosity of a fluid by different methods.
Online resources	a. **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/

Value added Course (VACPHY-01)

Semester-I

Paper: BASIC PHYSICS OF NANO TECHNOLOGY-I

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understand the basics of nanotechnology.
CO-02: Learn about types, properties of different nanotechnologies.
CO-03: Understand the basic concepts of tools and techniques in nanotechnologies
CO-04: Learn about uses and applications of nanotechnologies.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										
CO-02			✓		✓			✓			
CO-03	✓									✓	
CO-04					✓			✓			✓

B.SC.-I	FIRST SEMESTER	COURSE CODE: VACPHY-01
PAPER CODE: PVAC-1T	**Credit: (Theory-02), Theory: 30 Hours,**	
PAPER TITLE: BASIC PHYSICS OF NANO TECHNOLOGY-I		
THEORY MARKS: 50 (CCA: 50)		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 15Hours	Definition of nanotechnology, why Nanotechnology, tools and techniques, Field of Molecular Nanotechnology, uses of Nanotechnology	
UNIT-2 15 Hours	Basic idea of nanotechnology, Techniques used in Technology (types, advantages, drawbacks and their characteristics), Tools used in nanotechnology (types, advantages, drawbacks and their characteristics)	
SUGGESTED READINGS	1. Understanding of Nanotechnology by D.G. Sauder 2. Basics Of Nanotechnology by Bohra And L S Bio Green Publisher 3. Introduction to Nanoscience and Nanotechnology by k.k. chattopadhay, PHI Publication	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

Skill Enhancement Course (SECPHY-01)

Semester-I

Paper: ELECTRONIC INSTRUMENATATION-I

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understanding the physics of the devices their characteristics and applications, to be able to use them in electronic circuits.

CO-02: Students would be aware of various signal conditioning, processing and generation techniques thus being better equipped to understand their use in larger and complex systems.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓	✓				✓		✓	✓		
CO-02		✓	✓			✓			✓		✓

.

B.SC.-I	FIRST SEMESTER	COURSE CODE: SECPHY-01
PAPER CODE: PSEC-1T	**Credit: (Theory-02), Theory: 30 Hours,**	
PAPER TITLE: ELECTRONIC INSTRUMENATATION-I		
THEORY MARKS: 50 (CCA: 50)		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 15Hours	**Qualities of Measurement:** Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting	
UNIT-2 15 Hours	**Measurement of Resistance and Impedance:** Low Resistance by Kelvin's double bridge method, Medium Resistance by Wheatstone bridge method, High Resistance by Megger. Measurement of Self Inductance by Maxwell's bridge, , Measurement of Capacitance by Schering's bridge, Measurement of frequency by Wien's bridge.	
LAB	1. Design of multi range ammeter and voltmeter using galvanometer. 2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity. 3. Measurement of Capacitance by de'Sautys. 4. Measure of low resistance by Kelvin's double bridge. 5. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)	
SUGGESTED READINGS	1. H. S. Kalsi, Electronic Instrumentaion, TMH(2006) 2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, PrenticeHall (2005). 3. Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH 4. E.O.Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003). 5. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005) 6. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013). 7. Oliver and Cage, "Electronic Measurements and Instrumentation", TMH (2009). 8. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (ButerworthHeinmann2008). 9. A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpatRai and Sons (2007). 10. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

Discipline Specific Core Course (DSCPHY-02)

Semester-II

Paper: Electricity and Magnetism

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Demonstrate the application of Coulomb's law for the electric field, and also apply it to systems of point charges as well as line, surface, and volume distributions of charges.

CO-02: Demonstrate an understanding of the relation between electric field and potential, exploit the potential to solve a variety of problems, and relate it to the potential energy of a charge distribution.

CO-03: Apply Gauss's law of electrostatics to solve a variety of problems.

CO-04: Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws)

CO-05: Understand the concepts of induction and self-induction, to solve problems using Faraday's and Lenz's laws.

CO-06: Understand the basics of electrical circuits and analyze circuits using Network Theorems.

CO-07: In the laboratory course the student will get an opportunity to verify network theorems and study different circuits such as RC circuit, LCR circuit. Also, different methods to measure low and high resistance, capacitance, self-inductance, mutual inductance, strength of a magnetic field and its variation in space will be learnt.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓			✓				✓	✓		
CO-02			✓		✓			✓	✓		
CO-03				✓		✓				✓	
CO-04				✓							
CO-05	✓										✓
CO-06	✓										✓
CO-07				✓	✓	✓			✓		

B.Sc.-II	SECOND SEMESTER	COURSE CODE: DSCPHY-02
PAPER CODE: PSCC-2T	Credit: (Theory-03, Practical-1),	Theory: 45 Hours, Practical: 30 Hours
PAPER TITLE: Electricity and Magnetism		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) PRACTICAL MARKS: 50		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 11Hours	**Electric Field and Electric Potential:** Coulomb‟s law in vacuum expressed in Vector forms, dipole and Quadrupole, Gauss's law and its application: E due to (1) an Infinite Line of Charge, (2) a Charged Cylindrical Conductor, (3) an Infinite Sheet of Charge. **Dielectric Properties of Matter**: Dielectric, types of dielectrics, Polarization Vector P, Displacement vector **D**. Relations between **E**, **P** and **D**, Gauss' Law in dielectrics, Classisus Mossotti Equation,	
UNIT-2 14 Hours	**Magnetic Field**: Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole), Ampere‟s Circuital law (Integral and Differential Forms), Torque on a current loop in a uniform Magnetic Field	
UNIT-3 10Hrs	**Electrical Circuits**: Kirchhoff's Current Law& Kirchhoff's Voltage Law for AC circuits. power consumed by an a AC circuit, power factor. **Electromagnetic Induction**: Faraday's Law, integral and differential forms of Faraday's law, Transformers,	
UNIT- 4 10 Hrs	**Network theorems**: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem.	
SUGGESTED READINGS	1. Berkeley Physics Course, Electricity and Magnetism, Ed. E.M. Purcell (Mc Graw-Hill). 2. Halliday and Resnik, Physics, Vol. 2. 3. D J Grifith, Introduction to Electrodynamics (Prentice-Hall of India). 4. Raitz and Milford, Electricity and Magnetism (Addison-Wesley). 5. A S Mahajan and A A Rangwala, Electricity and Magnetism (Tata Mc Graw-hill). 6. A M Portis, Electromagnetic fields. 7. Pugh & Pugh, Principles of Electricity and Magnetism (Addison-Wesley). 8. Panofsky and Phillips, Classical Electricity and Magnetism, (India Book House). 9. S S Atwood, Electricity and Magnetism (Dover). 10. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House. 11. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11/e, 2011, Kitab Mahal.	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

B.Sc.-II	SECOND SEMESTER	COURSE CODE: DSCPHY-2LAB
PAPER CODE: PSCC-2P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSC-LAB: ELECTRICITY AND MAGNETISM		
PRACTICAL MARKS: 50		

CO: At the end of this course, the students will be able to

- ***To get the knowledge about use of various measuring instruments.***
- ***To get understand about the FORTRAN, CAND C++, DIFFERENT ELECTRICAL MEASURING DEVICES.***

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours	1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical ruses 2. Use of a vibration magnetometer to study a field. 3. Study of magnetic field B due to a current. 4. Measurement of low resistance by Carey-Foster bridge. 2. Measurement of inductance using impedance at different frequencies. 3. Study of decay of currents in LR and RC circuits. 4. Response curve for LCR circuit and response frequency and quality factor. 5. Study of waveforms using cathode-ray oscilloscope. 6. Characteristics of a choke and Measurement of inductance. 7. Study of Lorentz force. 8. Study of discrete and continuous LC transmission line. 9. Elementary FORTRAN programs, Flowcharts and their interpretation. 10. To find the product of two matrices. 11. Numerical solution of equation of motion. 12. To find the roots of quadratic equation. 13. To find the product of two matrices. 14. Numerical solution of equation of motion. 15. To find the roots of quadratic equation. 16. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width. 17. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor . 18. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer 19. Determine a high resistance by leakage method using Ballistic Galvanometer. 20. To determine self-inductance of a coil by Rayleigh's method. To determine the mutual inductance of two coils by Absolute method.

Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/

Generic Elective Course (GECPHY-02)

Semester-II

Paper: MATHEMATICAL PHYSICS

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understand functions of several variables.
CO-02: Represent a periodic function by a sum of harmonics using Fourier series and their applications in physical problems such as vibrating strings etc.
CO-03: Learn about gamma and beta functions and their applications.
CO-04: Solve linear partial differential equations of second order with separation of variable method.
CO-05: Understand the basic concepts of complex analysis and integration.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										✓
CO-02			✓		✓				✓		
CO-03								✓			
CO-04			✓	✓						✓	
CO-05	✓										

B.A/B.COM.-II	**SECOND SEMESTER** **COURSE CODE: GECPHY-02**
PAPER CODE: PGEC-1T	**Credit: (Theory-03, Practical-1), Theory: 45 Hours, Tutorial: 30 Hours**
PAPER TITLE: MATHEMATICAL PHYSICS	
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 11Hours	**Fourier series:** Periodic functions. Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Fourier Cosine Series and Fourier Sine Series
UNIT-2 14 Hours	**Some Special Integrals:** Beta and Gamma Functions and Relation between them. Expression of integrals in terms of Gamma Functions
UNIT-3 10Hrs	**Partial Differential Equations:** Multivariable functions, Partial derivatives, Functions Solutions to partial differential equations, using separation of variables:
UNIT- 4 10 Hrs	**Complex Analysis**: Functions of complex variable, Analytic function, Cauchy-Riemann equations, singular points, Cauchy Residue Theorem, Cauchy's Integral Formula, Residues, Cauchy's Residue Theorem.
SUGGESTED READINGS	**1)** Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India. **2)** Complex Variables and Applications, J. W. Brown and R. V. Churchill, 7th Ed. 2003, Tata McGraw-Hill **3)** Advanced Mathematics for Engineers and Scientists: Schaum Outline Series, M. R Spiegel, 2009, McGraw Hill Education. **4)** Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Harvill, 2014, Dover Publications. **5)** Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd Ed., 2006, Cambridge University Press.
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

Value added Course (VACPHY-02)

Semester-I

Paper: BASIC PHYSICS OF NANO TECHNOLOGY-II

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understand the basics of nanomaterials.
CO-02: Learn about types, properties of different nanomaterials.
CO-03: Understand the basic concepts of production of nanomaterials
CO-04: Learn about uses and applications of nanomaterials.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓									✓	
CO-02			✓		✓			✓			
CO-03	✓								✓		✓
CO-04					✓			✓			

B.SC.-II	SECOND SEMESTER	COURSE CODE: VACPHY-02
PAPER CODE: PVAC-2T	**Credit: (Theory-02), Theory: 30 Hours,**	
PAPER TITLE: BASIC PHYSICS OF NANO TECHNOLOGY-II		
THEORY MARKS: 50 (CCA: 50)		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 15Hours	Definition of nanomaterials, Properties of nanomaterials, methods of produce nanomaterials, applications of nanomaterials	
UNIT-2 15 Hours	Definition of Carbon nanomaterials, carbon nanomaterials (Types, uses, Properties, production and applications) , idea of carbon nanotubes, nanotubes (Types, uses, Properties, production and applications), idea of nanowires, nanowires (Types, Properties, uses, production and applications),	
SUGGESTED READINGS	1. PRINCIPLES OF NANOSCIENCE AND NANOTECHNOLOGY BY M.A. SHAH 2. Introduction to Nanoelectronics by Mitin , Cambridge india publisher	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

Skill Enhancement Course (SECPHY-02)

Semester-II

Paper: ELECTRONIC INSTRUMENATATION-II

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understanding the physics of the devices their characteristics and applications, to be able to use them in electronic circuits.

