B.Sc. (H) Physics

Scheme and Syllabus

Outcome Based Education System (OBES)/

Learning Outcomes based Curriculum Framework (LOCF)

Choice Base Credit System (CBCS)

ACADEMIC SESSION

(w.e.f. 2021-2022)

DEPARTMENT OF PHYSICS

FACULTY OF SCIENCES

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD HARYANA -121006

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

VISION

"J.C BOSE University of Science and Technology, YMCA, Faridabad aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building."

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the art technological exposure to its Scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

DEPARTMENT OF PHYSICS

VISION

A department that can effectively harness its multidisciplinary strengths to create an academically stimulating atmosphere; evolving into a well-integrated system that synergizes the efforts of its competent faculty towards imparting intellectual confidence that aids comprehension and complements the spirit of inquiry.

MISSION

- To create well-rounded individuals ready to comprehend scientific and technical challenges offered in the area of specialization.
- To counsel the students so that the roadmap becomes clearer to them and they have the zest to turn the blueprint of their careers into a material reality.
- To encourage critical thinking and develop their research acumen by aiding the nascent spirit for scientific exploration.
- Help them take economic, social, legal and political considerations when visualizing the role of technology in improving quality of life.
- To infuse intellectual audacity that makes them take bold initiatives to venture into alternative methods and modes to achieve technological breakthroughs.

B.Sc. (Hons.) Physics

Physics is the most fundamental of the sciences. New concepts, such as Quantum Mechanics and Relativity, are introduced at the degree level in order to understand nature at the deepest level. These theories have profound philosophical implications because they challenge our view of the everyday world. At the same time, they have a huge impact on society since they underpin the technological revolution. While studying one of the most intellectually satisfying disciplines, you will acquire transferable skills including numeracy, problem-solving, an ability to reason clearly and communicate well. Core physics topics include Newtonian Dynamics, Wave Phenomena, The Material Universe, Working with Physics, Practical Physics and Maths for Physics, Electromagnetism, Condensed Matter, Quantum and Atomic Physics and Nuclear and Particle Physics.

A wide range of options is available including Medical Physics, Astronomy, Statistical, and Low-Temperature Physics, and Surface Physics. You will also take Mathematics, Computing, and Experimental Physics modules in support of these studies. The programme includes a one-semester project in one of the research groups.

Aims of the bachelor's degree programme in Physics with honours

The overall aims of the bachelor's honors degree programme in physics are to:

- Producing graduates who are well-grounded in the fundamentals of Physics and acquisition of the necessary skills, in order to use their knowledge in Physics in a wide range of practical applications.
- Developing creative thinking and the power of imagination to enable the graduates to work in research in academia and industry for broader application.
- Accommodating their relevant fields in allied disciplines and allowing the graduates of Physics to fit into the interdisciplinary environment.
- Relating the training of Physics graduates to the employment opportunities within the country.

It also promotes research and creative activities of students by providing exposure to the realm of physical science and technical expertise. The B.Sc. (Hons.) programme in physics is designed to provide a thorough basic knowledge in physics at the undergraduate level. Apart from the

general topics in physics, many of the new topics included in the syllabus keep the students abreast with the latest developments taking place in the field. Also, the experiments chosen for each practical course are such that they bring out the concept of application of the theory in a practical situation. It also helps in creative thinking and self-learning.

PROGRAM OUTCOMES OF UG PROGRAM OF FACULTY OF SCIENCES

PO1	Disciplinary knowledge	Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.
PO2	Communication Skills	Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one‟s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information clearly and concisely to different groups.
PO3	Critical thinking	Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies, and theories by following a scientific approach to knowledge development.
PO4	Problem solving	Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one‟s learning to real-life situations.
PO5	Analytical reasoning	Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints.
PO6	Research-related skills	A sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing, and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

PO7	Cooperation/Teamwork	Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.
PO8	Scientific reasoning	Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence, and experiences LOCF 4 from an open-minded and reasoned perspective.
PO9	Reflective thinking	Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.
PO10	Information/digital literacy	Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.
PO11	Self-directed learning	Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
PO12	Multicultural competence	Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
PO13	Moral and ethical awareness/reasoning	Ability to embrace moral/ethical values in conducting one‟s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one‟s work, avoid unethical behavior such as fabrication, falsification, or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
PO14	Leadership readiness/qualities	Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO15	Lifelong learning	Ability to acquire knowledge and skills, including „learning how to learn", that is necessary for participating in 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 through knowledge/skill development/reskilling.

Program Specific Outcomes (PSOs)

The program specific outcomes (PSO's) are the statement of competencies/abilities that describes the knowledge and capabilities of the post-graduate will have by the end of program studies.

After successful completion of B. Sc. (H) Physics program, the students will be able to

PSO1	Demonstrates (i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications, and its linkages with related disciplinary areas/subjects; (ii) Demonstrate 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) Demonstrate skills in areas related to one's specialisation area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.
PSO2	Demonstrates the ability to use Physics skills such as 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.
PSO3	Plan and execute physics-related experiments or investigations, analyse 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.

JC BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

DEPARTMENT OF PHYSICS

SCHEME B.SC. (H) PHYSICS

SEMESTER I

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BPH-101A	Mathematical Physics-I	4	0	0	25	75	100	4	DCC
BPH-102A	Mechanics	4	0	0	25	75	100	4	DCC
BPH-103A	Mathematical Physics-I Lab	0	0	4	15	35	50	2	DCC
BPH-104A	Mechanics Lab	0	0	4	15	35	50	2	DCC
Ability Enhancement Compulsory Course (AECC) – Compulsory									
BENG-101A	English	2	0	0	25	75	100	2	AEC
Open Elective Course (OEC-I) - Select 1-paper & respective Lab (if any) of the following 4-disciplines									
OMTH-101A	Calculus	5	1	0	25	75	100	6	OEC
OELC-101A	Electronic circuit & PCB Designing	4	0	0	25	75	100	4	OEC
OCSC-101A	Introduction to Programming	4	0	0	25	75	100	4	OEC
OCHE-101A	Inorganic Chemistry	4	0	0	25	75	100	4	OEC
OELC-102A	Electronic circuit & PCB Designing Lab	0	0	4	15	35	50	2	OEC
OCSC-102A	Introduction to Programming Lab	0	0	4	15	35	50	2	OEC
OCHE-102A	Inorganic Chemistry Lab	0	0	4	15	35	50	2	OEC
Massive Open Elective Course (MOOC)*- Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Total Credits								**20**	

*The students have to pass at least one mandatory MOOC course with 4-6 credits (12-16 weeks) from the list given on the Swayam portal or the list given by the department/ university from 1st semester to 3rd semester as notified by the university. (Instructions to students overleaf)

L – Lecture; T - Tutorial; P - Practical

JC BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

DEPARTMENT OF PHYSICS

SCHEME B.SC. (H) PHYSICS

SEMESTER II

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BPH-201A	Electricity & Magnetism	4	0	0	25	75	100	4	DCC
BPH-202A	Waves & Optics	4	0	0	25	75	100	4	DCC
BPH-203A	Electricity & Magnetism Lab	0	0	4	15	35	50	2	DCC
BPH-204A	Waves & Optics Lab	0	0	4	15	35	50	2	DCC
Ability Enhancement Compulsory Course (AECC) – Compulsory									
BEVS-101A	Environmental Science	2	0	0	25	75	100	2	AEC
Open Elective Course (OEC-2) - Select 1- paper & respective Lab (if any) of the following 4-disciplines									
OMTH-201A	Linear Algebra	5	1	0	25	75	100	6	OEC
OELC-201A	Instrumentation	4	0	0	25	75	100	4	OEC
OCSC-201A	Introduction to Database System	4	0	0	25	75	100	4	OEC
OCHE-201A	Physical Chemistry	4	0	0	25	75	100	4	OEC
OELC-202A	Instrumentation Lab	0	0	4	15	35	50	2	OEC
OCSC-202A	Introduction to Database System Lab	0	0	4	15	35	50	2	OEC
OCHE-202A	Physical Chemistry Lab	0	0	4	15	35	50	2	OEC
Massive Open Elective Course (MOOC) – Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Mandatory Audit Course (MAC)									
XXX	Audit Course#	2	0	0	25	75	100	0	AUD
Total Credits								**20**	

As per the list provided by the University site

JC BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

DEPARTMENT OF PHYSICS

SCHEME B.SC. (H) PHYSICS

SEMESTER III

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BPH-301A	Mathematical Physics-II	4	0	0	25	75	100	4	DCC
BPH-302A	Thermal Physics	4	0	0	25	75	100	4	DCC
BPH-303A	Analog Systems & Applications	4	0	0	25	75	100	4	DCC
BPH-304A	Mathematical Physics-II Lab	0	0	4	15	35	50	2	DCC
BPH-305A	Thermal Physics Lab	0	0	4	15	35	50	2	DCC
BPH-306A	Analog Systems & Applications Lab	0	0	4	15	35	50	2	DCC
Skill Enhancement Course (SEC) – Select 1-paper and respective lab out of the following									
SECP-01A	Computational Physics Skills	2	0	0	25	75	100	2	SEC
SECP-02A	Electrical Circuits & Network Skills	2	0	0	25	75	100	2	SEC
SECP-03A	Basic Instrumentation Skills	2	0	0	25	75	100	2	SEC
SECP-04A	Computational Physics Skills Lab	0	0	2	15	35	50	0	SEC
SECP-05A	Electrical Circuits & Network Skills Lab	0	0	2	15	35	50	0	SEC
SECP-06A	Basic Instrumentation Skills Lab	0	0	2	15	35	50	0	SEC
SECP-07A	Renewable Energy and Energy Harvesting	2	0	0	25	75	100	2	SEC
SECP-08A	Renewable Energy and Energy Harvesting Lab	0	0	2	15	35	50	0	SEC
Open Elective Course (OEC-3) – Select 1- paper & respective Lab(if any) of the following 4-disciplines									
OMTH-301A	Differential Equations	5	1	0	25	75	100	6	OEC
OELC-301A	Communication Systems	4	0	0	25	75	100	4	OEC
OCSC-301A	Computer Networks & Internet Technology	4	0	0	25	75	100	4	OEC
OCHE-301A	Organic Chemistry	4	0	0	25	75	100	4	OEC
OELC-302A	Communication Systems Lab	0	0	4	15	35	50	2	OEC

OCSC-302A	Computer Networks & Internet Technology Lab	0	0	4	15	35	50	2	OEC
OCHE-302A	Organic Chemistry Lab	0	0	4	15	35	50	2	OEC
Massive Open Elective Course (MOOC) – Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Total Credits								**26**	

JC BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

DEPARTMENT OF PHYSICS

SCHEME B.SC. (H) PHYSICS

SEMESTER IV

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BPH-401A	Mathematical Physics-III	4	0	0	25	75	100	4	DCC
BPH-402A	Elements of Modern Physics	4	0	0	25	75	100	4	DCC
BPH-403A	Digital Systems & Applications	4	0	0	25	75	100	4	DCC
BPH-404A	Mathematical Physics-III Lab	0	0	4	15	35	50	2	DCC
BPH-405A	Elements of Modern Physics Lab	0	0	4	15	35	50	2	DCC
BPH-406A	Digital Systems & Applications Lab	0	0	4	15	35	50	2	DCC
Skill Enhancement Course (SEC) – Select 1-paper and respective Lab out of the following (not opted in Sem-III)									
SECP-01A	Computational Physics Skills	2	0	0	25	75	100	2	AEEC
SECP-02A	Electrical Circuits & Network Skills	2	0	0	25	75	100	2	AEEC
SECP-03A	Basic Instrumentation Skills	2	0	0	25	75	100	2	AEEC
SECP-04A	Computational Physics Skills Lab	0	0	2	15	35	50	0	SEC
SECP-05A	Electrical Circuits & Network Skills Lab	0	0	2	15	35	50	0	SEC
SECP-06A	Basic Instrumentation Skills Lab	0	0	2	15	35	50	0	SEC
SECP-07A	Renewable Energy and Energy Harvesting	2	0	0	25	75	100	2	SEC
SECP-08A	Renewable Energy and Energy Harvesting Lab	0	0	2	15	35	50	0	SEC

Open Elective Course (OEC-3) – Select 1- paper & respective Lab (if any) of the following 4-disciplines									
OMTH-401A	Numerical Methods	5	1	0	25	100	100	6	OEC
OELC-401A	Microprocessor & Microcontroller Systems	4	0	0	25	75	100	4	OEC
OCSC-401A	Information Security	4	0	0	25	75	100	4	OEC
OCHE-401A	Spectroscopy	4	0	0	25	75	100	4	OEC
OELC-402A	Microprocessor & Microcontroller Systems Lab	0	0	4	15	35	50	2	OEC
OCSC-402A	Information Security Lab	0	0	4	15	35	50	2	OEC
OCHE-402A	Spectroscopy Lab	0	0	4	15	35	50	2	OEC
Massive Open Elective Course (MOOC) – Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Total Credits								**26**	

JC BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

DEPARTMENT OF PHYSICS

SCHEME B.SC. (H) PHYSICS

SEMESTER V

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory									
BPH-501A	Quantum Mechanics & Applications	4	0	0	25	75	100	4	DCC
BPH-502A	Solid State Physics	4	0	0	25	75	100	4	DCC
BPH-503A	Quantum Mechanics & Applications Lab	0	0	4	15	35	50	2	DCC
BPH-504A	Solid State Physics Lab	0	0	4	15	35	50	2	DCC
Discipline Elective Course (DEC) select any 2-papers & respective labs (if any) out of the following 3-papers									
DECP-501A	Atomic & Molecular Physics	5	1	0	25	75	100	6	DEC
DECP-502A	Experimental Techniques	4	0	0	25	75	100	4	DEC
DECP-503A	Linear Algebra & Tensor Analysis	5	1	0	25	75	100	6	DEC
DECP-504A	Experimental Techniques Lab	0	0	4	15	35	50	2	DEC
DECP-505A	Biological & Medical Physics	5	1	0	25	75	100	6	DEC
DECP-506A	Astronomy & Astrophysics	5	1	0	25	75	100	6	DEC
Massive Open Elective Course (MOOC) – Online Compulsory Course in any one semester from Sem-I to Sem-V									
XXX	MOOC	4/6	0	0	25	75	100	4/6	MOOC
Total Credits								**24**	

JC BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

DEPARTMENT OF PHYSICS

SCHEME B.SC. (H) PHYSICS

SEMESTER VI

Subject Code	Title	L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
Discipline Core Course (DCC) – Compulsory 2-Papers									
BPH-601A	Electromagnetic Theory	4	0	0	25	75	100	4	DCC
BPH-602A	Statistical Mechanics	4	0	0	25	75	100	4	DCC
BPH-603A	Electromagnetic Theory Lab	0	0	4	15	35	50	2	DCC
BPH-604A	Statistical Mechanics Lab	0	0	4	15	35	50	2	DCC
Discipline Elective Course (DEC) – Select any 2-papers & respective lab (if any) out of the following 3-papers									
DECP-601A	Nuclear & Particle Physics	5	1	0	25	75	100	6	DEC
DECP-602A	Nano Materials & Applications	4	0	0	25	75	100	4	DEC
DECP-603A	Physics of Devices & Communication	4	0	0	25	75	100	6	DEC
DECP-604A	Nano Materials & Applications Lab	0	0	4	15	35	50	2	DEC
DECP-605A	Physics of Devices & Communication Lab	0	0	4	15	35	50	2	DEC
DECP-606A	Classical Dynamics	5	1	0	25	75	100	6	DEC
Total Credits								**24**	

Grand Total Credits: 144/146 [140 + 4/6 (for MOOC Course)]

NOTE: 1. Discipline Elective Course (DEC) papers may be added or deleted as per UGC guidelines.
2. Skill Enhancement Course (SEC) papers may be added or deleted as per UGC guidelines.

Instructions to the students regarding MOOC

1. Two types of courses will be circulated: branch-specific and general courses from the website https://swayam.gov.in in June and November every year for the forthcoming semester.
2. The department coordinators will be the course coordinators of their respective departments.
3. Every student has to pass a selected MOOC course within the duration as specified below:

Programme	**Duration**
B. Tech.	Sem. I to Sem. VII
M.Sc./M.Tech./MA/MBA	Sem. I to Sem. III
B.Sc./MCA	Sem. I to Sem. V

The passing of a MOOC course is mandatory for the fulfillment of the award of the degree of concerned programme.

4. A student has to register for the course for which he is interested and eligible which is approved by the department with the help of the course coordinator of the concerned department.
5. A student may register in the MOOC course of any programme. However, a UG student will register only in UG MOOC courses and a PG student will register in only PG MOOC courses.
6. The students must read all the instructions for the selected course on the website, get updated with all key dates of the concerned course, and must inform his/her progress to their course coordinator.
7. The student has to pass the exam (online or pen-paper mode as the case may be) with at least 25% marks.
8. The students should note that there will be a weightage of Assessment/quiz etc. and final examination appropriately as mentioned in the instructions for a particular course.
9. A student must claim the credits earned in the MOOC course in his/her mark sheet in the examination branch by forwarding his/her application through the course coordinator and chairperson.

Syllabus of B.Sc. (H) Physics

Semester I

Discipline Core Course (DCC)

B.Sc. (H) PHYSICS SEMESTER I
CODE: BPH-101A
SUBJECT NAME: MATHEMATICAL PHYSICS-I
NO. OF CREDITS: 4

L	T	P		
			SESSIONAL	: 25
			FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH101A.1 *Revise the knowledge of calculus, vectors and vector calculus.*

BPH101A.2 *Solve problems based on calculus, vectors and vector calculus.*

BPH101A.3 *Use of fundamentals of calculus, vectors and vector calculus for various problems in physics.*

BPH101A.4 *Learn the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.*

BPH101A.5 *Understand the Dirac delta function and its properties.*

BPH101A.6 *Analyze the transformation equations relating cartesian, spherical and cylindrical coordinate systems.*

UNIT-I

Calculus: Plotting of functions. Approximation: Taylor and binomial series (statements only). First Order differential. Equations exact and inexact differential equations and Integrating Factor.

Second-Order Differential equations: Homogeneous Equations with constant coefficients. Wronskian and general solution. Particular Integral with operator method, method of undetermined coefficients, and variation method of parameters. (12 Lectures)

UNIT-II

Vector Algebra: Properties of vectors. Scalar product and vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Vector Calculus: Vector Differentiation: Directional derivatives and normal derivatives. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. (12 Lectures)

UNIT-III

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface, and volume elements. Line, surface, and volume integrals of Vector fields. Flux of a vector field. Gauss's divergence theorem, Green's and Stokes Theorems, and their verification (no rigorous proofs). (12 Lectures)

UNIT-IV

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Dirac Delta function: Definition of Dirac delta function and simple examples. (12 Lectures)

Reference Books:

1. Mathematical Methods for Physicists, G.B.Arfken, H.J.Weber, F.E.Harris, 1513, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 1509, PHI learning
3. Differential Equations, George F. Simmons, 1507, McGraw Hill.
4. Advanced Engineering Mathematics, D.G. Zill and W.S.Wright, 5 Ed., 1512, Jones and Bartlett Learning
5. Mathematical Physics, Goswami, 1st edition, Cengage Learning
6. Engineering Mathematics, S.Pal and S.C. Bhunia, 1515, Oxford University Press
7. Advanced Engineering Mathematics, Erwin Kreyszig, 1508, Wiley India.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-101A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH101A.1	3	-	2	2	2	3	-	1	1	-	-	-	-	-	-	3	2	1
BPH101A.2	3	-	3	3	3	3	-	2	1	-	2	-	-	-	-	3	3	2
BPH101A.3	3	1	3	3	3	3	1	3	1	2	2	-	2	-	1	3	3	2
BPH101A.4	3	-	2	2	2	3	-	1	1	-	1	-	-	-	-	3	2	1
BPH101A.5	3	-	2	2	2	3	-	2	1	-	1	-	-	-	-	3	3	1
BPH101A.6	3	1	3	3	3	3	2	3	1	2	2	-	2	-	1	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: BPH-102A
SUBJECT NAME: MECHANICS
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH102A.1 *Explain the fundamental concepts of mechanics involving laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance.*

BPH102A.2 *Acquire thorough understanding of work and energy concepts in various mechanical systems.*

BPH102A.3 *Understand the analogy and differences between translational and rotational dynamics, and application of both motions.*

BPH102A.4 *Describe the principles of elasticity through the study of various elastic constants.*

BPH102A.5 *Apply Kepler's law to describe the motion of planets and satellites in circular orbit, through the study of the law of Gravitation.*

BPH102A.6 Illustrate the special theory of relativity and its effects on mass and energy of a moving object.

Unit-I

Fundamentals of Dynamics: Reference frames. Inertial frames, Review of Newton's Laws of Motion. Galilean transformations. Galilean invariance. Momentum of variable- mass system: motion of rocket. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Law of Conservation of Energy. (12 Lectures)

Unit-II

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Elasticity: Review of relation between Elastic constants. Twisting torque on a Cylinder or Wire (only qualitative discussion). (12 Lectures)

Unit-III

Gravitation: Law of gravitation. Gravitational potential energy. Inertial & gravitational mass. Potential and field due to spherical shell and solid sphere.

Central force Motion: Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit & applications, weightlessness and basic idea of Global Positioning System (GPS).

Oscillations: Review of SHM (Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time - average values). (12 Lectures)

Unit-IV

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. (12 Lectures)

Reference Books:

1. Introduction to Classical Mechanics, R. G. Takwale, P. S. Puranik, Tata McGraw-Hill.
2. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, McGraw-Hill.
3. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al., Tata McGraw-Hill.
4. Fundamentals of Physics, R. Resnick, D. Halliday and J. Walker, Wiley Publications.
5. Feynman Lecture Series, Vol.I, R.P.Feynman, R.B.Leighton, M.Sands, Pearson Education
6. Mechanics, D.S. Mathur, S.Chand and Company Limited.
7. Theoretical Mechanics, M.R. Spiegel, 1506, Tata McGraw Hill.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-102A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
BPH102A.1	3	3	3	3	3	2	2	3	3	3	2	-	3	2	3	3	3	2
BPH102A.2	3	3	3	3	3	2	3	3	3	3	3	-	2	3	3	3	3	3
BPH102A.3	3	3	3	3	2	2	2	3	3	3	3	-	1	2	3	3	3	3
BPH102A.4	3	3	2	3	3	2	3	3	3	2	2	-	2	1	3	3	3	3
BPH102A.5	3	3	3	3	2	1	3	3	3	2	2	-	2	2	3	3	3	3
BPH102A.6	3	3	3	3	3	2	3	3	3	2	2	-	2	1	3	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: BPH-103A
SUBJECT NAME: MATHEMATICAL PHYSICS –I LAB
NO. OF CREDITS: 2

L	T	P
0	0	4

SESSIONAL : 15
FINAL EXAM : 35
TOTAL : 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH103A.1 *Learn the basics of C/C++ programming language.*
BPH103A.2 *Learn conditional and unconditional loops and portray their use in various physics problems.*
BPH103A.3 *Understand the programming of numerical algebraic methods considering simple physics equations, in C++ programming language.*
BPH103A.4 *Solving simple problems with numerical differentiation and integration using C++ programming language.*
BPH103A.5 *Learn the generation of random numbers in C++ programming language.*
BPH103A.6 *Understand the evaluation and plotting of trigonometric functions like sinθ, cosθ and tanθ using programming language.*
BPH103A.7 *Determine computationally the area of BH Hysteresis loop*.
BPH103A.8 *Compute current values in RC, LC with DC source and analyze radioactive decay computationally*.

Topics	**Descriptions with Applications**
Errors and Error Analysis	Truncation and round-off errors, Absolute and relative errors, Floating-point computations
Review of C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, cin and cout, Decision making and looping statements *(if-statement, if-else statement, nested if statement, else-if statement, ternary operator, goto statement, switch statement, unconditional and conditional looping, while and do-while loop, for loop, nested loops, break and continue statements*). Arrays (1D and 2D) and strings, user-defined functions.
Programs: using C++ language	Sum and average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of a circle, area of a square, the volume of a sphere, value of pi

Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\alpha = tan\ \alpha$; $I = I_o\ (sin\ \alpha/\alpha)^2$ in optics,
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. *sin* ⟨, *cos* ⟨, *tan* etc.
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo Method	Given Position with equidistant time data calculate velocity and acceleration and vice versa. Find the area of the BH Hysteresis loop
Solution of Ordinary Differential Equations (ODE) First-order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth-order methods	First-order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Attempt following problems using RK 4 order method: • Solve the coupled differential equations $dx/dt = y + x - x^3/3$; $dy/dx = - x$ for four initial conditions x(0) = 0, y(0) = -1, -2, -3, -4. Plot x vs y for each of the four initial conditions on the same screen for 0 ≤ t ≤ 15.

Referred Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 1512, PHI Learning Pvt. Ltd.
2. Schaum's Outline of Programming with C++. J.Hubbard, 1500, McGraw-Hill Pub.
3. Numerical Recipes in C++: The Art of Scientific Computing, W.H. Press et.al., 2nd Edn., 1513, Cambridge University Press.
4. An introduction to Numerical methods in C++, Brian H. Flowers, 1509, Oxford University Press.
5. A first course in Numerical Methods, U.M. Ascher & C. Greif, 1512, PHI Learning.
6. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.
7. Computational Physics, Darren Walker, 1st Edn., 1515, Scientific International Pvt. Ltd.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-103A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH103A.1	3	1	2	2	3	3	3	1	1	3	2	-	2	2	2	3	3	2
BPH103A.2	3	1	2	2	3	3	3	2	1	3	2	-	2	2	2	3	3	2
BPH103A.3	3	1	2	2	3	3	3	2	1	3	2	-	2	2	2	3	3	2
BPH103A.4	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH103A.5	3	1	2	2	3	3	3	2	1	3	2	-	2	2	2	3	3	2
BPH103A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH103A.7	3	2	2	3	3	3	3	3	1	3	2	-	2	2	2	3	3	3
BPH103A.8	3	2	2	3	3	3	3	3	1	3	2	-	2	2	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: BPH-104A
SUBJECT NAME: MECHANICS LAB
NO. OF CREDITS: 2

L	T	P
0	0	4

SESSIONAL	: 15
FINAL EXAM	: 35
TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH104A.1 *Precisely measure the various physical parameters involved in mechanics and be able to compute random errors in these.*

BPH104A.2 *Compute Height, width and area of a window/Building using sextant.*

BPH104A.3 *Determination of spring constant by examining the motion of a spring*

BPH104A.4 *Estimate the moment of inertia of a flywheel.*

BPH104A.5 *Compute the value of acceleration due to gravity and velocity for a freely falling body using digital timing technique.*

BPH104A.6 *Estimate Young's modulus of a wire by optical lever method.*

BPH104A.7 *Determine the modulus of rigidity of a wire by Maxwell's needle method.*

BPH104A.8 *Calculate the value of acceleration due to gravity using Bar pendulum and Kater's Pendulum.*

Select at least 06 experiments from the following

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine **g** and velocity for a freely falling body using Digital Timing Technique
6. To determine the Young's Modulus of a Wire by Optical Lever Method.
7. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
8. To determine the elastic Constants of a wire by Searle's method.

9. To determine the value of g using Bar Pendulum.
10. To determine the value of g using Kater's Pendulum

Reference 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, I. Prakash & Ramakrishna, 11th Edn, 1511, Kitab Mahal.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-104A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH104A.1	3	3	3	3	3	2	3	3	3	2	2	-	3	1	3	3	3	3
BPH104A.2	3	3	3	3	3	2	3	3	2	2	2	-	2	2	3	3	3	3
BPH104A.3	3	3	3	3	3	2	3	3	2	3	1	-	2	2	3	3	3	3
BPH104A.4	3	3	3	3	3	2	3	3	3	2	1	-	2	2	3	3	2	3
BPH104A.5	3	3	3	3	3	2	3	3	2	3	1	-	2	1	3	3	3	3
BPH104A.6	3	3	3	3	3	1	3	3	3	2	2	-	1	1	3	3	2	3
BPH104A.7	3	3	3	3	3	2	3	3	2	2	1	-	2	1	3	3	3	3
BPH104A.8	3	3	3	3	3	1	3	3	3	2	1	-	2	1	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Ability Enhancement Compulsory Course (AECC)

B.Sc. (H) PHYSICS SEMESTER I
CODE: BENG-101A
SUBJECT NAME: ENGLISH
NO. OF CREDITS: 2

L	T	P		
2	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BENG101A.1 *Learn about communication process and ways to make communication effective by giving attention to all elements involved.*

BENG101A.2 *Understand the value of verbal communication as well as non- verbal aspects of communication in making inter personnel communication effective and intrapersonnel communication insightful.*

BENG101A.3 *Gain confidence by enhancing their abilities to articulate their ideas.*

BENG101A.4 *Able to scan, skim and revise documents for fruitful reading and comprehension.*

BENG101A.5 *Acquire better writing skills in formal communication.*

BENG101A.6 *Able to comprehend, analyze and interpret information for effective communication.*

Unit 1: Introduction: Theory of Communication, Types and modes of Communication

Unit 2: Language of Communication: Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication

Unit 3: Speaking Skills: Monologue Dialogue Group Discussion Effective Communication/ Mis-Communication Interview Public Speech

Unit 4: Reading and Understanding Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts. Writing Skills Documenting Report Writing Making notes Letter writing.

Reference Books:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BENG-101A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BENG101A.1	-	3	3	2	2	2	2	-	-	-	2	2	1	1	3	-	-	-
BENG101A.2	-	3	3	2	2	2	2	-	-	-	2	2	1	1	3	-	-	-
BENG101A.3	-	3	3	2	2	2	2	-	2	-	2	2	1	2	3	-	-	-
BENG101A.4	2	3	3	3	3	3	3	-	2	2	2	3	2	2	3	-	-	-
BENG101A.5	2	3	3	3	3	3	3	-	2	2	2	3	2	2	3	-	-	-
BENG101A.6	-	3	3	2	2	2	2	-	-	2	2	3	2	2	3	-	-	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Open Elective Courses (OEC)

B.Sc. (H) PHYSICS SEMESTER I
CODE: OMTH-101A
SUBJECT NAME: CALCULUS
NO. OF CREDITS: 6

L	T	P		
5	1	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OMTH101A.1 *Acquire knowledge about differential calculus.*

OMTH101A.2 *Learn about partial differentiation and maxima-minima of functions of two variables.*

OMTH101A.3 *Understand about integral calculus: single integral and double integral.*

OMTH101A.4 *Solve problems on triple integral and beta and gamma functions.*

OMTH101A.5 *Apply the knowledge of integral calculus to compute the enclosed area under plane curves and volume in solids of revolution.*

OMTH101A.6 *Explore the curvature of curves by determining radius of curvature and centre of curvature.*

UNIT I

Definition of limit, Continuity, types of discontinuity, Differentiability, Successive differentiation, Leibnitz's Theorem and applications, Taylor's & Maclaurin's Series for one variable, Asymptotes, Curvature, Radius of Curvature for Cartesian, Parametric and Polar-curves, Radius of curvature at the Origin (by using Newton's method), Centre of curvature.

(15 Lectures)

UNIT II

Functions of two or more variables, Partial derivatives of first and higher order, Total differential and differentiability, Euler's theorem for Homogeneous functions, Derivatives of Composite and Implicit functions, Jacobians, Taylor's series for functions of two variables, Maxima-Minima of

functions of two variables. Lagrange's Method of undetermined multipliers, Differentiation under the integral sign (Leibnitz rule). (15 Lectures)

UNIT III

Applications of Single integration to find volume of solids and surface area of solids by revolution, Double integral, Change of Order of Integration, Double integral in Polar co-ordinates, Applications of double integral to find (i) Area enclosed by plane curves (ii) Volume of solids of revolution. (15 Lectures)

UNIT IV

Triple Integral, curvilinear coordinates, Change of variables,Volume of solids, Beta & Gamma functions and relation between them. (15 Lectures)

Reference Books:

1. Shanti Narayan, Differential Calculus, S Chand Publisher
2. Shanti Narayan, Integral Calculus, S Chand Publisher
3. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 11/e (2012)
4. H. Anton, I. Bivens and S. Davis, Calculus, John Willey and Sons Inc, 7/e (2011)

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OMTH-101A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OMTH101A.1	3	-	2	2	2	3	-	1	-	-	-	-	-	-	-	2	1	-
OMTH101A.2	3	-	2	2	2	3	-	2	-	-	1	-	-	-	-	2	2	-
OMTH101A.3	3	-	3	3	3	3	-	3	-	2	2	-	-	-	-	2	2	-
OMTH101A.4	3	1	3	3	3	3	1	3	1	2	2	-	2	1	1	2	3	-
OMTH101A.5	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH101A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: OCSE-101A
SUBJECT NAME: INTRODUCTION TO PROGRAMMING
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCSE101A.1 Understand the syntax of the C^{++} language.

OCSE101A.2 Differentiate between Procedure-Oriented programming and Object-Oriented programming.

OCSE101A.3 Understand and apply various object oriented features.

OCSE101A.4 Explore the conditional and iterative statements in C^{++} language.

OCSE101A.5 Solve various computing problems using C^{++} language.

OCSE101A.6 Apply object oriented concepts in real world programs.

UNIT-I

Introduction to C and C^{++}: History of C and C++, Overview of Procedural Programming and Object-Orientation Programming, Using main() function, Compiling and Executing Simple Programs in C^{++}.

Data Types, Variables, Constants, Operators and Basic I/O:
Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.hetc). (10 Lectures)

UNIT-II

Expressions, Conditional Statements and Iterative Statements

Simple Expressions in C^{++} (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative).

Functions and Arrays

Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions. Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use various types of arrays (integer, float and character arrays / Strings) Two- dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multidimensional arrays. (18 Lectures)

UNIT-III

Derived Data Types (Structures and Unions)

Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures.

File I/O, Preprocessor Directives

Opening and closing a file, Reading and writing Text Files, Using put(), get(), read() and write() functions. (10 Lectures)

UNIT-IV

Using Classes in C^{++}:

Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Specifying the Protected and Private Access, Copy Constructors.

Inheritance and Polymorphism: Introduction to Inheritance and Polymorphism.