CO-02: Students would be aware of various signal conditioning, processing and generation techniques thus being better equipped to understand their use in larger and complex systems.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓					✓			✓		✓
CO-02			✓		✓✓	✓				✓	

B.SC.-II	SECOND SEMESTER	COURSE CODE: SECPHY-02
PAPER CODE: PSEC-2T	**Credit: (Theory-02), Theory: 30 Hours,**	
PAPER TITLE: ELECTRONIC INSTRUMENATATION-II		
THEORY MARKS: 50 (CCA: 50)		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 15Hours	**Oscilloscopes:** CRT, wave form display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, **Power scope:** Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time). Signal Generators: Audio oscillator, Pulse Generator, Function generators	
UNIT-2 15 Hours	**Transducers and sensors:** Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature compensation and applications), Capacitive (Variable Area Type – Variable Air Gap type – Variable Permittivity type), Inductive (LVDT) and piezoelectric transducers. Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).	
LAB	1. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.) 2. To determine the Characteristics of LVDT. 3. To determine the Characteristics of Thermistors and RTD. 4. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type. **5.** To study the Characteristics of LDR, Photodiode, and Phototransistor: (i) Variable Illumination. (ii) Linear Displacement. **6.** Characteristics of one Solid State sensor/ Fiber optic sensor	
SUGGESTED READINGS	R. P. Bali Consumer Electronics Pearson Education (2008) 2. R. G. Gupta Audio and Video systems Tata McGraw Hill (2004)	

Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

Discipline Specific Core Course (DSCPHY-03)

SEMESTER-III

Paper: Thermal Physics

Course Learning Outcomes

Course Learning Outcomes

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

CO-01: Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics.

CO-02: Understand the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.

CO-03: Know about reversible and Irreversible processes.

CO-04: Learn about Maxwell's relations and use them for solving many problems in Thermodynamics

CO-05: Understand the concept and behavior of ideal and real gases.

CO-06: Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equitation of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.

CO-07: In the laboratory course, the students are expected to do some basic experiments in thermal Physics, viz., determination of Mechanical Equivalent of Heat (J), coefficient of thermal conductivity of good and bad conductor, temperature coefficient of resistance, variation of thermo-emf of a thermocouple with temperature difference at its two junctions and calibration of a thermocouple.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓				✓	✓			✓		
CO-02	✓		✓								✓
CO-03	✓									✓	
CO-04						✓		✓			
CO-05	✓										✓
CO-06			✓		✓			✓			
CO-07				✓	✓	✓			✓		

B.Sc.-III	**THIRD SEMESTER** **COURSE CODE: DSCPHY-03**
PAPER CODE: PSCC-3T	**Credit: (Theory-03, Practical-1), Theory: 45 Hours, Practical: 30 Hours**
PAPER TITLE: THERMAL PHYSICS	
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 15 Hours	**Zeroth and First Law of Thermodynamics:** Extensive and intensive Thermodynamic Variables, , Zeroth Law of Thermodynamics & Concept of Temperature, First Law of Thermodynamics and its differential form, Internal Energy, Work Done during Isothermal and Adiabatic Processes, **Second Law of Thermodynamics:** Carnot's Cycle, Carnot Engine & efficiency, 2^{nd} Law of Thermodynamics: Kelvin Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.
UNIT-2 10 Hours	**Entropy:** Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics.
UNIT-3 10 Hours	**Thermodynamic Potentials:** Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb‟s Free Energy. Their Definitions, Properties and Applications. Clausius Clapeyron Equation and Ehrenfest equations. **Maxwell's Thermodynamic Relations**: Derivation of Maxwell‟s thermodynamic Relations and their applications, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Value of Cp-Cv, (3) Tds Equations, (4) Energy equations.
UNIT-4 10 Hours	**Real Gases:** Deviations from the Ideal Gas Equation. Andrew‟s Experiments on CO_2 Gas, Virial Equation. Critical Constants.. van der Waal‟s Equation of State for Real Gases. Values of Critical Constants.. Free Adiabatic Expansion of a Perfect Gas. Joule- Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and vander Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.
SUGGESTED READINGS	1. Heat and Thermodynamics: M.W. Zemansky and R.Dittman, (Tata McGraw-Hill.) 2. A Treatise on Heat :M.N.Saha and B.N.Srivastava, 1958 (Indian Press.) 3. Thermal Physics: S. C.Garg, R. M. Bansal and C. K. Ghosh (Tata McGraw-Hill.) 4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics :Sears and Salinger (Narosa). 5. Concepts in Thermal Physics: Blundell and Blundell (Oxford Univ. press)
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-III	THIRD SEMESTER	COURSE CODE: DSCPHY-3LAB
PAPER CODE: PSCC-3P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSC-LAB: THERMAL PHYSICS		
PRACTICAL MARKS: 50		

CO: At the end of this course, the students will be able to

- ***To get the knowledge about use of various measuring instruments.***
- ***To get understand about the simple harmonic motion, elasticity, surface tension and viscosity.***

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours	1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne‟s constant flow method. 2. To determine the Coefficient of Thermal Conductivity of Cu by Searle‟s Apparatus. 3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom‟s Method. 4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton‟s disc method. 5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT). 6. To study the variation of Thermo-emf of a Thermocouple with Difference of Temperature of its Two Junctions using a null method. And also calibrate the Thermocouple in a specified temperature range. 7. To calibrate a thermocouple to measure temperature in a specified Range using Op-Amp difference amplifier and to determine Neutral Temperature. .
Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/

Discipline Specific Elective Course (DSEPHY-01)

SEMESTER-III

Paper: Digital Systems and Applications

Course Learning Outcomes

Course Learning Outcomes

This course lays the foundation for understanding the digital logic circuits and their use in combinational and sequential logic circuit design. It also imparts information about the basic architecture, memory and input/output organization in a microprocessor system. The students also learn the working of CRO.

CO-01: Course learning begins with the basic understanding of active and passive components.

It then builds the concept of Integrated Chips (IC): its classification and uses.

CO-02: Differentiating the Analog and Digital circuits, the concepts of number systems like Binary,BCD, Octal and hexadecimal are developed to elaborate and focus on the digital systems.

CO-03: Sequential Circuits: Basic memory elements Flips-Flops, shift registers and 4-bits counters leading to the concept of RAM, ROM and memory organization.

CO-04: Timer circuits using IC 555 providing clock pulses to sequential circuits and develop multivibrators.

CO-05: Introduces to basic architecture of processing in an Intel 8085 microprocessor and to Assembly Language.

CO-06: Also impart understanding of working of CRO and its usage in measurements of voltage, current, frequency and phase measurement.

CO-07: In the laboratory students will learn to construct both combinational and sequential circuits by employing NAND as building blocks and demonstrate Adders, Subtractors, Shift Registers, and multivibrators using 555 ICs. They are also expected to use µP 8085 to demonstrate the same simple programme using assembly language and execute

the programme using a µP kit.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓							✓			✓
CO-02			✓		✓				✓		
CO-03									✓	✓	
CO-04		✓				✓			✓		
CO-05									✓		✓
CO-06		✓			✓						
CO-07				✓	✓	✓			✓		

B.Sc.-III	**THIRD SEMESTER** **COURSE CODE: DSEPHY-01**
PAPER CODE: PDEC-1T	**Credit: (Theory-03, Practical-1), Theory: 45 Hours, Practical: 30 Hours**
PAPER TITLE: Digital Systems and Applications	
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 15 Hours	**Digital Circuits:** Difference between Analog and Digital Circuits, Examples of linear and digital ICs, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, BCD, Octal and Hexadecimal numbers, AND, OR and NOT Gates (realisation using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates and application as Parity Checkers.
UNIT-2 13 Hours	**Boolean algebra:** De Morgan's Theorems, Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Idea of Minterms and Maxterms, Conversion of Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. **Data processing circuits:** Multiplexers, De-multiplexers, Decoders, Encoders.
UNIT-3 07 Hours	**Arithmetic Circuits:** Binary Addition. Binary Subtraction using 2's Complement, Half and Full Adders, Half & Full Subtractors, 4-bit binary Adder/Subtractor. **Sequential Circuits:** SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip- Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip- Flop.
UNIT-4 10 Hours	**Timers:** IC 555 block diagram and applications: Astable multivibrator and Monostable multivibrator. **Shift registers:** Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel- in- Parallel-out Shift Registers (only up to 4 bits). **Counters (4 bits):** Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.
SUGGESTED READINGS	1. Digital Principles and Applications, A.P.Malvino, D.P.Leach and G. Saha, 8th Ed., 2018, Tata McGraw Hill Education. 2. Fundamentals of Digital Circuits, Anand Kumar, 4th Edn, 2018, PHI Learning Pvt. Ltd. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill 3. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall. Digital Computer Electronics, A.P. Malvino, J.A. Brown, 3rd Edition, 2018, Tata McGraw Hill Education.Digital Design, Morris Mano, 5th Ed. Pearson.
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-III	THIRD SEMESTER	COURSE CODE: DSEPHY-1LAB
PAPER CODE: PDSEC-1P	Credit: Practical-1, Practical: 30 Hours	
PAPER TITLE: DSEC-LAB: Digital Systems and Applications		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours

Section-A: Digital Circuits Hardware design/Verilog Design

1. To design a combinational logic system for a specified Truth Table.
   (a) To convert Boolean expression into logic circuit & design it using logic gate ICs
   (b) To minimize a given logic circuit.
2. Half Adder, Full Adder and 4-bit binary Adder.
3. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
4. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
5. To build JK Master-slave flip-flop using Flip-Flop ICs
6. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
7. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
8. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO and to design an astable multivibrator of given specifications using 555 Timer.
9. To design a monostable multivibrator of given specifications using 555 Timer.

Section-B: Programs using 8085 Microprocessor:

1. Addition and subtraction of numbers using direct addressing mode
2. Addition and subtraction of numbers using indirect addressing mode
3. Multiplication by repeated addition.
4. Division by repeated subtraction.
5. Handling of 16-bit Numbers.
6. Use of CALL and RETURN Instruction.
7. Block data handling.
8. Parity Check
9. Other programs (e.g. using interrupts, etc.).