(14 Lectures)

Reference Books:

1. Herbtz Schildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.
2. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.
3. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.
4. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OCSE-101A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCSE101A.1	3	1	3	2	2	3	1	2	-	3	1	-	-	1	2	2	1	-
OCSE101A.2	3	2	3	3	3	3	2	3	-	3	2	-	2	2	2	2	2	-
OCSE101A.3	3	1	3	2	2	3	1	2	-	3	1	-	-	1	2	2	1	-
OCSE101A.4	3	2	2	3	3	3	2	3	-	3	2	-	2	2	2	2	2	-
OCSE101A.5	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE101A.6	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: OCSE-102A
SUBJECT NAME: INTRODUCTION TO PROGRAMMING LAB
NO. OF CREDITS: 2

			SESSIONAL	: 15
L	T	P	FINAL EXAM	: 35
0	0	4	TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCSE102A.1 Understand the basic algebraic operations in C^{++} language.

OCSE102A.2 Learn find and print commands in C^{++} language.

OCSE102A.3 Program the automatic computation of grades of students for given set of their marks.

OCSE102A.4 Understand iterative statements by printing natural numbers, odd or even numbers in C^{++} language.

OCSE102A.5 Analyze conditional statements by computing greatest of three numbers in C^{++} language.

OCSE102A.6 Determine computationally gross salary of a person.

OCSE102A.7 Perform matrix algebraic operations in C^{++} language.

OCSE102A.8 Apply object oriented concepts in real mathematical programs.

Introduction to Programming Lab

1. Write a program to print “HELLO”
2. Write a program to add two numbers.
3. Write a program to calculate simple interest.
4. Write a program to calculate absolute value of a number.
5. Write a program to swap the values of two numbers.
6. Write a program to find gross salary of a person.
7. Write a program to check if a number is even or odd.
8. Write a program to find greatest of three numbers.
9. Write a program to find grade of a student given his marks.
10. Write a program to find divisor or factorial of a given number.
11. Write a program to print the Fibonacci series.
12. Write a program to print first ten natural numbers.
13. Write a program to print the reverse of a number.
14. Write a program to print the multiplication table of a given number.

15. Write a program to find grade of a list of students given their marks.
16. Write a program using function power (a, b) to calculate the value of a raised to b.
17. Write a program to print a 1-D array of 10 numbers in reverse order.
18. Create Matrix class. Write a menu-driven program to perform following Matrix operations (2-D array implementation):
    a) Sum
    b) Difference
    c) Product
    d) Transpose
19. Write a program to calculate the length of a string.
20. Write a program to copy the contents of one file into another.

Reference Books:

1. Herbtz Schildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.
2. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.
3. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.
4. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OCSE-102A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCSE102A.1	3	1	3	2	2	3	2	2	-	3	1	1	-	1	2	2	1	-
OCSE102A.2	3	1	3	2	2	3	2	2	-	3	1	1	-	1	2	2	2	-
OCSE102A.3	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE102A.4	3	1	3	2	2	3	2	2	-	3	1	1	-	1	2	2	2	-
OCSE102A.5	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE102A.6	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE102A.7	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE102A.8	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: OELC-101A
SUBJECT NAME: ELECTRONIC CIRCUITS AND PCB DESIGNING
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OELC101A.1 Acquire knowledge about network theorems.

OELC101A.2 Learn about semiconductor diode and its applications.

OELC101A.3 Know the working of BJT and Small Signal amplifier.

OELC101A.4 Understand the fabrication and circuit designing on PCB.

OELC101A.5 Investigate the voltage regulation using zener diode.

OELC101A.6 Explore the principles of laminates, photo-printing, etching and soldering.

Unit-I

Network theorems (DC analysis only): Review of Ohms law, Kirchhoff's laws, voltage divider and current divider theorems, open and short circuits.
Thevenin's theorem, Norton's theorem and interconversion, superposition theorem, maximum power transfer theorem.
Semiconductor Diode and its applications: PN junction diode and characteristics, ideal diode and diode approximations. Block diagram of a Regulated Power Supply, Rectifiers: HWR, FWR- center tapped and bridge FWRs. Circuit diagrams, working and waveforms, ripple factor & efficiency(no derivations).Filters: circuit diagram and explanation of shunt capacitor filter with waveforms.
Zener diode regulator: circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator. (14 Lectures)

Unit-II

BJT and Small Signal amplifier: Bipolar Junction Transistor: Construction, principle & working of NPN transistor, terminology. Configuration: CE, CB, CC. Definition of α, β and γ and their interrelations, leakage currents. Study of CE Characteristics, Hybrid parameters.

Transistor biasing: need for biasing, DC load line, operating point, thermal runaway, stability and stability factor.

Voltage divider bias: circuit diagrams and their working, Q point expressions for voltage divider biasing.

Small signal CE amplifier: circuit, working, frequency response, re model for CE configuration, derivation for Av, Zin and Zout. (12 Lectures)

Unit-III

Types of PCB: Single sided board, double sided, Multilayer boards, Plated through holes technology, Benefits of Surface Mount Technology (SMT), Limitation of SMT, Surface mount components: Resistors, Capacitor, Inductor, Diode and IC‘s.

Layout and Artwork: Layout Planning: General rules of Layout, Resistance, Capacitance and Inductance, Conductor Spacing, Supply and Ground Conductors, Component Placing and mounting, Cooling requirement and package density, Layout check.

Basic artwork approaches, Artwork taping guidelines, General artwork rules: Artwork check and Inspection. (12 Lectures)

UNIT-IV

Laminates and Photoprinting: Properties of laminates, Types of Laminates, Manual cleaning process, Basic printing process for double sided PCB‘s, Photo resists, wet film resists, Coating process for wet film resists, Exposure and further process for wet film resists, Dry film resists

Etching and Soldering: Introduction, Etching machine, Etchant system. Principles of Solder connection, Solder joints, Solder alloys, Soldering fluxes. Soldering, Desoldering tools and Techniques. (10 Lectures)

Reference Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronics text lab manual, Paul B. Zbar.
3. Electric circuits, Joeseph Edminister, Schaum series.
4. Basic Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshresta and D.C Gupta -TMH.
5. Electronic devices, David A Bell, Reston Publishing Company/DB Tarapurwala Publ.
6. Walter C.Bosshart ―PCB DESIGN AND TECHNOLOGY‖ Tata McGraw Hill Publications, Delhi. 1983
7. Clyde F.Coombs ―Printed circuits Handbook‖ III Edition, McGraw Hill.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OELC-101A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OELC101A.1	3	-	2	2	2	3	-	1	-	-	-	-	-	-	-	3	3	-
OELC101A.2	3	-	3	3	3	3	1	3	1	2	2	-	-	-	1	3	3	-
OELC101A.3	3	-	2	2	2	3	-	2	-	-	1	-	-	-	-	3	3	-
OELC101A.4	3	1	3	3	3	3	1	3	1	2	2	-	2	1	1	3	3	-
OELC101A.5	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	3	3	-
OELC101A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	3	3	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: OELC-102A
SUBJECT NAME: ELECTRONIC CIRCUITS AND PCB DESIGNING LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OELC102A.1 Analyze the Thevenin's, superposition and maximum power transfer theorems.

OELC102A.2 Understand the voltage regulation using zener diode.

OELC102A.3 Learn and predict the characteristics of common emitter transistor.

OELC102A.4 Design the various basic electronic circuits for a given output.

OELC102A.5 Understand the basics of half wave and full wave rectifier.

OELC102A.6 Examine the performance of some basic electronic circuits.

OELC102A.7 Test of a power supply with zener regulator.

OELC102A.8 Design and study voltage divider biasing.

Electronic Circuits and PCB Designing Lab (Hardware and Circuit Simulation Software)

1. Verification of Thevenin's theorem
2. Verification of Super position theorem
3. Verification of Maximum power transfer theorem.
4. Half wave Rectifier – without and with shunt capacitance filter.
5. Centre tapped full wave rectifier – without and with shunt capacitance filter.
6. Zener diode as voltage regulator – load regulation.
7. Transistor characteristics in CE mode – determination of ri, ro and β.
8. Design and study of voltage divider biasing.
9. Designing of an CE based amplifier of given gain
10. Designing of PCB using artwork, its fabrication and testing.
11. Design, fabrication and testing of a 9 V power supply with zener regulator

Reference Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronics text lab manual, Paul B. Zbar.
3. Electric circuits, Joeseph Edminister, Schaum series.
4. Basic Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshresta and D.C Gupta -TMH.
5. Electronic devices, David A Bell, Reston Publishing Company/DB Tarapurwala Publ.
6. Walter C.Bosshart ―PCB DESIGN AND TECHNOLOGY‖ Tata McGraw Hill Publications, Delhi. 1983
7. Clyde F.Coombs ―Printed circuits Handbook‖ III Edition, McGraw Hill.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OELC-102A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OELC102A.1	3	2	3	3	3	3	3	2	1	3	3	-	3	3	2	3	3	3
OELC102A.2	3	1	2	2	3	3	3	1	1	2	2	-	2	2	2	3	3	2
OELC102A.3	3	1	2	2	3	3	3	2	1	2	2	-	2	2	2	3	3	2
OELC102A.4	3	2	3	3	3	3	3	3	1	3	3	-	3	3	2	3	3	3
OELC102A.5	3	1	2	2	3	3	3	2	1	2	2	-	2	2	2	3	3	2
OELC102A.6	3	2	3	3	3	3	3	3	2	2	3	-	3	3	2	3	3	3
OELC102A.7	3	2	3	3	3	3	3	3	1	3	3	-	3	3	2	3	3	3
OELC102A.8	3	2	3	3	3	3	3	3	1	3	3	-	3	3	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: OCHE-101A
SUBJECT NAME: INORGANIC CHEMISTRY
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCHE101A.1 *Solve the conceptual questions based on the quantum mechanical model of the atom.*

OCHE101A.2 *Draw the plausible structures and geometries of molecules using Radius Ratio Rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).*

OCHE101A.3 *Understand the concept of lattice energy using Born-Landé equation.*

OCHE101A.4 *Understanding of the bonding models, structures, reactivity's, and applications of coordination complexes, metal carbonyls, and organometallics.*

OCHE101A.5 *Diagrammatically explain the working of the sodium-potassium pump in organisms and the factors affecting*

OCHE101A.6 *Explain the applications of iron in biological systems with particular reference to haemoglobin, myoglobin, ferritin and transferrin*

Unit I

Atomic Structure: *Review of: Bohr's theory and its limitations, Heisenberg Uncertainty principle.*

Dual behaviour of matter and radiation, de-Broglie's relation.Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenicwavefunctions (atomic orbitals) and theirvariations for

1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number(*ms*).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations. (14 Lectures)

Unit II
Chemical Bonding and Molecular Structure

Ionic Bonding*:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ioniccharacter.

Covalent bonding*:* VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR (H_2O, NH_3, PCl_5, SF_6, ClF_3, SF_4) and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonalbipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.

(14 Lectures)

Unit III
Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeise'ssalt andferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies). (10 Lectures)

Unit IV

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{+2} ions: Na/K pump; Role of Mg^{+2} ions in energy production and chlorophyll. Role of iron in oxygen transport, haemoglobin, myoglobin, storage and transport of iron. (10 Lectures)

Reference Books:

1. J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.17
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
4. James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OCHE-101A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCHE101A.1	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-
OCHE101A.2	3	1	3	3	3	3	1	3	1	2	2	-	2	2	1	2	2	-
OCHE101A.3	3	-	2	3	3	3	-	3	-	-	1	-	-	-	-	2	1	-
OCHE101A.4	3	-	2	3	3	3	-	3	-	-	1	-	-	-	-	2	1	-
OCHE101A.5	3	1	3	3	3	3	1	3	1	2	2	-	2	2	1	2	2	-
OCHE101A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER I
CODE: OCHE-102A
SUBJECT NAME: INORGANIC CHEMISTRY LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCHE102A.1 *Learn the basics of preparation of inorganic complexes.*

OCHE102A.2 *Understand the method of volumetric analysis.*

OCHE102A.3 *Use of redox, iodometric and complexometric titrations.*

OCHE102A.4 *Analyze the inorganic compounds using colorimetry..*

OCHE102A.5 *Verify Beer - Lambert law for KMnO4 /K2Cr2O7 and determine the concentration of the given KMnO4 /K2Cr2O7 solution.*

OCHE102A.6 *Understand principles involved in chromatographic separations*.

OCHE102A.7 *Investigate following metal ions using paper chromatographic separation: i. Ni (II) and Co (II) ii. Cu(II) and Cd(II).*

OCHE102A.8 *Explore the role of ligands in inorganic chemistry*.

The students have to perform at least 6 experiments from the following

1. Preparations: (Any three)
   Preparation of Cuprous chloride, tetra ammine cupric sulphate, chrome alum, potassium trioxalatochromate(III), Nickel Dimethylglyoxime

2. Volumetric Analysis
   - Preparation of reference solutions.
   - Redox titrations: Determination of Fe2+ , C2O4 2- (using KMnO4 , K2Cr2O7)
   - Iodometric titrations: Determination of Cu2+ (using standard hypo solution).
   - Complexometric titrations: Determination of Mg2+ , Zn2+ by EDTA.

3. Colorimetry
   To verify Beer - Lambert law for KMnO4 /K2Cr 2O7 and determine the concentration of the given KMnO4 /K2Cr 2O7 solution.

4. Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions: i. Ni (II) and Co (II) ii. Cu(II) and Cd(II)

Reference Books:

1. J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.17
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
4. James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OCHE-102A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OCHE102A.1	3	1	1	3	2	3	1	3	-	-	1	1	1	1	1	2	1	1
OCHE102A.2	3	2	2	3	3	3	1	3	-	-	2	1	1	1	1	2	1	1
OCHE102A.3	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE102A.4	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE102A.5	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE102A.6	3	2	2	3	3	3	1	3	-	-	2	1	1	1	1	2	1	1
OCHE102A.7	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE102A.8	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Syllabus of B.Sc. (H) Physics

Semester II

Discipline Core Course (DCC)

B.Sc. (H) PHYSICS SEMESTER II
CODE: BPH-201A
SUBJECT NAME: ELECTRICITY AND MAGNETISM
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH201A.1 *Understand the concepts of electrical circuits and network theorems.*

BPH201A.2 *Solve the problems in direct current circuits using the basics of network theorems.*

BPH201A.3 *Learn the concepts of electrostatics and magnetostatics.*

BPH201A.4 *Analyze the problems of electrostatics and magnetostatics in matter.*

BPH201A.5 *Expertise the behaviour of dielectrics and magnetic materials in the presence of external electric fields and magnetic fields respectively.*

BPH201A.6 *Understand the concept of electromagnetic induction.*

Unit-I

Electrical Circuits and Network Theorems: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit. Ideal constant-voltage and constant-current sources. Review of Kirchhoff's Current Law & Kirchhoff's Voltage Law. Mesh & Node Analysis. Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem. Applications to dc circuits. (12 Lectures)

Unit-II

Electrostatics:

Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field of a dipole. Force and Torque on a dipole.

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. (12 Lectures)

Unit-III

Magnetostatics:

Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. Energy stored in a Magnetic Field.

Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Diamagnetism, Paramagnetism and Ferromagnetism. B-H curve and hysteresis. Curie Temperature. (12 Lectures)

Unit-IV

Dielectric Properties: Electric Field in matter. Polarization, Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics.

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in an Electromagnetic wave. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. (12 Lectures)

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S.Mahajan and Choudhury, 1512, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M.Sands, 1508, Pearson Education
5. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol.I, 1991, Oxford Univ. Press.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-201A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
BPH201A.1	3	3	3	3	3	3	2	3	2	2	2	-	3	-	2	2	2	2
BPH201A.2	3	3	3	3	3	2	2	3	2	3	3	-	2	-	2	2	2	3
BPH201A.3	3	3	3	3	3	3	2	3	2	3	2	-	3	-	2	2	3	2
BPH201A.4	3	3	3	3	3	2	3	3	2	2	2	-	2	-	2	2	3	2
BPH201A.5	3	3	3	3	3	3	2	3	2	2	2	-	2	-	2	3	2	2
BPH201A.6	3	3	3	3	3	2	2	3	2	2	2	-	2	-	2	2	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: BPH-202A
SUBJECT NAME: WAVES & OPTICS
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH202A.1 *Understand the Longitudinal and Transverse Waves.*

BPH202A.2 *Learn the superposition of Two Harmonic Waves.*

BPH202A.3 *Analyze interference phenomena in various systems.*

BPH202A.4 *Find out the wavelength of light.*

BPH202A.5 *Know the phenomenon of Diffraction of light in various systems.*

BPH202A.6 *Understand the phenomena of polarization along with its applications.*

Unit-I

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Superposition of Two Harmonic Waves**,** Phase and Group Velocities. (10 Lectures)

Unit-II

Interference: Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. Division of amplitude and wavefront. Young's double slit experiment. Interference in Thin Films: parallel and wedge-shaped films. 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) Refractive Index, and (4) Visibility of Fringes. (14 Lectures)

Unit-III

Diffraction: Fraunhofer diffraction: Single slit. Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power and Dispersive power of grating. Difference between dispersive power and resolving power of diffraction 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. (12 Lectures)

Unit-IV

Polarization: Unpolarized and Polarized Light. Types of Polarization. Production of Plane Polarized Light. Polarizer and Analyzer. Malus' Law. Double Refraction in Calcite Crystal. Nicol Prism. Elliptically and Circularly Polarized Light. Analysis of Polarized Light. Applications of Polarized Light. (12 Lectures)

Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 1507, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 1508, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 1513, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 1511, R. Chand Publications

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-202A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH202A.1	3	-	2	3	2	2	1	3	2	2	2	-	2	-	2	3	3	2
BPH202A.2	3	-	2	2	2	2	-	3	2	2	2	-	2	-	2	3	3	3
BPH202A.3	3	1	3	3	3	3	2	3	3	3	3	-	3	-	3	3	3	3
BPH202A.4	3	-	2	2	2	3	-	3	2	2	3	-	2	-	3	3	3	2
BPH202A.5	3	-	2	2	2	3	-	3	3	2	3	-	2	-	3	3	3	3
BPH202A.6	3	-	2	3	2	3	2	3	3	2	3	-	2	-	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: BPH-203A
SUBJECT NAME: ELECTRICITY AND MAGNETISM LAB
NO. OF CREDITS: 2

L	T	P		
			SESSIONAL	: 15
			FINAL EXAM	: 35
0	0	4	TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH203A.1 *Learn the basics and verify experimentally the network theorems.*

BPH203A.2 *Determine unknown resistance value using various methods.*

BPH203A.3 *Measure the magnetic field and its variation for a solenoid.*

BPH203A.4 *Study and analyze response curves of series and parallel LCR circuits.*

BPH203A.5 *Examine high resistance, charge and current sensitivity values of Ballistic Galvanometer.*

BPH203A.6 *Analyze the characteristics of RC circuits.*

BPH203A.7 *Determine self inductance and mutual inductance values.*

BPH203A.8 *Compare capacitances using De'Sauty's bridge.*

At least 6 experiments from the following

1. To study the characteristics of a series RC Circuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Foster's Bridge.
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton theorems.
7. To verify the Superposition, and Maximum power transfer theorems.
8. To determine self inductance of a coil by Anderson's bridge.
9. 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.

10. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
11. Measurement of charge sensitivity, current sensitivity and CDR of Ballistic Galvanometer
12. Determine a high resistance by leakage method using Ballistic Galvanometer.
13. To determine self-inductance of a coil by Rayleigh's method.
14. To determine the mutual inductance of two coils by Absolute method.

Reference 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., 1511,Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S.Panigrahi and B.Mallick, 1515, Cengage Learning.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-203A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH203A.1	3	3	3	3	3	3	2	3	2	2	2	-	3	-	2	2	2	2
BPH203A.2	3	3	3	3	3	3	2	3	2	3	3	-	2	-	2	2	3	3
BPH203A.3	3	3	3	3	3	3	2	3	2	3	2	-	3	-	2	2	2	2
BPH203A.4	3	3	3	3	3	3	3	3	2	2	2	-	2	-	2	3	3	3
BPH203A.5	3	3	3	3	3	3	3	3	2	2	2	-	2	-	3	2	2	2
BPH203A.6	3	3	3	3	3	3	2	3	2	2	2	-	2	-	2	2	3	2
BPH203A.7	3	3	3	3	3	3	2	3	2	2	2	-	2	-	2	2	3	2
BPH203A.8	3	3	3	3	3	3	2	3	2	2	2	-	2	-	2	2	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: BPH-204A
SUBJECT NAME: WAVES & OPTICS LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH204A.1 *Understand the basic concepts of optics.*

BPH204A.2 *Determine the optical parameters and properties like refractive index, resolving power and dispersive power etc.*

BPH204A.3 *Examine the principles of prediction of wavelength of unknown radiation by determining the wavelength of sodium light.*

BPH204A.4 *Investigate the motion of coupled oscillators.*

BPH204A.5 *Determine the thickness of a thin paper using optical methods.*

BPH204A.6 *Analyze the phenomenon of Diffraction of light in various systems.*

BPH204A.7 *Verify λ^2 –T law for an electric tuning fork by Melde's experiment.*

BPH204A.8 *Determine angle of prism using Schuster`s focusing.*

At least 6 experiments from the following

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –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 the 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's 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.

Reference 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., 1511, 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.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-204A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH204A.1	3	2	3	3	3	3	2	3	2	2	2	2	2	1	2	3	3	2
BPH204A.2	3	2	3	3	3	3	3	3	2	2	2	2	3	2	2	3	3	3
BPH204A.3	3	2	3	3	3	3	3	3	2	2	2	2	3	2	2	3	3	3
BPH204A.4	3	2	3	3	3	3	3	3	2	2	2	2	3	2	2	3	3	3
BPH204A.5	3	2	3	3	3	3	3	3	2	2	2	2	3	2	2	3	3	3
BPH204A.6	3	2	3	3	3	3	3	3	2	2	2	2	3	2	2	3	3	3
BPH204A.7	3	2	3	3	3	3	3	3	2	2	2	2	3	2	2	3	3	3
BPH204A.8	3	2	3	3	3	3	3	3	2	2	2	2	3	2	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Ability Enhancement Compulsory Course (AECC)

B.Sc. (H) PHYSICS SEMESTER II
CODE: BEVS-201A
SUBJECT NAME: ENVIRONMENTAL SCIENCE
NO. OF CREDITS: 2

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
2	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BEVS201A.1 *Learn the basics of ecosystem, biodiversity, renewable and non-renewable resources.*

BEVS201A.2 *Analyze the environmental pollution, policies and practices.*

BEVS201A.3 *Correlate the environment with human communities.*

BEVS201A.4 *Examine the surrounding environment via field work.*

BEVS201A.5 *Apply the knowledge to safeguard the environment.*

BEVS201A.6 *Understand the important facts about the environment and aware the surrounding community of the same.*

Unit 1: Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

Unit 2: Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3: Natural Resources: Renewable and Non-renewable Resources

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4: Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5: Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

Unit 6: Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.

- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 8: Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.

Reference Books

1. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
2. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
3. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
4. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
5. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
6. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BEVS-201A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BEVS201A.1	3	1	3	2	2	3	1	2	2	-	2	2	1	2	3	2	2	-
BE VS201A.2	3	2	3	2	3	3	2	3	3	-	3	2	1	3	3	2	2	-
BE VS201A.3	3	2	3	2	3	3	3	3	3	-	3	3	2	3	3	2	2	2
BE VS201A.4	3	2	3	2	3	3	2	3	3	-	3	3	2	3	3	2	2	2
BE VS201A.5	3	2	2	3	3	3	3	3	3	-	3	3	2	3	3	2	2	2
BE VS201A.6	3	2	3	2	3	3	3	3	3	-	3	3	2	3	3	2	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Open Elective Courses (OEC)

B.Sc. (H) PHYSICS SEMESTER II
CODE: OMTH-201A
SUBJECT NAME: LINEAR ALGEBRA
NO. OF CREDITS: 6

L	T	P		
5	1	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OMTH201A.1 *Learn the Gauss–Jordan row reduction, Reduced row echelon form.*

OMTH201A.2 *Locate and use information to solve problems of linear transformations and vector spaces.*

OMTH201A.3 *Describe the concept of linear independence, linear transformation and determinants.*

OMTH201A.4 *Find eigen-values and eigen-vectors and diagonalization of matrices.*

OMTH201A.5 *Understand orthogonal and orthonormal bases.*

OMTH201A.6 *Solve homogenous and non-homogenous system of equations using matrices.*

UNIT-I

Fundamental operation with vectors in Euclidean space $\mathbf{R}^n$, Linear combination of vectors, Dot product and their properties, Cauchy-Schwarz inequality, Triangle inequality, Projection of vectors, Some elementary results on vector in $\mathbf{R}^n$, Matrices, Echelon matrices, Row canonical form , Row equivalence, Rank, Linear combination of vectors, Row space, Eigenvalues, Eigenvectors, Eigenspace, Characteristic polynomials. (15 Lectures)

UNIT-II

Diagonalization of matrices. Definition and examples of vector space, Some elementary properties of vector spaces, Subspace, Span of a set, A spanning set for an eigenspace, Linear independence and linear dependence of vectors, Maximal linearly independent sets, Minimal spanning sets, Basis and dimension of a vector space. (15 Lectures)

UNIT-III

Application of rank, Homogenous and non-homogenous systems of equations, Coordinates of a vector in ordered basis, Transition matrix.

Linear transformations: Definition and examples, Elementary properties, The matrix of a linear transformation, Linear operator and Similarity, Kernel and range of a linear transformation.

(15 Lectures)

UNIT-IV

Dimension theorem, Oneto one and onto linear transformations, Invertible linear transformations. Isomorphism: Isomorphic vector spaces (to $\mathbf{R^n}$), Orthogonal and orthonormal vectors, Orthogonal and orthonormal bases, Orthogonal complement, Projection theorem (Statement only), Orthogonal projection onto a subspace. (15 Lectures)

Reference Books:

1. Schaum's Outlines, Linear Algebra, Mc Graw Hill Education.
2. S. Andrilli and D. Hecker, Elementary Linear Algebra, Academic Press, 4/e (2012)
3. B. Kolman and D.R. Hill, Introductory Linear Algebra with Applications, Pearson Education, 7/e (2003)

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OMTH-201A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OMTH201A.1	3	-	2	2	2	3	-	1	-	-	-	-	-	-	-	2	2	-
OMTH201A.2	3	2	3	3	3	3	2	3	-	2	2	-	2	2	1	2	3	-
OMTH201A.3	3	-	3	2	2	3	-	2	-	-	1	-	-	-	-	2	2	-
OMTH201A.4	3	-	3	2	2	3	-	2	-	-	1	-	-	-	-	2	3	-
OMTH201A.5	3	-	2	2	2	3	-	2	-	-	1	-	-	-	-	2	3	-
OMTH201A.6	3	-	3	3	3	3	-	3	-	2	2	-	2	-	1	2	3	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: OCSC-201A
SUBJECT NAME: INTRODUCTION TO DATABASE SYSTEM
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCSC201A.1 *Understand the basic concepts, applications and architecture of database systems.*

OCSC201A.2 *Master the basics of ER diagram.*

OCSC201A.3 *Understand relational database algebra expressions.*

OCSC201A.4 *Construct queries using Structured Query Language (SQL).*

OCSC201A.5 *Understand sound design principles for logical design of databases, normalization.*

OCSC201A.6 *Create relationships between and modify database tables using SQL.*

UNIT-I

Database: Introduction to database, relational data model, DBMS architecture, data independence, DBA, database users, end users, front end tools. (12 Lectures)

UNIT-II

E-R Modeling: Entity types, entity set, attribute and key, relationships, relation types, E- R diagrams, database design using ER diagrams (12 Lectures)

UNIT-III

Relational Data Model: Relational model concepts, relational constraints, primary and foreign key, normalization: 1NF, 2NF, 3NF. (12 Lectures)

UNIT-IV

Structured Query Language: SQL queries, create a database table, create relationships between database tables, modify and manage tables, queries, forms, reports, modify, filter and view data. (12 Lectures)

Reference Books:

1. Fundamentals of Database Systems by R. Elmasri and S.B. Navathe, 3rd edition, 2000, Addision-Wesley, Low Priced Edition.
2. An Introduction to Database Systems by C.J. Date, 7th edition, Addison-Wesley, Low Priced Edition, 2000.
3. Database Management and Design by G.W. Hansen and J.V. Hansen, 2nd edition, 1999, Prentice-Hall of India, Eastern Economy Edition.
4. Database Management Systems by A.K. Majumdar and P. Bhattacharyya, 5th edition, 1999, Tata McGraw-Hill Publishing.
5. A Guide to the SQL Standard, Date, C. and Darwen,H. 3rd edition, Reading, MA: 1994, Addison-Wesley.
6. Data Management & file Structure by Loomis, 1989, PHI11. P. Rob, C. Coronel, Database System Concepts by, Cengage Learning India, 2008.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OCSE-201A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCSE201A.1	3	1	3	2	2	3	1	2	-	3	1	-	-	1	2	2	1	-
OCSE201A.2	3	2	3	3	3	3	2	3	-	3	2	2	2	2	2	2	2	-
OCSE201A.3	3	1	3	2	2	3	1	2	-	3	1	-	-	1	2	2	1	-
OCSE201A.4	3	2	3	3	3	3	2	3	-	3	2	2	2	2	2	2	2	-
OCSE201A.5	3	2	3	3	3	3	2	3	-	3	2	2	2	2	2	2	2	-
OCSE201A.6	3	2	3	3	3	3	2	3	-	3	2	2	2	2	2	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: OCSC-202A
SUBJECT NAME: INTRODUCTION TO DATABASE SYSTEM LAB
NO. OF CREDITS: 2

L	T	P
0	0	4

SESSIONAL : 15
FINAL EXAM : 35
TOTAL : 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCSC202A.1 *Learn the basics of database systems.*

OCSC202A.2 *Understand the creation of database with three tables.*

OCSC202A.3 *Examine the details stored in the database.*

OCSC202A.4 *Extract the required information from the database.*

OCSC202A.5 *Understand sound design principles for logical design of databases, normalization.*

OCSC202A.6 *Organize the information using database systems.*

OCSC202A.7 *Create relationships between and modify database tables.*

OCSC202A.8 *Explore the effective management of large set of information using database systems.*

1) Create a database having two tables with the specified fields, to computerize a library system of a Delhi University College.

LibraryBooks (Accession number, Title, Author, Department, PurchaseDate, Price)
IssuedBooks (Accession number, Borrower)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.

b) Delete the record of book titled “Database System Concepts”.

c) Change the Department of the book titled “Discrete Maths” to “CS”.

d) List all books that belong to “CS” department.

e) List all books that belong to “CS” department and are written by author “Navathe”.

f) List all computer (Department=”CS”) that have been issued.

g) List all books which have a price less than 500 or purchased between "01/01/1999" and "01/01/2004".

2) Create a database having three tables to store the details of students of Computer Department in your college.

Personal information about Student (College roll number, Name of student, Date of birth, Address, Marks(rounded off to whole number) in percentage at 10 + 2, Phone number)

Paper Details (Paper code, Name of the Paper)

Student's Academic and Attendance details (College roll number, Paper code, Attendance, Marks in home examination).

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.

b) Design a query that will return the records (from the second table) along with the name of student from the first table, related to students who have more than 75% attendance and more than 60% marks in paper 2.

c) List all students who live in "Delhi" and have marks greater than 60 in paper1. d) Find the total attendance and total marks obtained by each student.

e) List the name of student who has got the highest marks in paper2

3) Create the following tables and answer the queries given below:

Customer (CustID, email, Name, Phone, ReferrerID)

Bicycle (BicycleID, DatePurchased, Color, CustID, ModelNo)
BicycleModel (ModelNo, Manufacturer, Style)

Service (StartDate, BicycleID, EndDate)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.

b) List all the customers who have the bicycles manufactured by manufacturer "Honda". c) List the bicycles purchased by the customers who have been referred by customer "C1".

d)List the manufacturer of red colored bicycles.

e)List the models of the bicycles given for service.

4) Create the following tables, enter at least 5 records in each table and answer the queries given below.

EMPLOYEE (Person_Name, Street, City)

WORKS (Person_Name, Company_Name, Salary)
COMPANY (Company_Name, City)

MANAGES (Person_Name, Manager_Name)

a)Identify primary and foreign keys.

b)Alter table employee, add a column "email" of type varchar(20).

c)Find the name of all managers who work for both Samba Bank and NCB Bank.

d) Find the names, street address and cities of residence and salary of all employees who work for "Samba Bank" and earn more than $10,000.

e) Find the names of all employees who live in the same city as the company for which they work.

f) Find the highest salary, lowest salary and average salary paid by each company.

g) Find the sum of salary and number of employees in each company.h)
Find the name of the company that pays highest salary.

5) Create the following tables, enter at least 5 records in each table and answer the queries given below.