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Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/
SUGGESTED READINGS	1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill 2. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, Mc- Graw Hill. 3. Microprocessor 8085: Architecture, Programming and interfacing, A.Wadhwa, 2010, PHI Learning

Discipline Specific Core Course (DSCPHY-04)

Semester-IV

Paper: Waves and Optics

Course Learning Outcomes

On successfully completing the requirements of this course, the students will have the skill and knowledge to:

CO-01: Understand Simple harmonic oscillation and superposition principle.

CO-02: Understand different types of waves and their velocities: Plane, Spherical, Transverse, Longitudinal.

CO-03: Understand Concept of normal modes in transverse and longitudinal waves: their frequencies and configurations.

CO-04: Understand Interference as superposition of waves from coherent sources derived from same parent source.

CO-05: Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture, understand Fraunhoffer and Fresnel Diffraction.

CO-06: In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt first hand. The motion of coupled oscillators, study of Lissajous figures and behaviour of transverse, longitudinal waves can be learnt in this laboratory course.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										✓
CO-02	✓		✓			✓					
CO-03	✓									✓	
CO-04	✓										✓
CO-05						✓	✓		✓		
CO-06		✓			✓	✓			✓		

B.Sc.-IV	**FOURTH SEMESTER** **COURSE CODE: DSCPHY-04**
PAPER CODE: PDSC-4T	**Credit: (Theory-03, Practical-1), Theory: 45 Hours, Practical: 30 Hours**
PAPER TITLE: WAVES AND OPTICS	
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 12 Hours	**Wave Motion:** Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Pressure of a Longitudinal Wave. **Wave Optics:** Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle.
UNIT-2 10 Hours	**Superposition of Two Harmonic Waves**: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities Normal Modes of Stretched Strings. Open and Closed Pipes.
UNIT-3 15 Hrs	**Interference:** Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism.. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **Interferometer**: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.
UNIT- 4 12 Hrs	**Fraunhofer diffraction**: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Diffraction grating. Resolving power of grating. **Fresnel Diffraction**: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave.. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral,. Straight edge, a slit and a wire.
SUGGESTED READINGS	1. Vibrations and Waves, A.P. French, 1st Edn., 2003, CRC press. 2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill 3. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons. 4. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-IV	FOURTH SEMESTER	COURSE CODE: DSCPHY-4LAB
PAPER CODE: PDSEC-4P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSCC-LAB: WAVES AND OPTICS		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours

At least 06 experiments from the following:

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ2–T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster`s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

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Online resources

- **e-Resources / e-books and e-learning portals for Physics**

- **Use of following sites**
  - https://www.e-booksdirectory.com/physics.php
  - https://www.pdfdrive.com/category/66
  - https://www.e-booksdirectory.com/listing.php?category=2
  - https://www.openculture.com/free-physics-textbooks
  - https://bookboon.com/en/physics-ebooks
  - https://www.pdfdrive.com/

    https://zlibrary.to/

SUGGESTED READINGS	1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House 2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011,Kitab Mahal 3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers 4. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal,1985, Vani Pub. 5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

Discipline Specific Elective Course (DSEPHY-02)

SEMESTER-IV

Paper: Mathematical Physics-II

Course Learning Outcomes

Course Learning Outcomes

After completing this course, student will be able to

CO-01: Determine continuity, differentiability and analyticity of a complex function, find the derivative of a function and understand the properties of elementary complex functions.

CO-02: Work with multi-valued functions (logarithmic, complex power, inverse trigonometric function) and determine branches of these functions

CO-03: Evaluate a contour integral using parametrization, fundamental theorem of calculus and Cauchy's integral formula.

CO-04: Find the Taylor series of a function and determine its radius of convergence.

CO-05: Determine the Laurent series expansion of a function in different regions, find the residues and use the residue theory to evaluate a contour integral and real integral.

CO-06: Understand the properties of Fourier and Laplace transforms and use these to solve boundary value problems.

CO-07: In the laboratory course, the students will learn the basics of the Scilab software/Python interpreter and apply appropriate numerical method to solve selected physics problems both using user defined and inbuilt functions from Scilab/Python.

MAPPING MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										✓
CO-02	✓		✓							✓	
CO-03						✓			✓		
CO-04			✓			✓					✓
CO-05			✓					✓		✓	
CO-06	✓				✓						
CO-07			✓		✓	✓			✓		

B.Sc.-IV	FOURTH SEMESTER	COURSE CODE: DSEPHY-02
PAPER CODE: PSDEC-2T	Credit: (Theory-03, Practical-1),	Theory: 45 Hours, Practical: 30 Hours
PAPER TITLE: MATHEMATICAL PHYSICS-II		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) PRACTICAL MARKS: 50		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 15 Hours	**Complex Analysis:** Euler's formula, De-Moivre's theorem, Roots of Complex Numbers. and Cauchy-Riemann Equations. Examples of analytic functions. Singularities: poles, removable singularity, essential singularity, Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application of Contour Integration in solving Definite Integrals.	
UNIT-2 13 Hours	**Fourier Transforms:**). Fourier Transform (FT). Examples: FT of single pulse, trigonometric, exponential and Gaussian functions. FT of derivatives, Inverse FT, Convolution theorem. Properties of FT s (translation, change of scale, complex conjugation, etc.). Solution of one- dimensional Wave Equation using FT. Fourier Sine Transform (FST) and Fourier Cosine Transform (FCT).	
UNIT-3 07 Hours	**Laplace Transforms:** Laplace Transform Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations,	
UNIT-4 10 Hours	**Dirac delta function:** Definition and properties. Representation of Dirac delta function as a Fourier Integral. Laplace and Fourier Transform of Dirac delta function.	
SUGGESTED READINGS	1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd Edition., 2006, Cambridge University Press 2. Complex Variables and Applications, J.W. Brown& R.V. Churchill, 7th Edition. 2003, Tata McGraw-Hill. 3. Laplace Transform: Schaum's Outline, M.R> Speigel, McGraw Hill Education.	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

B.Sc.-IV	FOURTH SEMESTER	COURSE CODE: DSEPHY-2LAB
PAPER CODE: PDSEC-2P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: MATHEMATICAL PHYSICS-II		
PRACTICAL MARKS: 50		
Topics (Course contents) **A tentative list lab work that can be amended by teacher /department concerned.**		

30 Hours	The aim of this Lab is to use the computational methods to solve physical problems. The course will consist of practical sessions and lectures on the related theoretical aspects of the Laboratory course. Evaluation done not only on the basis of programming but also on the basis of formulating the problem. **At least ten** programs must be attempted taking at least one from each programming section. The program list is only suggestive and students should be encouraged to do more problems. Scilab/C^{++} based simulations experiments based on Mathematical Physics problems like 1 Solve differential equations: $dy/dx = e^{-x}$ with $y = 0$ for $x = 0$ $dy/dx + e^{-x}y$ $= x^2\ d^2y/dt^2$ $+ 2\ dy/dt =$ - y d2y/dt2 + e-tdy/dt = -y 2 Dirac Delta Function: 3 Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program. 4 Evaluation of trigonometric functions e.g. *sin θ,* Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration. 5 Compute the n^{th} roots of unity for $n = 2, 3,$ and 4. 6 Find the two square roots of $-5+12j$. 7 Integral transform: FFT of 8 Solve Kirchoff's Current law for any node of an arbitrary circuit using Laplace's transform. 9 Solve Kirchoff's Voltage law for any loop of an arbitrary circuit using Laplace's transform. Perform circuit analysis of a general LCR circuit using Laplace's transform. .

Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/

Discipline specific core course (DSCPHY-05)

Semester-V

Paper: Elements of Modern Physics

Course Learning Outcomes

Course Learning Outcomes

After getting exposure to this course, the following topics would be learnt:

CO-01: Main aspects of the inadequacies of classical mechanics as well as understanding of the historical development of quantum mechanics.

CO-02: Formulation of Schrodinger equation and the idea of probability interpretation associated with wave-functions.

CO-03: The spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in details. Basic lasing

CO-04: The properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.

CO-05: Decay rates and lifetime of radioactive decays like alpha, beta, gamma decay. Neutrino, its properties and its role in theory of beta decay.

CO-06: Fission and fusion: Nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.

CO-07: In the laboratory course, the students will get opportunity to measure Planck's constant, verify photoelectric effect, determine e/m of electron, Ionization potential of atoms, study emission and absorption line spectra. They will also find wavelength of Laser sources by single and Double slit experiment, wavelength and angular spread of He-Ne Laser using plane diffraction grating.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓						✓				✓
CO-02			✓		✓						
CO-03										✓	
CO-04			✓				✓				
CO-05					✓						
CO-06			✓						✓		✓
CO-07	✓					✓	✓				

B.Sc.-V	FIFTH SEMESTER	COURSE CODE: DSCPHY-05
PAPER CODE: PDSC-5T Credit: (Theory-03, Practical-1), Theory: 45 Hours, Practical: 30 Hours		
PAPER TITLE: Elements of Modern Physics		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 13Hours	Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Probability. Wave amplitude and wave functions.	
UNIT-2 12 Hours	Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension. energy eigenvalues, eigenfunctions and their normalization;	
UNIT-3 10 Hours	Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, N-Z graph, Liquid Drop model: semi-empirical mass formula and binding energy.	
UNIT-4 10 Hours	**Radioactivity:** stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay: Fission and fusion: mass deficit, Fission: nature of fragments and emission of neutrons. Fusion and thermonuclear reactions driving stellar evolution (brief qualitative discussions).	
SUGGESTED READINGS	1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill. 2. Modern Physics by R A Serway, C J Moses and C A Moyer, 3rd edition, Thomson Brooks Cole, 2012. 3. Modern Physics for Scientists and Engineers by S T Thornton and A Rex, 4th edition, Cengage Learning, 2013. 4. Concepts of Nuclear Physics by B L Cohen, Tata McGraw Hill Publication, 1974. 5. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn., 2002, Wiley.	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

B.Sc.-V	FIFTH SEMESTER	COURSE CODE: DSCPHY-5LAB
PAPER CODE: PDSCC-5P	Credit: Practical-1, Practical: 30 Hours	
PAPER TITLE: DSCC-LAB: Elements of Modern Physics		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours

At least 05 experiments from the following:

1. Measurement of Planck's constant using black body radiation and photo-detector.
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine angular spread of He-Ne laser using plane diffraction grating

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Online resources

- **e-Resources / e-books and e-learning portals for Physics**

- **Use of following sites**
  - https://www.e-booksdirectory.com/physics.php
  - https://www.pdfdrive.com/category/66
  - https://www.e-booksdirectory.com/listing.php?category=2
  - https://www.openculture.com/free-physics-textbooks
  - https://bookboon.com/en/physics-ebooks
  - https://www.pdfdrive.com/
    https://zlibrary.to/

SUGGESTED BOOKS

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.
4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

Discipline specific Elective course (DSEPHY-03)

Semester-V

Paper: Quantum Mechanics

Course Learning Outcomes

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understand and explain the differences between classical and quantum mechanics

CO-02: Learn operator formalism for observables and basic commutation relations.