Suppliers (SNo, Sname, Status, SCity) Parts (PNo, Pname, Colour, Weight, City) Project (JNo, Jname, Jcity)

Shipment (Sno, Pno, Jno, Qunatity)

a) Identify primary and foreign keys.

b) Get supplier numbers for suppliers in Paris with status>20.

c) Get suppliers details for suppliers who supply part P2. Display the supplier list in increasing order of supplier numbers.

d) Get suppliers names for suppliers who do not supply part P2.

e) For each shipment get full shipment details, including total shipment weights. f)
Get all the shipments where the quantity is in the range 300 to 750 inclusive.

g) Get part nos. for parts that either weigh more than 16 pounds or are supplied by suppliers S2, or both.

h) Get the names of cities that store more than five red parts.

i) Get full details of parts supplied by a supplier in London.

j) Get part numbers for part supplied by a supplier in London to a project in London. k)
Get the total number of project supplied by a supplier (say, S1).

l) Get the total quantity of a part (say, P1) supplied by a supplier (say, S1)

Reference Books:

1. Fundamentals of Database Systems by R. Elmasri and S.B. Navathe, 3rd edition, 2000, Addision-Wesley, Low Priced Edition.
2. An Introduction to Database Systems by C.J. Date, 7th edition, Addison-Wesley, Low Priced Edition, 2000.
3. Database Management and Design by G.W. Hansen and J.V. Hansen, 2nd edition, 1999, Prentice-Hall of India, Eastern Economy Edition.
4. Database Management Systems by A.K. Majumdar and P. Bhattacharyya, 5th edition, 1999, Tata McGraw-Hill Publishing.
5. A Guide to the SQL Standard, Date, C. and Darwen,H. 3rd edition, Reading, MA: 1994, Addison-Wesley.
6. Data Management & file Structure by Loomis, 1989, PHI11. P. Rob, C. Coronel, Database System Concepts by, Cengage Learning India, 2008.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OCSE-202A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCSE202A.1	3	1	3	2	2	3	2	2	-	3	1	1	-	1	2	2	1	-
OCSE202A.2	3	1	3	2	2	3	2	2	-	3	1	1	-	1	2	2	2	-
OCSE202A.3	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE202A.4	3	2	3	3	3	3	2	2	-	3	2	2	-	2	2	2	2	-
OCSE202A.5	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE202A.6	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE202A.7	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE202A.8	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: OELC-201A
SUBJECT NAME: INSTRUMENTATION
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OELC201A.1 *Acquire knowledge about direct current (DC) and alternating current (AC) voltage and current measuring instruments.*

OELC201A.2 *Learn the construction, working and the applications of CRO and function generators.*

OELC201A.3 *Understand the working of transducer devices.*

OELC201A.4 *Examine the functioning of data acquisition systems and bio-medical instruments.*

OELC201A.5 *Investigate the computer controlled test and measurement system.*

OELC201A.6 *Explore the principles, working and applications of instrumentation in various fields and industry.*

Unit-I

DC and AC indicating Instruments: Accuracy and precision, Types of errors, PMMC galvanometer, sensitivity, Loading effect, Conversion of Galvanometer into ammeter, Voltmeter and Shunt type ohmmeter, Multimeter. (10 Lectures)

Unit-II

Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronisation, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).

Signal Generators: Audio oscillator, Pulse Generator, Function generators. (14 Lectures)

Unit-III

Transducers: Basic requirements of transducers, Transducers for measurement of non-electrical quantities: Types and their principle of working , measurement of Linear displacement, Acceleration, Flow rate, Liquid level, strain, Force, Pressure, Temperature. (10 Lectures)

UNIT-IV

Data acquisition systems: Block diagram, brief description of preamplifier, signal conditioner, instrumentation amplifier, waveform generator, A/D and D/A converter blocks, computer controlled test and measurement system.

Bio-medical instrumentation: Bio-Amplifiers: Bio potentials - Bio-electricity - Necessity for special types of amplifiers for biological signal amplifications - Different types of Bio- OP-Amps. Electrodes for ECG, EEG, and EMG, block diagram of ECG and EEG systems, brief analysis of graphs. (14 Lectures)

Reference Books:

1. Electrical Measurement in Measuring Instruments. Goldwing E.W. and Widdies.
2. Electrical and Electronics Measurement and Instrumentation Sahwany A.K.
3. Instrumentation devices and systems: Rangan, Sarma, Mani, TMH.
4. Instrumentation measurement and analysis: Nakra B C, Chaudry K K, TMH.
5. Handbook of biomedical instrumentation: Khandpur R S, TMH.
6. Measurement systems applications and design: Doeblin E O, McGraw Hill, 1990.
7. Electron measurements and instrumentation techniques: Cooper W D and Helfric A D, PHI, 1989.
8. Biomedical instrumentation and measurements: Leslie-Cromwell, Fred J Weibell, Erich A Pfieffer, PHI, 1994.
9. Mechatronics – principles and applications, Godfrey C Onwubolu, Elsevier, 2006.

SUGGESTED WEB SOURCES:

4. NPTEL :: Courses
5. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
6. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OELC-201A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OELC201A.1	3	1	3	3	3	3	1	2	1	2	2	-	2	1	1	3	3	2
OELC201A.2	3	-	2	2	2	3	-	2	-	-	-	-	-	-	-	3	3	2
OELC201A.3	3	-	3	3	3	3	-	3	-	-	1	-	-	-	-	3	3	2
OELC201A.4	3	2	3	3	3	3	1	3	1	2	2	-	2	2	1	3	3	2
OELC201A.5	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	3	3	2
OELC201A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: OELC-202A
SUBJECT NAME: INSTRUMENTATION LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OELC202A.1 *Learn the basics of instrumentation.*

OELC202A.2 *Determine the Characteristics of resistance transducer - Strain Gauge.*

OELC202A.3 *Examine the characteristics of linear variable differential transformer (LVDT), thermistors and resistance temperature detectors (RTD).*

OELC202A.4 *Design the multi range ammeter and voltmeter using galvanometer.*

OELC202A.5 *Analyze thermocouple and transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type for temperature measurement.*

OELC202A.6 *Characterize bio-amplifier for ECG signals and analyze them.*

OELC202A.7 *Measure heart sound using electronic stethoscope.*

OELC202A.8 *Monitor pulse rate with alarm system and respiration rate using thermister /other electrodes.*

At least 6 experiments from the following:

1. Design of multi range ammeter and voltmeter using galvanometer.
2. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
3. To determine the Characteristics of LVDT.
4. To determine the Characteristics of Thermistors and RTD.
5. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
6. Characterization of bio potential amplifier for ECG signals.
7. Study on ECG simulator.
8. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator.

9. Study of pulse rate monitor with alarm system.
10. Measurement of respiration rate using thermister /other electrodes.

Reference Books:

1. Electrical Measurement in Measuring Instruments. Goldwing E.W. and Widdies.
2. Electrical and Electronics Measurement and Instrumentation Sahwany A.K.
3. Instrumentation devices and systems: Rangan, Sarma, Mani, TMH.
4. Instrumentation measurement and analysis: Nakra B C, Chaudry K K, TMH.
5. Handbook of biomedical instrumentation: Khandpur R S, TMH.
6. Measurement systems applications and design: Doeblin E O, McGraw Hill, 1990.
7. Electron measurements and instrumentation techniques: Cooper W D and Helfric A D, PHI, 1989.
8. Biomedical instrumentation and measurements: Leslie-Cromwell, Fred J Weibell, Erich A Pfieffer, PHI, 1994.

SUGGESTED WEB SOURCES:

2. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OELC-202A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OELC202A.1	3	1	2	2	3	3	3	1	1	2	2	-	2	2	2	3	3	2
OELC202A.2	3	2	3	3	3	3	3	3	1	3	3	-	3	3	2	3	3	3
OELC202A.3	3	2	3	3	3	3	3	3	1	3	3	-	3	3	2	3	3	3
OELC202A.4	3	2	3	3	3	3	3	3	1	3	3	-	3	3	2	3	3	3
OELC202A.5	3	2	3	3	3	3	3	3	1	3	3	-	3	3	2	3	3	3
OELC202A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
OELC202A.7	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
OELC202A.8	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: OCHE-201A
SUBJECT NAME: PHYSICAL CHEMISTRY
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCHE201A.1 *Understand the basic concept of chemical thermodynamics.*

OCHE201A.2 *Determine the conditions of chemical equilibria and portrait the relationships between equilibrium constants.*

OCHE201A.3 *Analyze phase rule and phase equilibrium for one and two component systems.*

OCHE201A.4 *Learn the basics of electrochemistry and apply the concepts for improving the performance of cells.*

OCHE201A.5 *Understand the behaviour of ideal and non-ideal solutions and the governing laws.*

OCHE201A.6 *Solve the fundamental problems in physical chemistry.*

Unit I

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. (10 Lectures)

Unit II

Chemical Equilibrim:

Free energy change in a chemical reaction.Thermodynamic derivation of the law of chemical equilibrium. Distinction between *G* and *G*o, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases.

Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions.Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. (14 Lectures)

Unit III

Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature- composition curves of ideal and non-ideal solutions. Distillation of solutions.Lever rule.Azeotropes.Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation.Nernst distribution law and its applications, solvent extraction.

Phase Equilibrium

Phases, components and degrees of freedom of a system, criteria of phase equilibrium.Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl3-H2O and Na-Konly). (14 Lectures)

Unit IV

Electrochemistry

Reversible and irreversible cells.Concept of EMF of a cell.Measurement of EMF of a cell.Nernst equation and its importance.Types of electrodes.Standard electrode potential.Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: *G, H* and *S* from EMFdata.Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.pH determination using hydrogen electrode and quinhydrone electrode.Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only). (10 Lectures)

Reference Books

1. G. M. Barrow: *Physical Chemistry* Tata McGraw Hill (2007).
2. G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
3. J. C. Kotz, P. M. Treichel& J. R. Townsend: *General Chemistry* CengageLening India Pvt. Ltd., New Delhi (2009).
4. B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
5. R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OCHE-201A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OCHE201A.1	3	2	2	3	3	3	1	3	-	-	1	-	-	-	-	2	1	-
OCHE201A.2	3	1	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-
OCHE201A.3	3	1	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-
OCHE201A.4	3	-	2	3	3	3	-	3	-	-	1	-	-	-	-	2	2	-
OCHE201A.5	3	1	3	3	3	3	1	3	1	2	2	-	2	2	1	2	2	-
OCHE201A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER II
CODE: OCHE-202A
SUBJECT NAME: PHYSICAL CHEMISTRY LAB
NO. OF CREDITS: 2

L	T	P
0	0	4

SESSIONAL	: 15
FINAL EXAM	: 35
TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCHE202A.1 *Understand the basic concept of enthalpy.*

OCHE202A.2 *Determine the enthalpy change of electrolytes.*

OCHE202A.3 *Analyze the redox potential and EMF using Potentiometry.*

OCHE202A.4 *Determine the surface tension and viscosity.*

OCHE202A.5 *Learn a synthesis route of a polymer.*

OCHE202A.6 *Determine cell constant and conductance of solution*.

OCHE202A.7 *Expertise in the determination of enthalpy of ionization, hydration and neutralization*.

OCHE202A.8 *Evaluate the integral enthalpy of salt solution*.

The students have to perform at least 6 experiments from the following

1. Determination of enthalpy of ionization of ethanoic acid.
2. Determination of enthalpy of hydration of salt.
3. Study of solubility of benzoic acid in water and determine enthalpy change.
4. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
5. Determination of surface tension and viscosity.
6. Potentiometry- Determination of redox potential.
7. Determination of EMF using Potentiometry.
8. Determination of cell constant and conductance of solution.
9. Determination of integral enthalpy (endothermic or exothermic) solution of salt.
10. Synthesis of polymer.

Reference Books:

1. G. M. Barrow: *Physical Chemistry* Tata McGraw Hill (2007).
2. G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
3. J. C. Kotz, P. M. Treichel& J. R. Townsend: *General Chemistry* CengageLening India Pvt. Ltd., New Delhi (2009).
4. B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
5. R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OCHE-202A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OCHE202A.1	3	1	1	3	2	3	1	3	-	-	1	1	1	1	1	2	1	1
OCHE202A.2	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE202A.3	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE202A.4	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE202A.5	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE202A.6	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE202A.7	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE202A.8	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Syllabus of B.Sc. (H) Physics

Semester III

Discipline Core Course (DCC)

B.Sc. (H) PHYSICS SEMESTER III
CODE: BPH-301A
SUBJECT NAME: MATHEMATICAL PHYSICS-II
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH301A.1 *Learn the Fourier analysis of periodic functions and their applications in simple physical problems.*

BPH301A.2 *Understand the differentiation and integration of Fourier series.*

BPH301A.3 *Solve linear second order differential equations using the power series method.*

BPH301A.4 *Learn about the special functions, such as the Hermite polynomial, the Legendre polynomial, the Laguerre polynomial and Bessel functions.*

BPH301A.5 *Analyze the differential equations of special functions and their applications in various physical problems.*

BPH301A.6 *Learn the beta and gamma functions and apply the basics for computation of integrations.*

Unit-I

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Even and odd functions and their Fourier expansions. Applications. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity. (12 Lectures)

Unit-II

Series Solutions for Second Order Differential Equations: Power series representation of functions. Ordinary and Singular Points of Second Order Linear Differential Equations and their

importance. Series solution about an ordinary point. . Series solution about a regular singular point. Frobenius method and its applications to differential equations. (12 Lectures)

Unit-III

Special Functions-I: Bessel Functions: Bessel functions of the first kind Jn(x), Generating function, Recurrence relations, Expansion of Jn(x) when n is half an odd integer, Integral representation, Zeros of Bessel Functions ($J_o(x)$ and $J_1(x)$) and orthogonality; Legendre Polynomials Pn(x): Generating function, Recurrence relations and special properties, Rodrigues' formula, Orthogonality of Pn(x); Expansion of function in a series of Legendre Polynomials; Associated Legendre polynomials and their orthogonality. (12 Lectures)

Unit-IV

Special Function-II: Hermite Polynomials: generating function, recurrence relations and orthogonality; Laguerre Polynomials: generating function, recurrence relations and orthogonality.

Some Special Integrals: Beta Functions; Gamma Functions; Recursion relation; Gamma function of negative numbers; Relation between Beta and Gamma functions. Expression of Integrals in terms of Gamma Functions. (12 Lectures)

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
2. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
3. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
4. Mathematical Methods in the Physical Sciences, M.L. Boas, 2007, Wiley-India.
5. Mathematical methods for Scientists & Engineers, D.A.McQuarrie, 2003, Viva Books

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-301A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH301A.1	3	-	2	2	2	3	-	1	1	-	-	-	-	-	-	3	2	1
BPH301A.2	3	-	2	2	2	3	-	2	1	-	2	-	-	-	-	3	2	1
BPH301A.3	3	1	3	3	3	3	1	3	1	2	2	-	2	-	1	3	3	2
BPH301A.4	3	-	2	2	2	3	-	1	1	-	1	-	-	-	-	3	2	1
BPH301A.5	3	1	3	3	3	3	2	3	1	2	2	-	2	-	1	3	3	2
BPH301A.6	3	-	2	2	2	3	-	2	1	-	1	-	-	-	-	3	2	1

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: BPH-302A
SUBJECT NAME: THERMAL PHYSICS
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH302A.1 *Learn the fundamental laws of thermodynamics.*

BPH302A.2 *Understand the concept of internal energy, enthalpy, entropy and free energies.*

BPH302A.3 *Examine the principle and working of Carnot engines.*

BPH302A.4 *Determine thermodynamic potential and analyze maxwell's thermodynamic relations.*

BPH302A.5 *Understand and compare the behaviour of ideal and real gases.*

BPH302A.6 *Learn the basics of kinetic theory of gases and analyze the distribution of velocities in an ideal gas.*

Unit-I

Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes.

(12 Lectures)

Unit-II

Second Law of Thermodynamics: Reversible and Irreversible process with examples. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2^{nd} Law of Thermodynamics: Kelvin-Planck and Clausius Statements. Carnot's Theorem.

Entropy: Concept of Entropy, 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. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero. (12 Lectures)

Unit-III

Thermodynamic Potentials: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications, First and second order Phase Transitions with examples, Clausius Clapeyron Equation

Maxwell's Thermodynamic Relations: Derivation of Maxwell's thermodynamic Relations and their applications, Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Value of C_p-C_v, (3) TdS Equations. (12 Lectures)

Unit-IV

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. van der Waal's Equation of State for Real Gases. Values of Critical Constants. Joule-Thomson Porous Plug Experiment.

Kinetic Theory of Gases: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

(12 Lectures)

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-302A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
BPH302A.1	3	3	3	3	3	3	2	3	2	2	2	-	3	-	2	2	2	2
BPH302A.2	3	3	3	3	3	3	2	3	2	3	3	-	2	-	2	2	2	3
BPH302A.3	3	3	3	3	3	3	2	3	2	3	2	-	2	-	2	2	3	3
BPH302A.4	3	3	3	3	3	3	2	3	2	2	2	-	2	-	2	2	2	2
BPH302A.5	3	3	3	3	3	3	3	3	2	2	2	-	2	-	3	3	2	2
BPH302A.6	3	3	3	3	3	3	2	3	2	2	2	-	2	-	2	2	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: BPH-303A
SUBJECT NAME: ANALOG SYSTEMS AND APPLICATIONS
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH303A.1 *Know the fundamentals of Semiconductor physics and P-N diodes.*

BPH303A.2 *Apply the knowledge of semiconductors and P-N diodes to understand the working of rectifiers and filters.*

BPH303A.3 *Understand and analyze the characteristics of BJT in various configurations.*

BPH303A.4 *Learn the process of amplification and feedback in amplifiers.*

BPH303A.5 *Understand the theory, working and applications of various oscillator circuits.*

BPH303A.6 *Have an understanding of the physics of Op-Amp and its applications.*

UNIT-I

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 of Barrier Potential, Barrier Width and Current for abrupt Junction. Current Flow Mechanism in Forward and Reverse Biased Diode. (10 Lectures)

UNIT-II

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.

Bipolar Junction transistors: n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cut off 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. (10 Lectures)

UNIT-III

Amplifiers: Transistor Biasing and Stabilization Circuits. Need for bias stabilization, stability factor, Fixed Bias, Emitter feedback bias and Voltage Divider Bias. Transistor as 2-port Network, h-parameter Equivalent Circuit in CE configuration.h-parameters of Various transistors configurations (definition only). Classification of Class A, B & C Amplifiers (basic Idea).Two stage RC-coupled amplifier and its frequency response.

Feedback in Amplifiers: Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion, Noise and band width.

Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency.Hartley & Colpitts oscillators. (14 Lectures)

UNIT-IV

Operational Amplifiers (Black Box approach) & its applications : Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Comparator and Zero crossing detector

Integrated Circuits (Qualitative treatment only): Active and Passive components. Discrete components.Wafer.Chip.Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs. (14 Lectures)

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
7. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India.
8. Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning
9. Microelectronic Devices & Circuits, David A.Bell, 5th Edn.,2015, Oxford University Press

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-303A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
BPH303A.1	3	2	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH303A.2	3	2	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH303A.3	3	2	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH303A.4	3	2	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH303A.5	3	2	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3
BPH303A.6	3	2	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: BPH-304A
SUBJECT NAME: MATHEMATICAL PHYSICS-II LAB
NO. OF CREDITS: 2

			SESSIONAL	: 15
L	T	P	FINAL EXAM	: 35
0	0	4	TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH304A.1 *Learn the basics of numerical computation software scilab.*

BPH304A.2 *Understand the curve fitting procedures using scilab.*

BPH304A.3 *Examine the solutions of first and second order differential equations using scilab.*

BPH304A.4 *Investigate the generation and plotting of special functions like Bessel's function and Legendre polynomial.*

BPH304A.5 *Derive the solutions of linear systems of equations using scilab.*

BPH304A.6 *Solve computationally the oscillator, newton's law of cooling, wave equation, heat equation, Poisson's equation, Laplace equation and mesh equations of electrical circuits.*

BPH304A.7 *Apply the hierarchy of operations and multidimensional arrays of scilab to simple problems in physics.*

BPH304A.8 *Explore the scilab proficiency in analyzing simple physics problems.*

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Sub-array, Special values, Displaying output data, data file, Scalar and array operations, Hierararchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting, Branching Statements and program design, Relational and logical operators, the while loop, for loop, details of loop operations, break and continue statements, nested loops, logical arrays and vectorization. User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguements, preserving data between calls to a function, Complex and Character data, String function, Multidimensional arrays an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program.
Curve fitting, Least square fit, Goodness of fit, standard deviation using Scilab	Ohms law calculate R, Hookes law, Calculate spring constant, Given Bessel's function at N points find its value at an intermediate point
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalisation of matrices, Inverse of a matrix, Eigen vectors, eigen-values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Generation of Special functions using User defined functions in Scilab	Generating and plotting Legendre Polynomials Generating and plotting Bessel function

Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and Fourth order methods Second order differential equation Fixed difference method Partial differential equations	First order differential equation: ● Radioactive decay ● Current in RC, LC circuits with DC source ● Newton's law of cooling ● Classical equations of motion Second order Differential Equation: ● Harmonic oscillator (no friction) ● Damped Harmonic oscillator (Overdamped, Critical damped, Oscillatory) ● Forced Harmonic oscillator (Transient and Steady state solution) ● Apply above to LCR circuits also Partial Differential Equation: ● Wave equation ● Heat equation ● Poisson equation ● Laplace equation
Using Scicos/xcos	● Generating sine wave, square wave, sawtooth wave ● Solution of harmonic oscillator ● Study of heat phenomenon ● Phase space plots

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
3. Getting started with Matlab, Rudra Pratap, 2010, Oxford University Press.
4. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-304A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH304A.1	3	1	2	2	3	3	3	2	1	3	2	-	2	2	2	3	3	2
BPH304A.2	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH304A.3	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH304A.4	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH304A.5	3	2	3	3	3	3	3	3	1	3	2	-	2	2	2	3	3	2
BPH304A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH304A.7	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH304A.8	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: BPH-305A
SUBJECT NAME: THERMAL PHYSICS LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH305A.1 *Learn the basics of thermodynamics.*

BPH305A.2 *Develop the equivalence between work and heat.*

BPH305A.3 *Examine the coefficient of thermal conductivity of good and bad conductors of heat.*

BPH305A.4 *Calibrate a thermocouple for a specific range of temperature.*

BPH305A.5 *Explore the principle and working of Platinum Resistance Thermometer.*

BPH305A.6 *Determine Stefan's Constant*.

BPH305A.7 *Measure Planck's constant using black body radiation*

BPH305A.8 *Analyze the cooling temperature of a hot object as a function of time using a thermocouple.*

At least 6 experiments from the following

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.
7. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.
8. To determine Stefan's Constant.
9. Measurement of Planck's constant using black body radiation.

10. To record and analyze the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system.

Reference 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 Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal,1985, Vani Pub.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-305A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH305A.1	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH305A.2	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH305A.3	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH305A.4	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH305A.5	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH305A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH305A.7	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH305A.8	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: BPH-306A
SUBJECT NAME: ANALOG SYSTEMS AND APPLICATIONS LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH306A.1 *Understand the V-I characteristics of Zener diode and solar cells.*

BPH306A.2 *Analyze the characteristics of a transistor and an amplifier.*

BPH306A.3 *Design the inverting and non-inverting amplifier using Op-amp.*

BPH306A.4 *Explore the functioning of Op-amp as an Integrator and a Differentiator.*

BPH306A.5 *Understand the theory and working of oscillator circuits for a specific response.*

BPH306A.6 *Design electronic circuits for the solution of simultaneous equation and differential equation.*

BPH306A.7 *Design a digital to analog converter (DAC) of given specifications.*

BPH306A.8 *Analyze voltage regulation using Zener diode.*

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) & 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 $1^{st}/2^{nd}$order differential equation.

Reference Books:

1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, Mc-Graw Hill.
2. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4^{th} edition, 2000, Prentice Hall.
3. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
4. Electronic Devices & circuit Theory, R.L.Boylestad & L.D.Nashelsky, 2009, Pearson

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-306A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH306A.1	3	2	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH306A.2	3	2	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH306A.3	3	2	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH306A.4	3	2	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH306A.5	3	2	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3
BPH306A.6	3	2	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3
BPH306A.7	3	2	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3
BPH306A.8	3	2	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Open Elective Courses (OEC)

B.Sc. (H) PHYSICS SEMESTER III
CODE: OMTH-301A
SUBJECT NAME: DIFFERENTIAL EQUATIONS
NO. OF CREDITS: 6

L	T	P		
5	1	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OMTH301A.1 *Learn the basics of rodinary differential equations.*

OMTH301A.2 *Solve exact differential equations and linear differential equations.*

OMTH301A.3 *Explore the solution of homogenous system of differential equations.*

OMTH301A.4 *Predict general solutions of first order partial differential equations.*

OMTH301A.5 *Classify second order partial differential equations and reduce them to canonical forms.*

OMTH301A.6 *Examine existence and uniqueness of solutions of ordinary and partial differential equations.*

UNIT-I

First order ordinary differential equations: Basic concepts and ideas, Exact differential equations, Integrating factors, Bernoulli equations, Orthogonal trajectories of curves, Existence and uniqueness of solutions (12 Lectures)

UNIT-II

Second order differential equations: Homogenous linear equations of second order, Second order homogenous equations with constant coefficients, Differential operator, Euler-Cauchy equation.

(12 Lectures)

UNIT-III

Existence and uniqueness theory, Wronskian , Nonhomogenous ordinary differential equations, Solution by undetermined coefficients, Solution by variation of parameters, Higher order homogenous equations with constant coefficients, solution of homogeneous system of differential equations. (10 Lectures)

UNIT IV

Partial differential equations: Basic Concepts and definitions, Mathematical problems, First order equations: Classification, Construction, Geometrical interpretation, Method of characteristics, General solutions of first order partial differential equations, Canonical forms and method of separation of variables for first order partial differential equations, Classification of second order partial differential equations, Reduction to canonical forms, Second order partial differential equations with constant coefficients, General solutions. (14 Lectures)

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 9/e, (2006).
2. Tyn Myint–U and Lokenath Debnath; Linear Partial Differential Equations for Scientists and Engineers, Springer, Indian Reprint (2009)
3. C.H. Edwards and D.E. Penny, Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India, 2005.
4. S.L. Ross, *Differential Equations,* 3rd Ed., John Wiley and Sons, India, 2004.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OMTH-301A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OMTH301A.1	3	1	2	2	2	3	1	1	-	-	1	-	-	1	-	2	1	-
OMTH301A.2	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH301A.3	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH301A.4	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH301A.5	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH301A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: OELC-301A
SUBJECT NAME: COMMUNICATION SYSTEMS
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OELC301A.1 *Learn amplitude modulation and demodulation techniques.*

OELC301A.2 *Understand frequency modulation and demodulation techniques.*

OELC301A.3 *Learn various digital communication techniques.*

OELC301A.4 *Examine cellular communication and satellite communication.*

OELC301A.5 *Understand advantage and disadvantages of digital transmission.*

OELC301A.6 *Figure noise in transmission lines.*

Unit-I

Noise and Transmission lines: Noise-Introduction, internal and external noises, signal to noise ratio and noise figure.

Amplitude Modulation/demodulation techniques: Block diagram of electronic communication system. Modulation-need and types of modulation-AM, FM & PM. Amplitude modulation – representation, modulation index, expression for instantaneous voltage, power relations, frequency spectrum, DSBFC, DSBSC and SSBSC (mention only). Limitations of AM.
Demodulation- AM detection: principles of detection, linear diode, principle of working and waveforms.
Block diagram of AM transmitter and Receiver. (10 Lectures)

Unit-II

Frequency Modulation/demodulation techniques: Frequency Modulation: definition, modulation index, FM frequency spectrum diagram, bandwidth requirements, frequency deviation and carrier swing, FM generator-varactor diode modulator.
FM detector – principle, slope detector-circuit, principle of working and waveforms. Block diagram of FM transmitter and Receiver. Comparison of AM and FM. (10 Lectures)

Unit- III

Digital communication: Introduction to pulse and digital communications, digital radio, sampling theorem, types- PAM, PWM, PPM, PCM – quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital transmission, characteristics of data transmission circuits – Shannon limit for information capacity, bandwidth requirements, data transmission speed, noise, cross talk, echo suppressors, distortion and equalizer, MODEM– modes, classification, interfacing (RS232). TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA. (14 Lectures)

Unit- IV

Cellular Communication: Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts.

Satellite communication: Introduction, to Orbit, types of orbits, Block diagram of satellite transponder. (14 Lectures)

Reference Books:

1. Electronic Communication, George Kennedy, 3rd edition, TMH.
2. Electronic Communication, Roddy and Coolen, 4th edition, PHI.
3. Electronic Communication systems, Kennedy & Davis, IV edition-TATA McGraw Hill.
4. Advanced Electronic Communication systems, Wayne Tomasi- 6th edition, Low priced edition- Pearson education.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OELC-301A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OELC301A.1	3	-	3	3	3	3	-	2	-	-	-	-	-	-	-	3	3	-
OELC301A.2	3	-	3	3	3	3	-	2	-	2	2	-	2	2	1	3	3	-
OELC301A.3	3	-	3	3	3	3	-	2	-	-	-	-	-	-	-	3	3	-
OELC301A.4	3	2	2	3	3	3	2	3	1	2	2	-	2	2	1	3	3	-
OELC301A.5	3	-	3	3	3	3	-	2	-	2	2	-	-	-	-	3	3	-
OELC301A.6	3	2	2	3	3	3	2	3	1	2	2	-	2	2	1	3	3	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: OELC-302A
SUBJECT NAME: COMMUNICATION SYSTEMS LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OELC302A.1 *Learn amplitude modulation and demodulation techniques.*

OELC302A.2 *Analyze Amplitude Modulation and Frequency Modulation Transmitter/Receiver.*

OELC302A.3 *Understand Time Division Multiplexing and de multiplexing.*

OELC302A.4 *Examine Pulse-Amplitude Modulation (PAM) modulator and demodulator.*

OELC302A.5 *Analyze Frequency-Shift Keying (FSK) modulation.*

OELC302A.6 *Explore pulse and digital communication types.*

OELC302A.7 *Portray the working of Voltage Controlled Oscillator (VCO) using IC 566.*

OELC302A.8 *Analyze Frequency Modulation (FM) using IC8038.*

At least 06 experiments from the following:

1. Amplitude modulator and Amplitude demodulator
2. Study of FM modulator using IC8038
3. Study of VCO using IC 566
4. Study of Time Division Multiplexing and de multiplexing
5. Study of AM Transmitter/Receiver
6. Study of FM Transmitter/Receiver
7. ASK modulator and demodulator
8. Study of FSK modulation
9. Study of PWM and PPM
10. Study of PAM modulator and demodulator

Reference Books:

1. Electronic Communication, George Kennedy, 3rd edition, TMH.
2. Electronic Communication, Roddy and Coolen, 4th edition, PHI.
3. Electronic Communication systems, Kennedy & Davis, IV edition-TATA McGraw Hill.
4. Advanced Electronic Communication systems, Wayne Tomasi- 6th edition, Low priced edition- Pearson education.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OELC-302A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OELC302A.1	3	1	2	2	3	3	3	1	1	2	2	-	2	2	2	3	3	2
OELC302A.2	3	2	3	3	3	3	3	2	1	2	2	-	2	2	2	3	3	2
OELC302A.3	3	2	3	3	3	3	3	2	1	3	3	-	3	3	2	3	3	3
OELC302A.4	3	2	3	3	3	3	3	2	1	3	3	-	3	3	2	3	3	3
OELC302A.5	3	2	3	3	3	3	3	2	1	3	3	-	3	3	2	3	3	3
OELC302A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
OELC302A.7	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
OELC302A.8	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: OCHE-301A
SUBJECT NAME: ORGANIC CHEMISTRY
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCHE301A.1	*Learn the fundamentals of organic chemistry.*
OCHE301A.2	*Understand the basics of stereochemistry and differentiate various isomers.*
OCHE301A.3	*Examine the reaction mechanisms of various organic compounds.*
OCHE301A.4	*Analyze the chemical properties of organic compounds.*
OCHE301A.5	*Learn the preparation methods of different organic compounds.*
OCHE301A.6	*Apply the basics of organic chemistry to design the chemical reactions of various functional groups*.

Unit I
Fundamental of organic chemistry
Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.
Reaction intermediates: Carbocations, Carbanions and free radicals. Electrophiles and nucleophiles
Aromaticity: Benzenoids and Hückel's rule.
Stereochemistry: Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). (12 Lectures)

Unit II
Aliphatic Hydrocarbons: Functional group approach for the following reactions (preparations physical property & chemical reactions) to be studied with mechanism in context to their structure.

Alkanes: *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.
Alkenes: *Preparation:* Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) andtrans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.
Alkynes: *Preparation:* Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides and acidity of alkynes, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4. Hydration to form carbonyl compounds.
(12 Lectures)

Unit III
Aromatic hydrocarbons: *Preparation* (benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.
Reactions: (benzene): Electrophilic substitution reactions: nitration, halogenation sulphonation. Friedel-Craft's reaction (alkylation and acylation) Side chain oxidation of alkyl benzenes.
Alkyl Halides: *Preparation:* from alkenes *and* alcohols.
Reactions: Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions, hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.
Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.
Reactions (Chlorobenzene): Aromatic electrophilic and nucleophilic substitution (replacement by – OHgroup) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3).
Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards Nucleophilic substitution reactions. (12 Lectures)

Unit IV
Alcohols: *Preparation:* Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.
Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3), factors affecting acidity, Oppeneauer oxidation
Diols: oxidation of diols. Pinacol-Pinacolone rearrangement.
Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. acidity and factors affecting
Ethers (aliphatic and aromatic). Preparation : Williamson ether synthesis. **Reactions:** Cleavage of ethers with HI
Aldehydes and ketones (aliphatic and aromatic): *Preparation:* from acid chlorides and from nitriles.
Reactions – Nucleophilic addition, Nucleophilic addition – elimination reaction including Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation,

Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction. (12 Lectures)

Reference Books:

1. T. W. Graham Solomons: *Organic Chemistry, John Wiley and Sons*.
2. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
3. I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
4. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
5. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OCHE-301A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCHE301A.1	3	1	2	3	3	3	1	3	-	-	2	-	2	-	-	2	2	-
OCHE301A.2	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-
OCHE301A.3	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-
OCHE301A.4	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-
OCHE301A.5	3	1	2	3	3	3	1	3	-	-	2	-	2	-	-	2	2	-
OCHE301A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: OCHE-302A
SUBJECT NAME: ORGANIC CHEMISTRY LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCHE302A.1 *Learn the basics of identification of functional groups.*
OCHE302A.2 *Analyze the unknown organic compound containing aromatic groups.*
OCHE302A.3 *Analyze the unknown organic compound containing alcohols and phenols.*
OCHE302A.4 *Examine the unknown organic compound containing aldehydes.*
OCHE302A.5 *Identify the unknown organic compound containing ketones.*
OCHE302A.6 *Examine oxidation of ethanol/isopropanol*.
OCHE302A.7 *Investigate condensation reactions of aldehydes*.
OCHE302A.8 *Explore the acylation reaction of phenols*.