CO-03: Solve Schrödinger equation for simple potentials like linear Harmonic oscillator and Hydrogen atoms.

CO-04: Understand the space, time and displacement symmetries.

CO-05: Formulate the Heisenberg & Dirac formulation of quantum mechanics-explain various types of imperfections in crystals.

CO-06: Solve the linear harmonic oscillator and hydrogen-like atom problems using Dirac formulation-analyze the mechanisms behind elastic and plastic deformation is solids and compare different strengthening techniques.

CO-07: Demonstrate angular momentum operators associated with spherical and symmetrical systems. -summarize ceramics and its types and relate their applications with properties.

MAPPING MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										
CO-02			✓					✓		✓	✓
CO-03				✓		✓					
CO-04	✓										
CO-05						✓			✓		✓
CO-06		✓			✓					✓	
CO-07			✓		✓	✓			✓		

B.Sc.-V	FIFTH SEMESTER	COURSE CODE: DSEPHY-03
PAPER CODE: PDSEC-3T Credit: (Theory-03, Practical-1), Theory: 45 Hours, Practical: 30 Hours		
PAPER TITLE: QUANTUM MECHANICS		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 12 Hours	Basic Postulates of Quantum Mechanics. Interpretation of the eigenvalues eigenfunctions, expectation values, orthonormality, completeness, Dirac bra and ket notation. Dirac δ function.	
UNIT-2 12Hours	Commuting operators, Unitary transformation. Matrix representation of operators. Time evolution and Schrodinger equation. The Schrodinger and Heisenberg pictures.	
UNIT-3 11 Hours	Operator algebra method of finding energy eigenvalues and eigenstates of the linear harmonic oscillator. System of identical particles. Symmetric and antisymmetric wave functions. Pauli's exclusion principle. Slater determinant.	
UNIT-4 10 Hours	Angular momentum in Quantum Mechanics: Commutation relations of angular momentum operators. Relativistic quantum Mechanics: Klien- Gordon and Dirac equation. Properties of Dirac matrices. Free particle solution of Dirac equation.	
SUGGESTED READINGS	1. B H Bransden & C J Joachain, Quantum Mechanics, Pearson Education, 2000. 2. R H Shankar, Principles of Quantum Mechanics, Springer 2008. 3. J J Sakurai, Modern Quantum Mechanics, Addition- Wessley, 1993. 4. B Craseman and J Powell, Quantum Mechanics, Addition- Wessley. 5. S Gasiorowicz, Quantum Physics, Wiley. 6. Ajoy Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Science.	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

B.Sc.-V	FIFTH SEMESTER	COURSE CODE: DSEPHY-3LAB
PAPER CODE: PDSEC-3P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSCC-LAB: QUANTUM MECHANICS		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours	1. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency 2. Study of Zeeman effect: with external magnetic field; Hyperfine splitting 3. To show the tunneling effect in tunnel diode using I-V characteristics. 4. Quantum efficiency of CCDs .
Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/
SUGGESTED BOOKS	1. Schaum's outline of Programming with C++. J. Hubbard, 2000, McGraw Hill Publication 2. An introduction to computational Physics, T. Pang, 2nd Edn.,2006, Cambridge Univ. Press 3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer. 4. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co. 5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press.

Generic Elective course (GECPHY-03)

Semester-V

Paper: Quantum Mechanics

Course Learning Outcomes

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understand and explain the differences between classical and quantum mechanics

CO-02: Learn operator formalism for observables and basic commutation relations.

CO-03: Solve Schrödinger equation for simple potentials like linear Harmonic oscillator and Hydrogen atoms.

CO-04: Understand the space, time and displacement symmetries.

CO-05: Formulate the Heisenberg & Dirac formulation of quantum mechanics-explain various types of imperfections in crystals.

CO-06: Solve the linear harmonic oscillator and hydrogen-like atom problems using Dirac formulation-analyze the mechanisms behind elastic and plastic deformation is solids and compare different strengthening techniques.

CO-07: Demonstrate angular momentum operators associated with spherical and symmetrical systems. -summarize ceramics and its types and relate their applications with properties.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										
CO-02			✓					✓			
CO-03				✓						✓	✓
CO-04	✓										
CO-05						✓	✓				
CO-06		✓		✓		✓					✓
CO-07		✓				✓			✓		

B.Sc.-V	FIFTH SEMESTER	COURSE CODE: GECPHY-03
PAPER CODE: PGEC-3T	**Credit: (Theory-03, Practical-1),**	**Theory: 45 Hours, Practical: 30 Hours**
PAPER TITLE: QUANTUM MECHANICS		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 12 Hours	Basic Postulates of Quantum Mechanics. Interpretation of the eigenvalues eigenfunctions, expectation values, orthonormality, completeness, Dirac bra and ket notation. Dirac δ function.	
UNIT-2 12Hours	Commuting operators, Unitary transformation. Matrix representation of operators. Time evolution and Schrodinger equation. The Schrodinger and Heisenberg pictures.	
UNIT-3 11 Hours	Operator algebra method of finding energy eigenvalues and eigenstates of the linear harmonic oscillator. System of identical particles. Symmetric and antisymmetric wave functions. Pauli's exclusion principle. Slater determinant.	
UNIT-4 10 Hours	Angular momentum in Quantum Mechanics: Commutation relations of angular momentum operators. Relativistic quantum Mechanics: Klien- Gordon and Dirac equation. Properties of Dirac matrices. Free particle solution of Dirac equation.	
SUGGESTED READINGS	2. B H Bransden & C J Joachain, Quantum Mechanics, Pearson Education, 2000. 3. R H Shankar, Principles of Quantum Mechanics, Springer 2008. 4. J J Sakurai, Modern Quantum Mechanics, Addition- Wessley, 1993. 5. B Craseman and J Powell, Quantum Mechanics, Addition- Wessley. 6. S Gasiorowicz, Quantum Physics, Wiley. 7. Ajoy Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Science.	
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion	

B.Sc.-V	FIFTH SEMESTER	COURSE CODE: GECPHY-3LAB
PAPER CODE: PGEC-3P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSCC-LAB: QUANTUM MECHANICS		
PRACTICAL MARKS: 50		
Topics (Course contents) **A tentative list lab work that can be amended by teacher /department concerned.**		
30 Hours	5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency 6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting 7. To show the tunneling effect in tunnel diode using I-V characteristics. 8. Quantum efficiency of CCDs .	
Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/	
SUGGESTED BOOKS	1.Schaum's outline of Programming with C++. J. Hubbard, 2000, McGraw Hill Publication 2.An introduction to computational Physics, T. Pang, 2nd Edn.,2006, Cambridge Univ. Press 3.Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer. 4.Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co. 5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press.	

Discipline Specific Core Course (DSCPHY-06)
Semester-VI
Paper: Solid State Physics-I
Course Learning Outcomes

Course Learning Outcomes

On successful completion of the module students should be able to

CO-01: Elucidate the concept of lattice, crystals and symmetry operations.

CO-02: Understand the elementary lattice dynamics and its influence on the properties of materials.

CO-03: Describe the main features of the physics of electrons in solids: origin of energy bands, and their influence electronic behavior.

CO-04: Explain the origin of dia-, para-, and ferro-magnetic properties of solids.

CO-05: Explain the origin of the dielectric properties exhibited by solids and the concept of polarizability.

CO-06: Learn the properties of superconductivity in solid.

CO-07: In the laboratory students will carry out experiments based on the theory that they have

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓								✓	✓	
CO-02	✓		✓								✓
CO-03						✓	✓				
CO-04							✓			✓	
CO-05								✓			✓
CO-06		✓			✓						
CO-07						✓		✓	✓		

B.Sc.-VI	**SIXTH SEMESTER** **COURSE CODE: DSCPHY-06**
PAPER CODE: PDSC-6T	**Credit: (Theory-03, Practical-1), Theory: 45 Hours, Practical: 30 Hours**
PAPER TITLE: SOLID STATE PHYSICS-I	
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 10 Hours	**Crystal Structure and Elementary Lattice Dynamics:** Amorphous and Crystalline Materials. Lattice with a Basis. Unit Cell. Types of Lattices. Miller Indices. Reciprocal Lattice. Diffraction of X- rays by Crystals. Bragg's Law.
UNIT-2 10 Hours	**Elementary band theory:** Band Gap. Conductors, Semiconductors and insulators. P- and N- type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.
UNIT-3 10 Hours	**Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferro- magnetic materials. Classical Langevin Theory of dia– and Para- magnetic Domains.Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. **Applications:** Piezoelectric, Pyroelectric, Ferroelectric, Ferromagnetic materials
UNIT-4 10 Hours	**Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability.Clausius Mossotti Equation. Classical Theory of Electric Polarizability. **Superconductivity:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors
SUGGESTED READINGS	1. Introduction to Solid State Physics, Charles Kittel, 8th Ed.,2004, Wiley India Pvt. Ltd. 2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed.,2006, Prentice-Hall of India. 3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill. 4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning. 5. Elementary Solid State Physics, M.Ali Omar, 2006, Pearson 6. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VI	SIXTH SEMESTER	COURSE CODE: DSCPHY-6LAB
PAPER CODE: PDSCC-6P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: SOLID STATE PHYSICS-I		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours

At least 06 experiments from the following:

1. Measurement of susceptibiity of paramagnetic solution (Quinck's Tube Method).
2. To measure the Magnetic susceptibility of solids.
3. To determine the Coupling Coefficient of a piezoelectric crystal.
4. To study the dielectric response of materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of a metal using Surface Plasmon Resonance (SPR) technique.
6. To determine the refractive index of a dielectric material using SPR technique.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Iron (Fe) using solenoid & determine the energy loss from Hysteresis loop.
9. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150^0C) by four-probe method and determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.
11. Analysis of X-Ray diffraction data in terms of unit cell parameters and estimation of particle size.
12. Measurement of change in resistance of a semiconductor with magnetic field.

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Online resources

- **e-Resources / e-books and e-learning portals for Physics**

- **Use of following sites**
  - https://www.e-booksdirectory.com/physics.php
  - https://www.pdfdrive.com/category/66
  - https://www.e-booksdirectory.com/listing.php?category=2
  - https://www.openculture.com/free-physics-textbooks
  - https://bookboon.com/en/physics-ebooks
  - https://www.pdfdrive.com/
    https://zlibrary.to/

SUGGESTED BOOKS

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

Discipline Specific Elective Course (DSEPHY-04)

Semester-VI

Paper: Analog Systems and Applications

Course Learning Outcomes

Course Learning Outcomes

At the end of this course, the following concepts will be learnt

CO-01: Characteristics and working of pn junction.

CO-02: Two terminal devices: Rectifier diodes, Zener diode, photodiode etc.

CO-03: NPN and PNP transistors: Characteristics of different configurations, biasing, stabilization and their applications.

CO-04: CE and two stage RC coupled transistor amplifier using h-parameter model of the transistor.

CO-05: Designing of different types of oscillators and their stabilities.

CO-06: Ideal and practical op-amps: Characteristics and applications.

CO-07: In the laboratory course, the students will be able to study characteristics of various diodes and BJT. They will be able to design amplifiers, oscillators and DACs. Also different applications using Op-Amp will be designed.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										
CO-02			✓								✓
CO-03					✓				✓		
CO-04	✓		✓								
CO-05		✓				✓			✓		
CO-06		✓			✓						✓
CO-07			✓			✓		✓			

B.Sc.-VI	SIXTH SEMESTER	COURSE CODE: DSEPHY-4
PAPER CODE: PDSEC-4T	**Credit: (Theory-03, Practical-1),**	**Theory: 45 Hours, Practical: 30 Hours**
PAPER TITLE: Analog Systems and Applications		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 10 Hours	**Semiconductor Diodes:** P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Barrier Width and Current for abrupt Junction. Equation of continuity, Current Flow Mechanism in Forward and Reverse Biased Diode.	
UNIT-2 10 Hours	**Two-terminal Devices and their Applications:** (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter, (2) Zener Diode and Voltage Regulation. Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell, Qualitative idea of Schottky diode and Tunnel diode.	
UNIT-3 10 Hours	**Bipolar Junction transistors:** n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow.	
UNIT-4 10 Hours	**Feedback in Amplifiers:** Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. **Sinusoidal Oscillators:** Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators	

SUGGESTED READINGS	1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall. 2. Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall 3. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India 4. Electronic Principles, A. Malvino, D.J. Bates, 7th Edition, 2018, Tata Mc-Graw Hill Education 5. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VI	SIXTH SEMESTER	COURSE CODE: DSEPHY-4LAB
PAPER CODE: PDSEC-4P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: Analog Systems and Applications		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours

At least 08 experiments from the following:

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I & power curves of solar cells and find maximum power point & efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
4. To study the various biasing configurations of BJT for normal class A operation.
5. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6. To study the frequency response of voltage gain of a two stage RC-coupled transistor amplifier.
7. To design a Wien bridge oscillator for given frequency using an op-amp.
8. To design a phase shift oscillator of given specifications using BJT.
9. To design a digital to analog converter (DAC) of given specifications.
10. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
11. (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response

    (b) To design non-inverting amplifier using Op-amp (741,351) and study frequency response
12. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode

    (b) To study the zero-crossing detector and comparator.
13. To design a precision Differential amplifier of given I/O specification using Op-amp.
14. To investigate the use of an op-amp as an Integrator.
15. To investigate the use of an op-amp as a Differentiator.
16. To design a circuit to simulate the solution of simultaneous equation and 1st/2ndorder differential equation.

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Online resources

- **e-Resources / e-books and e-learning portals for Physics**

- **Use of following sites**
  - https://www.e-booksdirectory.com/physics.php
  - https://www.pdfdrive.com/category/66
  - https://www.e-booksdirectory.com/listing.php?category=2
  - https://www.openculture.com/free-physics-textbooks
  - https://bookboon.com/en/physics-ebooks
  - https://www.pdfdrive.com/

    https://zlibrary.to/

SUGGESTED BOOKS	1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, Mc-Graw Hill. OP-Amps.

Generic Elective Course (GECPHY-04)

Semester-VI

Paper: Analog Systems and Applications

Course Learning Outcomes

Course Learning Outcomes

At the end of this course, the following concepts will be learnt

CO-01: Characteristics and working of pn junction.

CO-02: Two terminal devices: Rectifier diodes, Zener diode, photodiode etc.

CO-03: NPN and PNP transistors: Characteristics of different configurations, biasing, stabilization and their applications.

CO-04: CE and two stage RC coupled transistor amplifier using h-parameter model of the transistor.

CO-05: Designing of different types of oscillators and their stabilities.

CO-06: Ideal and practical op-amps: Characteristics and applications.

CO-07: In the laboratory course, the students will be able to study characteristics of various diodes and BJT. They will be able to design amplifiers, oscillators and DACs. Also different applications using Op-Amp will be designed.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓										
CO-02			✓								✓
CO-03					✓				✓		
CO-04	✓		✓								✓
CO-05		✓				✓			✓		
CO-06		✓			✓						
CO-07			✓			✓		✓			

B.Sc.-VI	SIXTH SEMESTER	COURSE CODE: GECPHY-04
PAPER CODE: PGEC-4T	Credit: (Theory-03, Practical-1),	Theory: 45 Hours, Practical: 30 Hours
PAPER TITLE: Analog Systems and Applications		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) PRACTICAL MARKS: 50		

Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q.
ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q.
iii) Short Answer Type- Word Limit 200-250, Total-5 Q.
iv) Long Answer Type- Word Limit 500-600, Total-5 Q.

UNIT-1 10 Hours	**Semiconductor Diodes:** P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Barrier Width and Current for abrupt Junction. Equation of continuity, Current Flow Mechanism in Forward and Reverse Biased Diode.
UNIT-2 10 Hours	**Two-terminal Devices and their Applications:** (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter, (2) Zener Diode and Voltage Regulation. Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell, Qualitative idea of Schottky diode and Tunnel diode.
UNIT-3 10 Hours	**Bipolar Junction transistors:** n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow.
UNIT-4 10 Hours	**Feedback in Amplifiers:** Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. **Sinusoidal Oscillators:** Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators
SUGGESTED READINGS	1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall. 2. Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall 3. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India 4. Electronic Principles, A. Malvino, D.J. Bates, 7th Edition, 2018, Tata Mc-Graw Hill Education 5. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VI	SIXTH SEMESTER	COURSE CODE: GECPHY-4LAB
PAPER CODE: PGEC-4P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: Analog Systems and Applications		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours

At least 08 experiments from the following:

17. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
18. Study of V-I & power curves of solar cells and find maximum power point & efficiency.
19. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
20. To study the various biasing configurations of BJT for normal class A operation.
21. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
22. To study the frequency response of voltage gain of a two stage RC-coupled transistor amplifier.
23. To design a Wien bridge oscillator for given frequency using an op-amp.
24. To design a phase shift oscillator of given specifications using BJT.
25. To design a digital to analog converter (DAC) of given specifications.
26. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
27. (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response

    (b) To design non-inverting amplifier using Op-amp (741,351) and study frequency response
28. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode

    (b) To study the zero-crossing detector and comparator.
29. To design a precision Differential amplifier of given I/O specification using Op-amp.
30. To investigate the use of an op-amp as an Integrator.
31. To investigate the use of an op-amp as a Differentiator.
32. To design a circuit to simulate the solution of simultaneous equation and 1st/2ndorder differential equation.

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Online resources

- **e-Resources / e-books and e-learning portals for Physics**

- **Use of following sites**
  - https://www.e-booksdirectory.com/physics.php
  - https://www.pdfdrive.com/category/66
  - https://www.e-booksdirectory.com/listing.php?category=2
  - https://www.openculture.com/free-physics-textbooks
  - https://bookboon.com/en/physics-ebooks
  - https://www.pdfdrive.com/

    https://zlibrary.to/

SUGGESTED BOOKS	1.Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, Mc-Graw Hill. OP-Amps.

Discipline Specific Core Course (DSCPHY-07)
Semester-VII
Paper: Solid State Physics-II
Course Learning Outcomes

Course Learning Outcomes

On successful completion of the module students should be able to

CO-01: Elucidate the concept of lattice, crystals and symmetry operations.

CO-02: Understand the elementary lattice dynamics and its influence on the properties of materials.

CO-03: Describe the main features of the physics of electrons in solids: origin of energy bands, and their influence electronic behavior.

CO-04: Explain the origin of dia-, para-, and ferro-magnetic properties of solids.

CO-05: Explain the origin of the dielectric properties exhibited by solids and the concept of polarizability.

CO-06: Understand the basics of phase transitions and the preliminary concept and experiments related to superconductivity in solid.

CO-07: In the laboratory students will carry out experiments based on the theory that they have learned to measure the magnetic susceptibility, dielectric constant, trace hysteresis loop.

They will also employ to four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓			✓							
CO-02		✓	✓								✓
CO-03					✓				✓		
CO-04	✓		✓								✓
CO-05						✓			✓		
CO-06					✓						
CO-07	✓		✓			✓		✓			

B.SC.-VII	SEVENTH SEMESTER	COURSE CODE: DSCPHY-07
PAPER CODE:PDSCC-7	Credit: (Theory-03, Practical-01),	Theory: 45 Hrs, Practical: 30 Hrs

PAPER TITLE: Solid State Physics-II

THEORY MARKS: 100 (SEE: 80 & CCA : 20)
PRACTICAL MARKS: 50

Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q.
ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q.
iii) Short Answer Type- Word Limit 200-250, Total-5 Q.
iv) Long Answer Type- Word Limit 500-600, Total-5 Q.

UNIT-1 11 Hours	**Crystal Structure:**. Lattice Translation Vectors. Lattice with a Basis. Types of Lattices. Unit Cell, Symmetry and Symmetry Elements. Diffraction of X-rays: single crystal and powder method. Bragg's Law, Laue Condition. Edward's construction. Atomic and Geometrical Factor. Simple numerical problem on SC, BCC, FCC.
UNIT-2 12 Hours	**Elementary Lattice Dynamics**: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids, T^3 law.
UNIT-3 12 Hours	**Electrons in Solids:** Electrons in metals- Introduction to Drude Model, Density of states (1- D, 2-D, 3-D) (basic idea), Elementary band theory: Kronig Penney model. Band Gap, direct and indirect bandgap. Effective mass, mobility, Hall Effect (Metal and Semiconductor).
UNIT-4 10 Hours	**Dielectric Properties of Materials:** Polarization. Local Electric Field in solids. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mossotti Equation. Classical Theory of Electric Polarizability. AC polarizability, Normal and Anomalous Dispersion. Complex Dielectric Constant. Langevin-Debye equation.
SUGGESTED READINGS	1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd. 2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India. 3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill. 4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer.
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VII	SEVENTH SEMESTER	COURSE CODE: DSCPHY-7LAB
PAPER CODE: PDSCC-7P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: SOLID STATE PHYSICS-II		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours

At least 06 experiments from the following:

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method).
2. To measure the Magnetic susceptibility of solids.
3. To determine the Coupling Coefficient of a piezoelectric crystal.
4. To study the dielectric response of materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of a metal using Surface Plasmon Resonance (SPR) technique.
6. To determine the refractive index of a dielectric material using SPR technique.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Iron (Fe) using solenoid & determine the energy loss from Hysteresis loop.
9. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150^0C) by four-probe method and determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.
11. Analysis of X-Ray diffraction data in terms of unit cell parameters and estimation of particle size.
12. Measurement of change in resistance of a semiconductor with magnetic field.