The students have to perform at least 6 experiments from the following

1. Qualitative analysis of unknown organic compounds containing aryl halides.
2. Qualitative analysis of unknown organic compounds containing aromatic hydrocarbons.
3. Qualitative analysis of unknown organic compounds containing alcohols.
4. Qualitative analysis of unknown organic compounds containing aldehydes.
5. Qualitative analysis of unknown organic compounds containing ketones.
6. Qualitative analysis of unknown organic compounds containing phenols.
7. Oxidation of ethanol/isopropanol (Iodoform reaction).
8. Aldol condensation using either conventional or green methods.
9. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone and benzaldehyde.
10. Acylation of phenols.

Reference Books:

1. T. W. Graham Solomons: *Organic Chemistry, John Wiley and Sons*.
2. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
3. I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
4. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
5. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OCHE-302A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OCHE302A.1	3	1	1	3	2	3	1	3	-	-	1	1	1	1	1	2	1	1
OCHE302A.2	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE302A.3	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE302A.4	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE302A.5	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE302A.6	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE302A.7	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2
OCHE302A.8	3	2	3	3	3	3	2	3	1	-	2	2	2	2	2	2	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: OCSC-301A
SUBJECT NAME: COMPUTER NETWORKS AND INTERNET TECHNOLOGIES
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCSC301A.1 *Understand basic computer network technology, different types of network topologies and protocols.*

OCSC301A.2 *Enumerate the layers of the OSI model and TCP/IP*

OCSC301A.3 *Analyze the services and features of the various layers of data networks.*

OCSC301A.4 *Learn services and protocols of physical and data link layer and understand IEEE 802 standards.*

OCSC301A.5 *Design, calculate, and apply subnet masks and addresses to fulfill networking requirements.*

OCSC301A.6 *Create web pages using HTML and JavaScript.*

UNIT-I

Computer Networks: Introduction to computer network, data communication, components of data communication, data transmission mode, data communication measurement, LAN, MAN, WAN, wireless LAN, internet, intranet, extranet.

Network Models: Client/ server network and Peer-to-peer network, OSI, TCP/IP, layers and functionalities.

Transmission Media: Introduction, Guided Media: Twisted pair, Coaxial cable, Optical fiber. Unguided media: Microwave, Radio frequency propagation, Satellite

LAN Topologies : Ring, Bus, Star , Mesh and tree topologies.

Network Devices: NIC, repeaters, hub, bridge, switch, gateway and router. (12 Lectures)

UNIT-II

Internet Terms: Web page, Home page, website, internet browsers, URL, Hypertext, ISP, Web server, download and upload, online and offline.

Internet Applications: www, telnet, ftp, e-mail, social networks, search engines, Video Conferencing, e-Commerce, m-Commerce, VOIP, blogs. (10 Lectures)

UNIT-III

Introduction to Web Design: Introduction to hypertext markup language (html) Document type definition, creating web pages, lists, hyperlinks, tables, web forms, inserting images, frames, hosting options and domain name registration. Customized Features: Cascading style sheet (css) for text formatting and other manipulations. (14 Lectures)

UNIT-IV

JavaScript Fundamentals: Data types and variables, functions, methods and events, controlling program flow, JavaScript object model, built-in objects and operators. (12 Lectures)

Reference Books:

1. Computer networks – Tannenbaum
2. Data Communication and Networking – Forouzan – Tata McGraw Hill.
3. D.R. Brooks, An Introduction to HTML and Javascript for Scientists and Engineers, Springer W. Willard, 4.HTML A Beginner's Guide, Tata McGraw-Hill Education, 2009.
4. J. A. Ramalho, Learn Advanced HTML 4.0 with DHTML, BPB Publications, 2007

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OCSE-301A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCSE301A.1	3	2	3	3	2	3	1	2	-	3	1	-	-	1	2	2	1	-
OCSE301A.2	3	2	3	3	3	3	2	3	-	3	2	-	2	2	2	2	2	-
OCSE301A.3	3	2	3	3	3	3	2	3	-	3	2	-	2	2	2	2	2	-
OCSE301A.4	3	1	3	2	2	3	1	2	-	3	1	-	-	1	2	2	1	-
OCSE301A.5	3	2	3	3	3	3	2	3	-	3	2	2	2	2	2	2	2	-
OCSE301A.6	3	2	3	3	3	3	2	3	-	3	2	2	2	2	2	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III
CODE: OCSC-302A
SUBJECT NAME: COMPUTER NETWORKS AND INTERNET TECHNOLOGIES LAB
NO. OF CREDITS: 2

L	T	P
0	0	4

SESSIONAL	: 15
FINAL EXAM	: 35
TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCSC302A.1 Learn the basics of HTML document and Javascript.

OCSC302A.2 Examine the creation of HTML document in various formats.

OCSC302A.3 Explore the Javascript for simple algebraic problems.

OCSC302A.4 Create tables and forms using HTML.

OCSC302A.5 Sort numbers form a given set using Javascript.

OCSC302A.6 Apply HTML and Javascript for the creation of webpages.

OCSC302A.7 Introduce different effects in website of 6 – 7 pages using HTML.

OCSC302A.8 Generate multiple frames in HTML documents.

Practical exercises based on concepts listed in theory using HTML.

1. Create HTML document with following formatting – Bold, Italics, Underline, Colors, Headings, Title, Font and Font Width, Background, Paragraph, Line Brakes, Horizontal Line, Blinking text as well as marquee text.

2. Create HTML document with Ordered and Unordered lists, Inserting Images, Internal and External linking

3. Create HTML document with Table:

<table>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td colspan="2" rowspan="3">Some image here</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
</table>

4. Create Form with Input Type, Select and Text Area in HTML.
5. Create an HTML containing Roll No., student's name and Grades in a tabular form.
6. Create an HTML document (having two frames) which will appear as follows:

About Department 1 Department 2 Department 3	This frame would show the contents according to the link clicked by the user on the left frame

7. Create an HTML document containing horizontal frames as follows:

Department Names (could be along with Logos)
Contents according to the Link clicked

8. Create a website of 6 – 7 pages with different effects as mentioned in above problems.

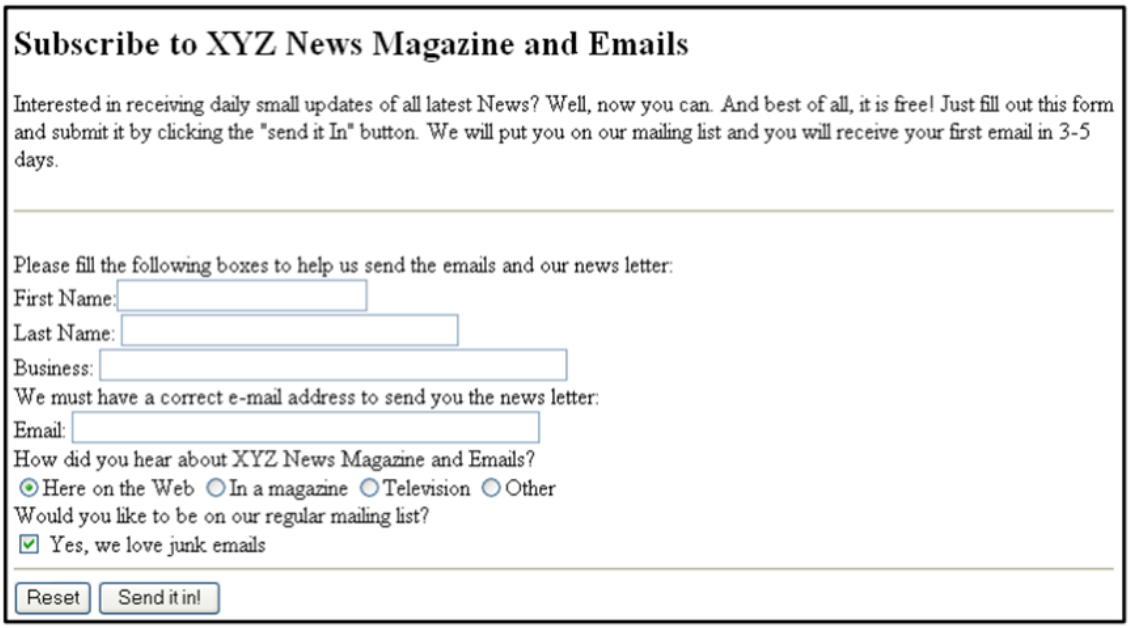
9. Create HTML documents (having multiple frames) in the following formats

Frame 1
Frame 2

Frame 1	
Frame 2	Frame 3

10. Create a form using HTML which has the following types of controls:

I. Text Box
II. Option/radio buttons
III. Check boxes
IV. IV. Reset and Submit buttons



List of Practicals using Javascript :

Create event driven program for following:

1. Print a table of numbers from 5 to 15 and their squares and cubes using alert.
2. Print the largest of three numbers.
3. Find the factorial of a number n.
4. Enter a list of positive numbers terminated by Zero. Find the sum and average of these numbers.
5. A person deposits Rs 1000 in a fixed account yielding 5% interest. Compute the amount in theaccount at the end of each year for n years.
6. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the list.

Reference Books:

1. Computer networks – Tannenbaum
2. Data Communication and Networking – Forouzan – Tata McGraw Hill.
3. D.R. Brooks, An Introduction to HTML and Javascript for Scientists and Engineers, Springer W. Willard, 4.HTML A Beginner's Guide, Tata McGraw-Hill Education, 2009.
4. J. A. Ramalho, Learn Advanced HTML 4.0 with DHTML, BPB Publications, 2007

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OCSE-302A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OCSE302A.1	3	1	3	2	2	3	2	2	-	3	1	1	-	1	2	2	1	-
OCSE302A.2	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE302A.3	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE302A.4	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE302A.5	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE302A.6	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE302A.7	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE302A.8	3	2	2	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Syllabus of B.Sc. (H) Physics

Semester IV

Discipline Core Course (DCC)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: BPH-401A
SUBJECT NAME: MATHEMATICAL PHYSICS-III
NO. OF CREDITS: 4

L	T	P		
			SESSIONAL	: 25
			FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH401A.1	*Learn the concepts of complex numbers, function of complex variables and analyze their singularities.*
BPH401A.2	*Perform integration of functions of complex variables.*
BPH401A.3	*Understand the basics of Fourier and Laplace Transforms.*
BPH401A.4	*Solve simple physics problems using Fourier and Laplace Transforms.*
BPH401A.5	*Analyze theorems involving integral transforms and their applications.*
BPH401A.6	*Develop the skills of solving various physics problems entailing complex variables, functions of complex variables and their integrals, and integral transforms.*

Unit-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. (12 Lectures)

Unit-II

Integration of a function of a complex variable: Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals. (12 Lectures)

Unit-III

Integrals Transforms: Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train and other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation,

change of scale, complex conjugation, etc.). One dimensional Wave Equations, Dirac delta function, definition and properties. (12 Lectures)

Unit-IV

Laplace Transforms: Laplace Transform (LT) of Elementary functions. 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, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Coupled differential equations of 1st order. Solution of heat flow along semi infinite bar using Laplace transform. (12 Lectures)

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P.Dennery and A.Krzywicki, 1967, Dover Publications
3. Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press Complex Variables, A.K. Kapoor, 2014, Cambridge Univ. Press
4. Complex Variables and Applications, J.W.Brown & R.V.Churchill, 7th Ed. 2003, Tata McGraw-Hill.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-401A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH401A.1	3	-	2	2	2	3	-	1	1	-	-	-	-	-	-	3	2	1
BPH401A.2	3	1	3	3	3	3	-	2	1	-	2	-	-	-	-	3	2	1
BPH401A.3	3	-	2	2	2	3	-	1	1	-	1	-	-	-	-	3	3	2
BPH401A.4	3	1	3	3	3	3	1	2	1	2	2	-	2	-	1	3	2	1
BPH401A.5	3	1	3	3	3	3	2	2	1	2	2	-	2	-	1	3	3	2
BPH401A.6	3	1	3	3	3	3	2	3	1	2	2	-	2	-	2	3	2	1

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: BPH-402A
SUBJECT NAME: ELEMENTS OF MODERN PHYSICS
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH402A.1 *Know the basic concepts of old Quantum theory.*
BPH402A.2 *Understand the interference and basics of the wave theory.*
BPH402A.3 *Learn the basic properties of nucleus and nuclear binding energy.*
BPH402A.4 *Have an understanding of Nuclear radioactivity laws and basics of Lasers.*
BPH402A.5 *Apply the concepts of Nuclear physics in understanding different models.*
BPH402A.6 *Acquire conceptual understanding of Quantum mechanical scattering and tunneling.*

Unit-I
Basics of Quantum Mechanics: Planck's quantum, Planck's constant and light as a collection of photons; 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.
Position measurement- gamma ray microscope thought experiment; Wave-particle duality; Heisenberg uncertainty principle; Estimating minimum energy of a confined particle using uncertainty principle. (12 Lectures)

Unit-II
Quantum Mechanics and its applications: Two slit interference experiment with photons, atoms and particles; linear superposition principle; Matter waves and wave amplitude; Schrodinger wave 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.
Particle in a one dimensional box- energy eigen values and eigen functions, normalization; Quantum mechanical tunnelling in one dimension-across a step potential & rectangular potential barrier. (12 Lectures)

Unit-III

Nuclear Physics: 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, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy. Nuclear Fission, Nuclear Fission reactor and Nuclear Fusion. (12 Lectures)

Unit-IV

Radioactivity and Lasers: Stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

Lasers: Metastable states. Spontaneous and Stimulated emissions. Einstein Coefficients, Optical Pumping and Population Inversion. Properties of Lasers, Basic lasing system. (12 Lectures)

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-402A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH402A.1	3	1	2	2	3	3	3	2	1	3	2	-	2	2	2	3	3	2
BPH402A.2	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH402A.3	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH402A.4	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH402A.5	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH402A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: BPH-403A
SUBJECT NAME: DIGITAL SYSTEMS AND APPLICATIONS
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH403A.1	*Learn the fundamentals of digital logic gate- circuits and Boolean algebra.*
BPH403A.2	*Understand the circuitry, working and applications of data processing circuits and arithmetic circuits.*
BPH403A.3	*Learn the theory and working principle of basic sequential circuits like flip-flops of various types.*
BPH403A.4	*Apply the knowledge of flip-flops to various shift registers, counters and their applications.*
BPH403A.5	*Understand the working of Timer ICs, Memory ICs and their applications.*
BPH403A.6	*Learn the basics of microprocessor and assembly Language.*

UNIT-I

Digital Circuits: Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. (10 Lectures)

UNIT-II

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Idea of Minterms and Maxterms. Conversion of Truth table into Equivalent Logic Circuit by (1) Sum of Products (SOP), Product of Sum (POS) Method and (2) Karnaugh Map.

Data processing circuits: Multiplexers, De-multiplexers, Decoders, Encoders. (10 Lectures)

UNIT-III

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 latch using NAND and NOR gates, SR, D, T 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.
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.
Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator.
Conversion: D/A Resistive networks (Weighted and R-2R Ladder). A/D conversion, Accuracy and Resolution. (16 Lectures)

UNIT-IV
Memory Organization: Structure of computer memory, Data storage (idea of RAM and ROM). Types of ROM: PROM, EPROM, EEPROM; Types of RAM- Static and dynamic RAM. Computer memory.
Intel 8085 Microprocessor Architecture: Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers.
Introduction to Assembly Language:1 byte, 2 byte and 3 byte instructions. (12 Lectures)

Reference Books:

1. Digital Principles and Applications, A.P.Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Electronics G K Kharate ,2010, Oxford University Press Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-403A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH403A.1	3	1	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH403A.2	3	1	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH403A.3	3	1	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH403A.4	3	1	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH403A.5	3	1	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3
BPH403A.6	3	1	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: BPH-404A
SUBJECT NAME: MATHEMATICAL PHYSICS-III LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH404A.1 *Learn the computational skills of numerical modelling and simulation using scilab software.*

BPH404A.2 *Understand the behavior of special functions like Bessel's and Legendre, using scilab.*

BPH404A.3 *Examine the solutions of first and second order differential equations using scilab.*

BPH404A.4 *Evaluate the Dirac Delta Function using scilab.*

BPH404A.5 *Investigate the Frobenius method and Fourier series solutions using scilab.*

BPH404A.6 *Analyze curve fitting procedures and perform Integral transform using scilab.*

BPH404A.7 *Estimate error in a set of data recorded in a physics experiment.*

BPH404A.8 *Explore the scilab proficiency in analyzing simple physics problems.*

At least 6 experiments from the following:

C^{++}/Scilab based simulations experiments on Mathematical Physics problems like

1. Solve differential equations:

$dy/dx = e^{-x}$ with $y = 0$ for $x = 0$

$dy/dx + e^{-x}y = x^2$

$d^2y/dt^2 + 2\, dy/dt = -y$

$d^2y/dt^2 + e^{-t}dy/dt = -y$

2. Dirac Delta Function:

Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}}\int e^{\frac{-(x-2)^2}{2\sigma^2}}(x+3)\,dx$ *, for = 1, 0.1, 0.01 and show it tends to 5*

3. Fourier Series:

(i) Program to sum $\sum_{n=1}^{\infty}(0.2)^n$

(ii) Evaluate the Fourier coefficient of a given periodic function (square wave)

4. Frobenius method and special functions:

(i) $\int_{-1}^{+1} P_n(x).P_m(x)\,dx = \delta_{n,m}$

(ii) Plot $P_n(x)$ and $J_n(x)$

Show recursion relation

5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).