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Online resources

- **e-Resources / e-books and e-learning portals for Physics**

- **Use of following sites**
  - https://www.e-booksdirectory.com/physics.php
  - https://www.pdfdrive.com/category/66
  - https://www.e-booksdirectory.com/listing.php?category=2
  - https://www.openculture.com/free-physics-textbooks
  - https://bookboon.com/en/physics-ebooks
  - https://www.pdfdrive.com/

    https://zlibrary.to/

SUGGESTED BOOKS	1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House. 2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal 3. Elements of Solid-State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India 4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press 5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

Discipline Specific Elective Course (DSEPHY-05)

Semester-VII

Paper: ElectromagneticTheory

Course Learning Outcomes

Course Learning Outcomes

At the end of this course the student will be able to:

CO-01: Apply Maxwell's equations to deduce wave equation, electromagnetic field energy, momentum and angular momentum density.

CO-02: Understand electromagnetic wave propagation in unbounded media: Vacuum, dielectric medium, conducting medium, plasma.

CO-03: Understand electromagnetic wave propagation in bounded media: reflection and transmission coefficients at plane interface in bounded media.

CO-04: Understand polarization of Electromagnetic Waves: Linear, Circular and Elliptical Polarization. Production as well as detection of waves in laboratory.

CO-05: Learn the features of planar optical wave guide.

CO-06: Understand the fundamentals of propagation of electromagnetic waves through optical fibres.

CO-07: In the laboratory course, the students get an opportunity to perform experiments with Polarimeter, Babinet Compensator, Ultrasonic grating, simple dipole antenna. Also, to study phenomena of interference, refraction, diffraction and polarization.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓			✓							
CO-02			✓				✓				✓
CO-03	✓				✓				✓		
CO-04			✓								✓
CO-05		✓				✓			✓		
CO-06					✓						✓
CO-07	✓	✓	✓			✓		✓			

B.SC.VII SEVENTH SEMESTER COURSE CODE: DSEPHY-05	
PAPER CODE: PDSEC-5 Credit: (Theory-03, Practical-01), Theory: 45 Hrs, Practical: 30 Hrs	
PAPER TITLE: Electromagnetic Theory	
THEORY MARKS: 100 (SEE: 80 & CCA : 20) **PRACTICAL MARKS: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 11 Hours	**Maxwell Equations:** Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Poynting's Theorem and Poynting's Vector.
UNIT-2 11 Hours	**EM Wave Propagation in Unbounded Media:** Plane em waves through vacuum and isotropic dielectric medium: transverse nature, refractive index, dielectric constant, wave impedance. Plane em waves through conducting medium: relaxation time, skin depth, attenuation constant.
UNIT-3 13 Hours	**EM Waves in Bounded Media:** Boundary conditions at a plane interface between two media. Reflection & Refraction of plane em waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization, Brewster's law. Reflection & Transmission coefficients. Total internal reflection,
UNIT-5 13 Hours	**Wave Guides:** Planar optical wave guides. Planar dielectric wave guide ($-d/2 < x < d/2$). Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. **Optical Fibres:** Acceptance Angle, Numerical Aperture. Step and Graded Index fibres (Definitions Only). Single and Multiple Mode Fibres.
SUGGESTED READINGS	1. ntroduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings. 2. Electromagnetic Field and Waves, P. Lorrain and D. Corson, 2nd Ed., 2003, CBS Publisher. 3. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 2010, Wiley 4. Principle of Optics, M. Born and E. Wolf, 6th Edn., 1980, Pergamon Press 5. Optics, (2017), 6th Edition, Ajoy Ghatak, McGraw-Hill Education, New Delhi
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VII	SEVENTH SEMESTER	COURSE CODE: DSEPHY-5LAB
PAPER CODE: PDSEC-5P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: ELECTROMAGNETIC THEORY		
PRACTICAL MARKS: 50		

Topics (Course contents)

A tentative list lab work that can be amended by teacher /department concerned.

30 Hours

At least 06 experiments from the following

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan's law of radiation and to determine Stefan's constant.
12. To determine Boltzmann constant using V-I characteristics of PN junction diode.
13. To find Numerical Aperture of an Optical Fibre.
14. To verify Brewster's Law and to find Brewster's angle.

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Online resources

- **e-Resources / e-books and e-learning portals for Physics**
- **Use of following sites**
  - https://www.e-booksdirectory.com/physics.php
  - https://www.pdfdrive.com/category/66
  - https://www.e-booksdirectory.com/listing.php?category=2
  - https://www.openculture.com/free-physics-textbooks
  - https://bookboon.com/en/physics-ebooks
  - https://www.pdfdrive.com/
    https://zlibrary.to/

SUGGESTED BOOKS	1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House. 2. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer 3. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Pres. 4. Engineering Practical Physics, S. Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.

Discipline Specific Elective Course (DSEPHY-06)

Semester-VII

Paper: Nuclear and Particle Physics-I

Course Learning Outcomes

Course Learning Outcomes

At the end of this course the student will be able to:

CO-01: To be able to understand the basic properties of nuclei as well as knowledge of experimental determination of the same, the concept of binding energy, its various dependent parameters, N-Z curves and their significance

CO-02: To appreciate the formulations and contrasts between different nuclear models such as Liquid drop model, Fermi gas model and Shell Model and evidences in support.

CO-03: Knowledge of radioactivity and decay laws. A detailed analysis, comparison and energy kinematics of alpha, beta and gamma decays.

CO-04: Familiarization with different types of nuclear reactions, Q- values, compound and direct reactions.

CO-05: To know about energy losses due to ionizing radiations, energy losses of electrons, gamma ray interactions through matter and neutron interaction with matter. Through the section on accelerators students will acquire knowledge about Accelerator facilities in India along with a comparative study of a range of detectors and accelerators which are building blocks of modern day science.

CO-06: It will acquaint students with the nature and magnitude of different forces, particle interactions, families of sub- atomic particles with the different conservation laws, concept of quark model.

CO-07: The acquired knowledge can be applied in the areas of nuclear medicine, medical physics, archaeology, geology and other interdisciplinary fields of Physics and Chemistry. It will enhance the special skills required for these fields.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓	✓		✓	✓						
CO-02	✓										✓
CO-03					✓				✓		
CO-04			✓								
CO-05	✓	✓				✓			✓		
CO-06	✓				✓						✓
CO-07	✓	✓	✓			✓		✓			

B.SC.-VII	SEVENTH SEMESTER	COURSE CODE: DSEPHY-06
PAPER CODE: PDSEC-6	Credit: (Theory-03, Practical-01),	Theory: 45 Hrs, Practical: 30 Hrs
PAPER TITLE: Nuclear and Particle Physics-I		
THEORY MARKS: 100 (SEE: 80 & CCA : 20) TUTORIAL MARKS: 50		
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.		
UNIT-1 10 Hours	**Nuclear Models:** Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, nucleon separation energies (up to two nucleons), evidence for nuclear shell structure and the basic assumption of shell model.	
UNIT-2 10 Hours	**Radioactivity decay:** Decay rate and equilibrium (Secular and Transient)(a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α- decay spectroscopy, decay Chains. (b) β- decay: energy kinematics for β-decay, β-spectrum, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission from the excited state of the nucleus & kinematics, internal conversion	
UNIT-3 12 Hours	**Nuclear Reactions:** Types of Reactions, units of related physical quantities, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction,	
UNIT-4 13Hours	**Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). **Particle physics:** Particle interactions (concept of different types of forces), basic features,Conservation Laws (energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness) concept of quark model, color quantum number and gluons.	
SUGGESTED READINGS	1. Nuclear Physics: principles and applications by J Lilley, Wiley Publication, 2006. 2. Radiation detection and measurement, G F Knoll, John Wiley & Sons, 2010. Introduction to elementary particles by D J Griffiths, Wiley, 2008 3. Basic ideas and concepts in Nuclear Physics: An introductory approach by K Heyde, third edition, IOP Publication, 1999. 4. Nuclear Physics by S N Ghoshal, First edition, S. Chand Publication, 2010. Introductory Nuclear Physics by K S Krane, Wiley-India Publication, 2008	

Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

Discipline Specific Core Course (DSCC-6)
Semester-VII
Paper: Solid State Physics-I
Course Learning Outcomes

Course Learning Outcomes

On successful completion of the module students should be able to

CO-01: Elucidate the concept of lattice, crystals and symmetry operations.

CO-02: Understand the elementary lattice dynamics and its influence on the properties of materials.

CO-03: Describe the main features of the physics of electrons in solids: origin of energy bands, and their influence electronic behavior.

CO-04: Explain the origin of dia-, para-, and ferro-magnetic properties of solids.

CO-05: Explain the origin of the dielectric properties exhibited by solids and the concept of polarizability.

CO-06: Learn the properties of superconductivity in solid.

CO-07: In the laboratory students will carry out experiments based on the theory that they have learned to measure the magnetic susceptibility, dielectric constant, trace hysteresis loop.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓	✓		✓	✓						✓
CO-02											✓
CO-03					✓		✓		✓		
CO-04			✓								
CO-05		✓		✓		✓				✓	
CO-06					✓						✓
CO-07	✓	✓	✓			✓		✓			

B.SC.-VII	SEVENTH SEMESTER	COURSE CODE: DSEPHY-07
PAPER CODE: PDSEC-7	Credit: (Theory-03, Practical-01),	Theory: 45 Hrs, Practical: 30 Hrs

PAPER TITLE: Statistical Mechanics

THEORY MARKS: 100 (SEE: 80 & CCA : 20)
PRACTICAL MARKS: 50

Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q.
ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q.
iii) Short Answer Type- Word Limit 200-250, Total-5 Q.
iv) Long Answer Type- Word Limit 500-600, Total-5 Q.

UNIT-1 10 Hours	**Classical-Statistics**: Macrostates and Microstates, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur-Tetrode equation. Law of Equipartition of Energy (with proof)
UNIT-2 15 Hours	**Bose-Einstein Statistics**: B-E Distribution law, Thermodynamic functions of a strongly degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law.
UNIT-3 10 Hours	**Fermi-Dirac Statistics:** Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly degenerate Fermi Gas, Fermi Energy Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit**.**
UNIT-4 10 Hours	**Theory of Radiation:** Stefan-Boltzmann law and its thermodynamic proof. Wien's Displacement law. Wien's Distribution law. Rayleigh-Jean's Law. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation Deduction of Wien's Distribution Law, Rayleigh-Jean's Law, Stefan-Boltzmann Law and Wien's Displacement law from Planck's law.
SUGGESTED READINGS	1. Statistical Mechanics: R.K. Pathria and P. D. Beale (Academic Press) 2. Introductory Statistical Mechanics: R. Bowley and M. Sanchez (Oxford Univ. Press) 3. Statistical Physics: F. Mandl (Wiley) 4. A treatise on Heat: M.N. Saha and B.N. Srivastava (Indian Press) 5. Problems and Solutions on Thermodynamics andStatistical Mechanics: Lim Yung-Kou (Sarat Book House)
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VII	SEVENTH SEMESTER	COURSE CODE: DSEPHY-7LAB
PAPER CODE: PDSEC-7P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: STATISTICAL MECHANICS		
PRACTICAL MARKS: 50		
Topics (Course contents)		
A tentative list lab work that can be amended by teacher /department concerned.		

30 Hours	Use C/C++/Scilab/Python/other numerical simulations for solving the problems based on Statistical Mechanics like: 1. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions: a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations b) Study of transient behavior of the system (approach to equilibrium) c) Relationship of large N and the arrow of time d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution. 2. Plot the probability of various macrostates in coin-tossing experiment (two level system) versus number of heads with 4, 8, 16 coins etc. 3. Computation of the partition function Z(b) for the systems with a finite number of single particle levels (e.g., 2 level, 3 level etc.) and finite number of non-interacting particles N under Maxwell-Boltzmann/ Fermi-Dirac/Bose Einstein statistics: a) Study the behavior of Z(b), average energy, C_v, and entropy and its dependence upon the temperature, total number of particles N and the spectrum of single particle energy states. b) Plot the probability of occupancy of all the states w.r.t. temperature. 4. Plot the Maxwell speed distribution function at different temperatures in a 3-dimension system. Calculate the average speed, root mean square and most probable speed 5. Plot Specific Heat of Solids w.r.t temperature a) Dulong-Petit law, b) Einstein distribution function c) Debye distribution function 6. Plot the following functions with energy at different temperatures a) Maxwell-Boltzmann distribution b) Fermi-Dirac distribution c) Bose-Einstein distribution 7. Plot the distribution of particles w.r.t. energy (dN/de versus e) in 3 Dimensions for a) Relativistic and non-relativistic bosons both at high and low temperature. b) Relativistic and non-relativistic fermions both at high and low temperature. 8. Plot Planck's law of Blackbody radiation w.r.t. wavelength/frequency at different temperatures. Compare it with Rayleigh-Jean's Law and Wien's distribution law for a given temperature.

Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/
SUGGESTED BOOKS	1. Elementary Numerical Analysis: K.E. Atkinson (Wiley) 2. Introduction to Modern Statistical Mechanics: D. Chandler (Oxford University Press) 3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics: F. W. Sears and G. L. Salinger (Narosa) 4. Modern Thermodynamics with Statistical Mechanics: Carl S. Helrich (Springer) 5. Statistical and Thermal Physics with Computer Applications: H. Gould and J.Tobochnik (Princeton University Press)

Discipline Specific Elective Course (DSEC-4)

Semester-VIII

Paper: Analog Systems and Applications

Course Learning Outcomes

Course Learning Outcomes

At the end of this course, the following concepts will be learnt

CO-01: Characteristics and working of pn junction.

CO-02: Two terminal devices: Rectifier diodes, Zener diode, photodiode etc.

CO-03: NPN and PNP transistors: Characteristics of different configurations, biasing, stabilization and their applications.

CO-04: CE and two stage RC coupled transistor amplifier using h-parameter model of the transistor.

CO-05: Designing of different types of oscillators and their stabilities.

CO-06: Ideal and practical op-amps: Characteristics and applications.

CO-07: In the laboratory course, the students will be able to study characteristics of various diodes and BJT. They will be able to design amplifiers, oscillators and DACs. Also different applications using Op-Amp will be designed.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓	✓			✓						
CO-02	✓		✓								✓
CO-03					✓		✓		✓		
CO-04			✓					✓			
CO-05	✓	✓		✓		✓				✓	
CO-06					✓						✓
CO-07		✓		✓		✓		✓			

B.SC.-VIII	**EIGHTH SEMESTER COURSE CODE:DSCPHY-08**
PAPER CODE:PDSCC-8	**Credit: (Theory-03,Practical-01), Theory: 45 Hrs, Practical: 30 Hrs**
PAPER TITLE:	**PHYSICS OF DEVICES AND INSTRUMENTS**
THEORY MARKS: 100 (SEE:80 CCA : 20) **PRACTICAL: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 12 Hours	Devices: Characteristic and small signal equivalent circuits of UJT and JFET. Metal- semiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO2-Si based MOS. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices. Tunnel diode.
UNIT-2 12 Hours	Introduction to communication systems: Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase.
UNIT-3 12 Hours	Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters. Multivibrators: Astable and Monostable Multivibrators using transistors.
UNIT-4 12 Hours	Phase Locked Loop(PLL): Basic Principles, Phase detector(XOR & edge triggered), Voltage Controlled Oscillator (Basics, varactor). Loop Filter– Function, Loop Filter Circuits, transient response, lock and capture.
SUGGESTED READINGS	• Physics of Semiconductor Devices, S.M. Sze & K.K. Ng, 3rd Ed.2008, John Wiley & Sons • Electronic devices and integrated circuits, A.K. Singh, 2011, PHI Learning Pvt. Ltd. • Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000,PHI Learning Pvt. Ltd • Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt. Ltd. • Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill. • Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed., 2009, PHI Learning Pvt. Ltd. • Semiconductor Physics and Devices, D.A. Neamen, 2011, 4th Edition, McGraw Hill • PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India

Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VIII	EIGHTH SEMESTER	COURSE CODE: DSCPHY-8LAB
PAPER CODE: PDSCC-8P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSCC-LAB: PHYSICS OF DEVICES AND INSTRUMENTS		
PRACTICAL MARKS: 50		
Topics (Course contents) **A tentative list lab work that can be amended by teacher /department concerned.**		

30 Hours	**Experiments from both Section A and Section B:** **Section-A** • To design a power supply using bridge rectifier and study effect of C-filter. • To design the active Low pass and High pass filters of given specification. • To design the active filter (wide band pass and band reject) of given specification. • To study the output and transfer characteristics of a JFET. • To design a common source JFET Amplifier and study its frequency response. • To study the output characteristics of a MOSFE • To study the characteristics of a UJT and design a simple Relaxation Oscillator. • To design an Amplitude Modulator using Transistor. • To design PWM, PPM, PAM and Pulse code modulation using ICs. • To design an Astable multivibrator of given specifications using transistor. • To study a PLL IC (Lock and capture range). • To study envelope detector for demodulation of AM signal. • Study of ASK and FSK modulator. • Glow an LED via USB port of PC. • Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port. **Section-B:** **SPICE/MULTISIM simulations for electrical networks and electronic circuits** 1. To verify the Thevenin and Norton Theorems. 2. Design and analyze the series and parallel LCR circuits 3. Design the inverting and non-inverting amplifier using an Op-Amp of given gain 4. Design and Verification of op-amp as integrator and differentiator 5. Design the 1st order active low pass and high pass filters of given cutoff frequency 6. Design a Wein`s Bridge oscillator of given frequency. 7. Design clocked SR and JK Flip-Flop`s using NAND Gates 8. Design 4-bit asynchronous counter using Flip-Flop ICs 9. Design the CE amplifier of a given gain and its frequency response. 10. Design an Astable multivibrator using IC555 of given duty cycle. .

Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/
SUGGESTED BOOKS	• Basic Electronics:A text lab manual, P.B. Zbar, A.P. Malvino, M.A.Miller,1994, Mc-Graw Hill • Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. • Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall. • OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn., 2000, Prentice Hall. • Introduction to PSPICE using ORCAD for circuits & Electronics, M.H. Rashid, 2003, PHI Learning. • PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India

Discipline Specific Elective Course (DSEPHY-08)

Semester-VIII

Paper: NUCLEAR & PARTICLE PHYSICS-II

Course Learning Outcomes

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Learn the ground state properties of a nucleus – the constituents and their properties, mass number and atomic number, relation between the mass number and the radius and the mass number, average density, range of force, saturation property, stability curve, the concepts of packing fraction and binding energy, binding energy per nucleon vs. mass number graph, explanation of fusion and fission from the nature of the binding energy graph.

CO-02: Know about the nuclear models and their roles in explaining the ground state properties of the nucleus –(i) the liquid drop model, its justification so far as the nuclear properties are concerned, the semi-empirical mass formula, (ii) the shell model, evidence of shell structure, magic numbers, predictions of ground state spin and parity, theoretical deduction of the shell structure, consistency of the shell structure with the Pauli exclusion principles.

CO-03: Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta and gamma rays, the properties of the constituents of these rays and the mechanisms of the emissions of these rays, outlines of Gamow's theory of alpha decay and Pauli's theory of beta decay with the neutrino hypothesis, the electron capture, the fine structure of alpha particle spectrum, the Geiger-Nuttall law, the radioactive series.

CO-04: Learn the basic aspects of nuclear reactions, the Q-value of such reaction and its derivation from conservation laws, The reaction cross-sections, the types of nuclear reactions, direct and compound nuclear reactions, Rutherford scattering by Coulomb potential.

CO-05: Learn some basic aspects of interaction of nuclear radiation with matter- interaction of gamma ray by photoelectric effect, Compton scattering

and pair production, energy loss due to ionization, Cerenkov radiation.

CO-06: Learn about the detectors of nuclear radiations- the Geiger-Mueller counter, the scintillation counter, the photo-multiplier tube, the solid state and semiconductor detectors.

CO-07: The students are expected to learn about the principles and basic constructions of particle accelerators such as the Van-de-Graff generator, cyclotron, betatron and synchrotron. They should know about the accelerator facilities in India.

CO-08: Gain knowledge on the basic aspects of particle Physics – the fundamental interactions, elementary and composite particles, the classifications of particles: leptons, hadrons (baryons and mesons), quarks, gauge bosons. The students should know about the quantum numbers of particles: energy, linear momentum, angular momentum, isospin, electric charge, colour charge, strangeness, lepton numbers, baryon number and the conservation laws associated with them.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓	✓			✓						
CO-02			✓				✓				
CO-03					✓		✓		✓		
CO-04			✓					✓			✓
CO-05	✓	✓		✓		✓				✓	
CO-06					✓						✓
CO-07	✓						✓		✓		
CO-08		✓		✓		✓		✓			

B.SC.-VIII EIGHTH SEMESTER COURSE CODE: DSEPHY-08	
PAPER CODE:PDEC-8 Credit: (Theory-03, Practical-01), Theory: 45 Hrs, Practical: 30 Hrs	
PAPER TITLE: Nuclear and Particle Physics-II	
THEORY MARKS: 100 (SEE-80 & CCA-20) **PRACTICAL: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 10 Hours	**General Properties of Nuclei**: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.
UNIT-2 10 Hours	**Nuclear Reactions:** Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering).
UNIT-3 15 Hours	**Particle physics:** Particle interactions; basic features, types of particles and its families.Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quarkmodel, color quantum number and gluons.
UNIT-4 10 Hours	**Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

SUGGESTED READINGS	• Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008). • Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998). • Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004). • Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press • Introduction to Elementary Particles, D. Griffith, John Wiley & Sons • Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi • Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004). • Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000). • Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007). • Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)
Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

Discipline Specific Elective Course (DSEPHY-09)

Semester-VIII

Paper: Electronics

Course Learning Outcomes

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understand the design and functional performance of electronic circuits using various semiconductor devices.

CO-02: understand the functional properties and characteristics of semiconductor devices in analog & digital circuits using analog and digital signals.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓	✓			✓				✓		
CO-02			✓				✓				✓

B.SC.-VIII EIGHTH SEMESTER COURSE CODE: DSEPHY-09	
PAPER CODE:PDSEC-9 Credit: (Theory-03, Practical-01), Theory: 45 Hrs, Practical: 30 Hrs	
PAPER TITLE: Electronics	
THEORY MARKS: 100 (SEE-80 & CCA-20) **PRACTICAL: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 10 Hours	**Circuit Analysis:** Admittance, impedance, scattering and hybrid matrices for two and three-port networks and their cascade and parallel combinations. Review of Laplace Transforms. Response functions, location of poles and zeros of response functions of active and passive systems (Nodal and Modified Nodal Analysis).
UNIT-2 10 Hours	**Physics of Semiconductor Devices**: p-n junction, BJT, JFET, equivalent circuits and high frequency effects, UJT, 4 layer pnpn device (SCR). MOS diode, accumulation, depletion and inversion, MOSFET: I-V, C-V characteristics. Enhancement and depletion mode MOSFET. Metal-semiconductor junctions; Ohmic and rectifying contacts, Schottky diode, I-V, C-V relations.
UNIT-3 15 Hours	**Digital Circuit**: Introduction to digital IC parameters (switching time, propagation delay, fan out, fan in etc.). TTL, MOS and CMOS gates, Emitter-coupled logic, MOSFET as transmission gate. A/D and D/A converters. Basics of micro-processor and micro-controller.
UNIT-4 10 Hours	**Communication System**: Amplitude, Angle and Pulse-analog modulation: Generation and detection. Model of communication system, classification of signals, representation of signals
SUGGESTED READINGS	1. Network Analysis and Synthesis by F.F. Kuo 2. Network Analysis with Applications by W.D. Stanley 3. Electronic Devices and Circuits by J. Millman and C.C. Halkias 4. Semiconductor Devices: Physics and technology by S M Szee 5. Communication Systems by Simon Haykins 6. Digital Signal Processing by J. G. Proakis and D. G. Manolakis 7. Solid State Electronic Devices by B.G. Streetman 8. Digital Design by M. Mano 9. Digital principles and Applications by A.P. Malvino and D.P.Leac

Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VIII	EIGHTH SEMESTER	COURSE CODE: DSEPHY-9LAB
PAPER CODE: PDSEC-9P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: ELECTRONICS		
PRACTICAL MARKS: 50		
Topics (Course contents) **A tentative list lab work that can be amended by teacher /department concerned.**		

30 Hours	At least 06 experiments from the following: 1. To design and study of a Regulated Power Supply using diodes. 2. To design CLAMPERS and CLIPPERS using semiconductor diodes. 3. To study the merits and demerits of different biasing techniques. 4. To study the frequency response of (i) low pass filter, (ii) bandpass filter and highpass filter 5. To study the characteristics and applications of Silicon Controlled Rectifier: (i). To plot the SCR characteristics under different gate current conditions and to obtain the values of the following parameters, (a) Forward break over voltage (V_{BRF}) for specified gate current, (b) Forward ON voltage (V_F) (ii). To measure holding current (I_H) (iii).To study the effect of varying dc gate current on the firing point of the SCR connected as an *ac* rectifier. 6. Push-Pull Amplifier**,** (i). To study the output waveforms of push-pull amplifier in different classes of operation and to measure the efficiencies in each case, and (ii). To plot the frequency response of the amplifier operated at the class *AB*. 7. To design Modulation and Demodulation circuits and (i). To sketch the modulated waveform for at least two modulating signal frequencies and different indices of modulation. (ii). To sketch the demodulated signal for a particular modulating signal and modulation index for three values of the *RC* time constant. 8. To determine the energy band gap in p-n junction diode. 9. Experiment on FET and MOSFET characterization and application as an amplifier. a. To measure V_p. b. To plot the output characteristics of the CS configuration. c. To plot the transfer characteristics and hence to obtain trans-conductance d. To measure V_p e. To plot the output characteristics of the CS configuration. f. To plot the transfer characteristics and hence to obtain trans conductance (g_m) g. To plot the frequency response of the CS FET amplifier with and without feedback. 10.Experiment on Uni-Junction Transistor and its application. (i). To plot the input characteristics of UJT and to obtain the values *of* □, I_P, V_V,I_v, $V_{e(sat)}$ (ii). To plot the output characteristics of UJT and to obtain the value of R_{BB} (iii).To study the working of a UJT saw tooth generator 11.To design a circuit that can be used for addition and subtraction of two given four bit binary numbers using transistors/diodes. Explain its working and verify the result. 12.To design analog to digital converter (ADC) of given specifications. 13.To design digital to analog converter (DAC) using ladder network. 14.Electronic voltmeter (i). To determine, the percentage error for, the ordinary voltmeter and electronic voltmeter and to determine their internal resistances, (ii). To plot the frequency response of the same. 16.To examine the properties of the MOS amplifier configurations, and to investigate their small signal performance. To design a multi-stage CMOS amplifier of a given specifications. .

Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/
SUGGESTED BOOKS	Basic Electronics: A text lab manual by Paul Zbar, Albert Malvino, Michael Miller

Discipline Specific Elective Course (DSEPHY-10)

Semester-VIII

Paper: Applied Optics

Course Learning Outcomes

Course Learning Outcomes

After completing the course the students will able to : -

CO-01: Understand basic lasing mechanism qualitatively, types of lasers, characteristics of laser light and its application in developing LED, Holography.
CO-02: Gain concepts of Fourier optics and Fourier transform spectroscopy.
CO-03: Understand basic principle and theory of Holography.
CO-04: Grasp the idea of total internal reflection and learn the characteristics of optical fibers.

MAPPING OF CO (COURSE OUTCOME) AND PO (PROGRAMME OUTCOME):

POs / COs	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11
CO-01	✓	✓			✓						✓
CO-02			✓				✓				
CO-03					✓		✓		✓		
CO-04	✓		✓					✓			✓

B.SC.-VIII EIGHTH SEMESTER COURSE CODE: DSEPHY-10	
PAPER CODE: PDSEC-10 Credit: (Theory-03, Practical-01), Theory: 45 Hrs, Practical: 30 Hrs	
PAPER TITLE: Applied Optics	
THEORY MARKS: 100 (SEE-80 & CCA-20) **PRACTICAL: 50**	
Question Pattern-i) Objective Type Question-MCQ, Fill up the blanks, True/False, Total- 10 Q. ii) Very Short Answer Type- Word Limit 70-100, Total-5 Q. iii) Short Answer Type- Word Limit 200-250, Total-5 Q. iv) Long Answer Type- Word Limit 500-600, Total-5 Q.	
UNIT-1 12 Hours	**Lasers:** an introduction, Planck's radiation law (qualitative idea), Energy levels, Absorption process, Spontaneous and stimulated emission processes, Theory of laser action, Population of energy levels, Einstein's coefficients and optical amplification, properties of laser beam, Ruby laser, He-Ne laser, and semiconductor lasers; Light Emitting Diode (LED) and photo-detectors.
UNIT-2 12 Hours	Fourier Optics and Fourier Transform Spectroscopy (Qualitative explanation) Concept of Spatial frequency filtering, Fourier transforming property of a thin lens, Fourier Transform Spectroscopy (FTS): measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry, and forensic science.
UNIT-3 10Hours	**Holography:** Basic principle and theory: recording and reconstruction processes, Requirements of holography- coherence, etc. Types of holograms: The thick or volume hologram, Multiplex hologram, white light reflection hologram; application of holography in microscopy
UNIT-4 11 Hours	**Optical fibres:** Total Internal Reflection, Basic characteristics of the optical fibre: Principle of light propagation through a fibre, the coherent bundle, The numerical aperture, Attenuation in optical fibre and attenuation limit; Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating.
SUGGESTED READINGS	1. Introduction to Fourier Optics, Joseph W. Goodman, The McGraw- Hill, 1996. 2. Introduction to Fiber Optics, A. Ghatak & K. Thyagarajan, Cambridge University Press. 3. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books 4. Optical Electronics, Ajoy Ghatak and K. Thyagarajan, 2011, Cambridge University Press. 5. Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.

Practicum (02 Credit)	Peer/Micro teaching, Class Seminar, Quiz, Group Discussion

B.Sc.-VIII	EIGHTH SEMESTER	COURSE CODE: DSEPHY-10LAB
PAPER CODE: PDSEC-10P	**Credit: Practical-1, Practical: 30 Hours**	
PAPER TITLE: DSEC-LAB: APPLIED OPTICS		
PRACTICAL MARKS: 50		
Topics (Course contents)		
A tentative list lab work that can be amended by teacher /department concerned.		

30 Hours	Teacher may give long duration project based on this paper Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the physics lab, including necessary precautions. Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors. Application to the specific experiments done in the lab. **Experiments on Lasers:** a. To determine the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid-state laser. b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid-state laser. c. To find the polarization angle of laser light using polarizer and analyzer. d. Thermal expansion of quartz using laser. e. To determine the wavelength and angular spread of laser light by using plane diffraction grating. **Experiments on Semiconductor Sources and Detectors:** a. V-I characteristics of LED b. Study the characteristics of solid-state laser. c. Study the characteristics of LDR d. Characteristics of Photovoltaic Cell/ Photodiode. e. Characteristics of IR sensor **Experiments on Fourier Optics:** a. Optical image addition/subtraction. b. Optical image differentiation c. Fourier optical filtering d. Construction of an optical 4f system **Experiments on Fourier Transform Spectroscopy** To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters. Computer simulation can also be done. **Experiments on Holography and interferometry:** b. Recording and reconstruction of holograms (Computer simulation can also be done). c. To construct a Michelson interferometer or a Fabry Perot interferometer. d. To determine the wavelength of sodium light by using Michelson's interferometer. e. To measure the refractive index of air. **Experiments on Fibre Optics** a. To measure the numerical aperture of an optical fibre.

Online resources	➢ **e-Resources / e-books and e-learning portals for Physics** ➢ **Use of following sites** ➢ https://www.e-booksdirectory.com/physics.php ➢ https://www.pdfdrive.com/category/66 ➢ https://www.e-booksdirectory.com/listing.php?category=2 ➢ https://www.openculture.com/free-physics-textbooks ➢ https://bookboon.com/en/physics-ebooks ➢ https://www.pdfdrive.com/ https://zlibrary.to/