6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.

7. 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.

8. Integral transform: FFT of e^{-x^2}

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
3. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
4. Getting started with Matlab, Rudra Pratap, 2010, Oxford University Press.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-404A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH404A.1	3	1	2	2	3	3	3	2	1	3	2	-	2	2	2	3	3	2
BPH404A.2	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH404A.3	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH404A.4	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH404A.5	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH404A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH404A.7	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
BPH404A.8	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: BPH-405A
SUBJECT NAME: MODERN PHYSICS LAB
NO. OF CREDITS: 2

			SESSIONAL	: 15
L	T	P	FINAL EXAM	: 35
0	0	4	TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH405A.1	*Learn the basic concepts of modern physics.*
BPH405A.2	*Determine the wavelength and angular spread of laser light using the diffraction method.*
BPH405A.3	*Validate experimentally the value of Planck's constant.*
BPH405A.4	*Understand Photo-electric effect by plotting photo current versus intensity and wavelength of light and maximum energy of photo-electrons versus frequency of light.*
BPH405A.5	*Investigate the rotational spectrum of Iodine vapour.*
BPH405A.6	*Derive the work function of materials.*
BPH405A.7	*Design the Millikan drop apparatus to determine the charge of an electron.*
BPH405A.8	*Examine wavelength of H-alpha emission line of Hydrogen atom.*

At least 06 experiments from 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

Reference 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, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Mahal

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-405A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH405A.1	3	1	2	2	3	3	3	2	1	3	2	-	2	2	2	3	3	2
BPH405A.2	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH405A.3	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH405A.4	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH405A.5	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH405A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH405A.7	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2
BPH405A.8	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: BPH-406A
SUBJECT NAME: DIGITAL SYSTEMS & APPLICATIONS LAB
NO. OF CREDITS: 2

			SESSIONAL	: 15
L	T	P	FINAL EXAM	: 35
0	0	4	TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH406A.1 *Learn the working of Digital circuits and logic gates.*

BPH406A.2 *Understand the various arithmetic circuits like adders, subtractors, binary adders etc.*

BPH406A.3 *Design multivibrator of given specifications using 555 Timer.*

BPH406A.4 *Implement and investigate combinational logic systems.*

BPH406A.5 *Design various flip-flop circuits using logic gates and ICs.*

BPH406A.6 *Understand the basic 1-byte, 2-byte programming using 8085 Microprocessor.*

BPH406A.7 *Design combinational logic system for a specified Truth Table.*

BPH406A.8 *Build 4-bit Counter and shift register using D-type/JK Flip-Flop ICs.*

At least 06 experiments each from section A and Section B Section-A: Digital Circuits Hardware design/Verilog Design

1. To design a combinational logic system for a specified Truth Table.
   (b) To convert Boolean expression into logic circuit & design it using logic gate ICs.
   (c) 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 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. Other programs (e.g. Parity Check, using interrupts, etc.).

Reference Books:

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 Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
4. Microprocessor 8085:Architecture, Programming and interfacing, A.Wadhwa, 2010, PHI Learning.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-406A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH406A.1	3	1	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH406A.2	3	1	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH406A.3	3	1	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH406A.4	3	1	3	3	3	3	3	3	2	3	3	-	2	2	3	3	3	3
BPH406A.5	3	1	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3
BPH406A.6	3	1	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3
BPH406A.7	3	1	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3
BPH406A.8	3	1	3	3	3	3	3	3	3	3	3	-	2	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Open Elective Courses (OEC)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: OMTH-401A
SUBJECT NAME: NUMERICAL METHODS
NO. OF CREDITS: 6

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
5	1	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OMTH401A.1 *Understand about the solution of algebraic equations, transcendental equations and simultaneous algebraic equations.*

OMTH401A.2 *Analyze Newton's forward and backward interpolation formulae, Central difference interpolation formula, Gauss forward and backward interpolation formulae, Langranges interpolation formula and Newton's divided difference formulae.*

OMTH401A.3 *Examine the solutions of Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Boole's rule and Weddle's rule.*

OMTH401A.4 *Solve numerically the ordinary differential equations.*

OMTH401A.5 *Determine solutions of simultaneous algebraic equations.*

OMTH401A.6 *Predict numerical solutions of differentiation and integration.*

UNIT-I

Floating point representation and computer arithmetic, Significant digits, Errors: Roundoff error, Local truncation error, Global truncation error, Order of a method, Convergence and terminal conditions, Solution of algebraic and transcendental equations: Bisection method, method of false position, secant method, iteration method, Newton's Raphson method. (15 Lectures)

UNIT-II

Difference operators. Newton's forward and backward interpolation formulae. Central difference interpolation formula. Gauss forward and backward interpolation formulae. Langrange's interpolation formula and Newton's divided difference formulae. (15 Lectures)

UNIT-III

Solution of simultaneous algebraic equations: Jacobi's method, Gauss-Seidal method, Relaxation method.

Numerical differentiation and integration: Formula for derivatives, Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Boole's rule and Weddle's rule. (15 Lectures)

UNIT-IV

Numerical solution of O.D.E.: Taylor series, Picard's method, Euler's Method, Modified Euler method, Runge-Kutta second and fourth order methods, predictor collector methods (Adams-Bashforth and Milne's method only). (15 Lectures)

References Books:

1. K. Atkinson and W. Han, Elementary Numerical Analysis, John Wiley,2006.
2. Numerical Methods in Engg. &Science : B.S. Grewal :khanna publications.
3. Numerical Methods for Scientific and Engg. Computations : M.K. Jain, S.R.K. Iyengerand R.K. Jain-Wiley Eastern Ltd
4. Taneja, H.C. "Advanced Engineering Mathematics", IK International, New Delhi.
5. Introductory Methods of Numerical Analysis: S.S. Shastri, PHI learning pvt limited.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OMTH-401A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OMTH401A.1	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH401A.2	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH401A.3	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH401A.4	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH401A.5	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-
OMTH401A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	3	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: OELC-401A
SUBJECT NAME: MICROPROCESSOR AND MICROCONTROLLER SYSTEM
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OELC401A.1	*Know the number system and basics of microprocessor 8085.*
OELC401A.2	*Learn the basic programming instructions of 8085 microprocessor.*
OELC401A.3	*Examine the interfacing of various I/O devices.*
OELC401A.4	*Learn the basics of Microcontroller, counters and timers.*
OELC401A.5	*Analyze the working of Microcontroller, counters and timers.*
OELC401A.6	*Explore the instructions set and operations of 8085 microprocessor.*

Unit-1

Number systems: Binary, hexadecimal – conversion from binary to decimal and vice-versa, binary to hexadecimal and vice-versa, decimal to hexadecimal and vice versa, addition and subtraction of binary numbers and hexadecimal numbers. Subtraction using 2‘s complement, signed number arithmetic.

Introduction to Microprocessor: Introduction, applications, basic block diagram, speed, word size, memory capacity, classification of microprocessors (mention different microprocessors being used)

Microprocessor 8085: Features, architecture -block diagram, internal registers, register pairs, flags, stack pointer, program counter, types of buses. Multiplexed address and data bus, generation of control signals, pin description of microprocessor 8085. (12 Lectures)

Unit-2

8085 Instructions: Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions. Stack operations, subroutine calls and return operations. Delay loops, use of counters, timing diagrams-instruction cycle, machine cycle, T- states, time delay.
(12 Lectures)

Unit-3

Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time

Interfacing of memory chips, address allocation technique and decoding; Interfacing of I/O devices, LEDs and toggle-switches as examples, memory mapped and isolated I/O structure; Input/output techniques: CPU initiated unconditional and conditional I/O transfer.

(10 Lectures)

Unit- 4

Introduction to Microcontrollers: Basic block diagram, comparison of microcontroller with microprocessors, comparison of 8 bit, 16 bit and 32 bit microcontrollers.

MICROCONTROLLER 8051- architecture -internal block diagram, key features of 8051, pin diagram, memory organization, Internal RAM memory, Internal ROM. General purpose data memory, special purpose/function registers, external memory.

Counters and timers: 8051 oscillator and clock, program counter, TCON, TMOD, timer counter interrupts, timer modes of operation. Input / output ports and circuits/ configurations, serial data input / output – SCON, PCON, serial data transmission modes. (14 Lectures)

Reference Books:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar - Wiley Eastern Limited- IV Edition.
2. Fundamentals of Microprocessor & Microcomputer: B. Ram Danpat Rai Publications.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay ―The 8051 Microcontroller and Embedded Systems, 2nd Edition, Pearson Education 2008.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OELC-401A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OELC401A.1	3	-	2	2	2	3	-	1	2	-	-	-	-	-	1	3	3	-
OELC401A.2	3	-	2	2	2	3	-	3	2	-	-	-	-	-	1	3	3	-
OELC401A.3	3	2	3	3	3	3	2	2	3	2	2	-	2	2	1	3	3	-
OELC401A.4	3	-	2	2	2	3	-	3	2	-	-	-	-	-	1	3	3	-
OELC401A.5	3	2	3	3	3	3	2	3	3	2	2	-	2	2	1	3	3	-
OELC401A.6	3	2	3	3	3	3	2	3	3	2	2	-	2	2	1	3	3	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: OELC-402A
SUBJECT NAME: MICROPROCESSOR AND MICROCONTROLLER SYSTEM LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OELC402A.1 *Learn the basics of Microprocessor 8085.*
OELC402A.2 *Explore the basic algebraic operations using 8085 microprocessor.*
OELC402A.3 *Understand the programming using Microprocessor.*
OELC402A.4 *Verify the truth table of logic gates.*
OELC402A.5 *Understand the interfacing of integrated circuit 8255.*
OELC402A.6 *Generate terms of Fibonacci series using 8085 microprocessor.*
OELC402A.7 *Program for multi-byte addition and subtraction using microprocessor 8085.*
OELC402A.8 *Learn to transfer a block of data using 8085 microprocessor.*

At least 6 experiments from the following:

1. Program to transfer a block of data.
2. Program for multibyte addition
3. Program for multibyte subtraction
4. Program to multiply two 8-bit numbers.
5. Program to divide a 16 bit number by 8 bit number.
6. Program to search a given number in a given list.
7. Program to generate terms of Fibonacci series.
8. Program to sort numbers in ascending/descending order.
9. Program to find the square root of an integer.
10. To study interfacing of IC 8255.
11. Program to verify the truth table of logic gates.

Reference Books:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar - Wiley Eastern Limited- IV Edition.
2. Fundamentals of Microprocessor & Microcomputer: B. Ram Danpat Rai Publications.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay ―The 8051 Microcontroller and Embedded Systems, 2nd Edition, Pearson Education 2008.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OELC-402A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OELC402A.1	3	2	3	3	3	3	3	2	1	3	3	-	3	3	3	3	3	3
OELC402A.2	3	2	3	3	3	3	3	1	1	3	3	-	3	3	3	3	3	3
OELC402A.3	3	2	3	3	3	3	3	2	1	3	3	-	3	3	3	3	3	3
OELC402A.4	3	2	3	3	3	3	3	3	1	3	3	-	3	3	3	3	3	3
OELC402A.5	3	2	3	3	3	3	3	2	1	3	3	-	3	3	3	3	3	3
OELC402A.6	3	2	3	3	3	3	3	3	1	3	3	-	3	3	3	3	3	3
OELC402A.7	3	2	3	3	3	3	3	3	1	3	3	-	3	3	3	3	3	3
OELC402A.8	3	2	3	3	3	3	3	3	1	3	3	-	3	3	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: OCHE-401A
SUBJECT NAME: SPECTROSCOPY
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCHE401A.1	*Learn the basics of spectroscopy, rotational spectrum and vibrational spectrum.*
OCHE401A.2	*Understand the principle and working of various spectroscopy techniques.*
OCHE401A.3	*Examine the effect of electronic transitions, conjugation and functional groups on the spectrum.*
OCHE401A.4	*Predict energy levels of rigid rotator using rotational spectrum.*
OCHE401A.5	*Examine pure rotational and pure vibrational Raman spectra of diatomic molecules.*
OCHE401A.6	*Apply the spectroscopy techniques to elucidate simple organic compounds*.

Unit I

Spectroscopy:

Introduction, Electromagnetic radiation, regions of spectrum, basic features of spectroscopy, statement of Born-oppenheimer approximation, Degrees of freedom.

Rotational Spectrum:

Selection rules, Energy levels of rigid rotator (semi-classical principles), rotational spectra of diatomic molecules , spectral intensity distribution using population distribution (Maxwell-Boltzmann distribution), determination of bond length and isotopic effect. (12 Lectures)

Unit II

Ultraviolet (UV) absorption spectroscopy:

Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones,Woodward- Fieser rules, calculation of λ_{max} of simple conjugated dienes and unsaturated ketones. Applications of UV Spectroscopy in structure elucidation of simple. (12 Lectures)

Unit III

Vibrational spectrum:

Infrared (IR) absorption spectroscopy Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Applications of IR spectroscopy in structure elucidation of simple organic compounds

Raman Spectrum:

Concept of polarizibility, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules, Quantum theory of Raman spectra. (12 Lectures)

Unit IV

NMR Spectroscopy:

Principle of nuclear magnetic resonance, the PMR spectrum,number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift,shielding and deshielding of protons, proton counting,splitting of signals and coupling constants, magnetic equivalence of protons.Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide, 1,1-dibromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde and acetophenone.

Simple problems on PMR spectroscopy for structure determination of organic compounds.

(12 Lectures)

Reference Books:

1. Introduction to Spectroscopy- A Guide for Students of Organic Chemistry, 2nd Edn. By Donald L. Pavia, Gary M. Lampman and George S. Kriz. Saunders Golden Sunburst Series. Harcourt Brace College Publishers, New York.
2. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley.
3. Application of Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.
4. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, Tata McGraw-Hill.
5. Spectroscopy of Organic Compounds by P.S. Kalsi, Wiley Estern, New Delhi.
6. Organic Spectgroscopy by William Kemp, John Wiley.
7. Organic Mass Spectrometry by K.G. Das & E.P. James, Oxford & IBH Publishing Co.
8. Organic Spectroscopy (Principles & Applications) by Jagmohan.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OCHE-401A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OCHE401A.1	3	1	3	3	3	3	1	3	1	2	2	-	2	2	1	2	2	-
OCHE401A.2	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-
OCHE401A.3	3	2	2	3	3	3	2	3	1	2	1	-	2	2	1	2	1	-
OCHE401A.4	3	2	2	3	3	3	2	3	1	2	1	-	2	2	1	2	1	-
OCHE401A.5	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-
OCHE401A.6	3	2	3	3	3	3	2	3	1	2	2	-	2	2	1	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: OCHE-402A
SUBJECT NAME: SPECTROSCOPY LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCHE402A.1 *Observe the spectrum of simple organic compounds.*

OCHE402A.2 *Learn practical approach to structural elucidation of organic compounds with specific examples.*

OCHE402A.3 *Interpret various types of spectra in structure elucidation.*

OCHE402A.4 *Examine the pH-dependence of the UV-Vis spectrum of* $K_2Cr_2O_7$.

OCHE402A.5 *Analyze qualitatively organic compounds containing mono-functional groups.*

OCHE402A.6 *Verify Lambert-Beer's law.*

OCHE402A.7 *Determine the concentrations in a mixture using Lambert-Beer's law.*

OCHE402A.8 *Apply the spectroscopy techniques to elucidate simple organic compounds.*

1. Verify Lambert-Beer's law and determine the concentration of CuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration II. Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.

2. Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H2SO4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule-1 , kJ mol-1 , cm-1 , eV)

3. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of K2Cr2O7.

4. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

5. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).

6. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides)

Reference Books:

1. Introduction to Spectroscopy- A Guide for Students of Organic Chemistry, 2nd Edn. By Donald L. Pavia, Gary M. Lampman and George S. Kriz. Saunders Golden Sunburst Series. Harcourt Brace College Publishers, New York.
2. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley.
3. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, Tata McGraw-Hill.
4. Spectroscopy of Organic Compounds by P.S. Kalsi, Wiley Estern, New Delhi.
5. Organic Spectroscopy by William Kemp, John Wiley.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OCHE-402A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
OCHE402A.1	3	2	3	3	3	3	2	3	1	-	2	2	2	1	2	2	2	2
OCHE402A.2	3	2	3	3	3	3	2	3	1	-	2	2	2	1	2	2	2	2
OCHE402A.3	3	2	3	3	3	3	2	3	1	-	2	2	2	1	2	2	2	2
OCHE402A.4	3	2	3	3	3	3	2	3	1	-	2	2	2	1	2	2	2	2
OCHE402A.5	3	2	3	3	3	3	2	3	1	-	2	2	2	1	2	2	2	2
OCHE402A.6	3	2	3	3	3	3	2	3	1	-	2	2	2	1	2	2	2	2
OCHE402A.7	3	2	3	3	3	3	2	3	1	-	2	2	2	1	2	2	2	2
OCHE402A.8	3	2	3	3	3	3	2	3	1	-	2	2	2	1	2	2	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: OCSC-401A
SUBJECT NAME: INFORMATION SECURITY
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCSC401A.1	*Understand theory of fundamental cryptography, encryption and decryption algorithms*.
OCSC401A.2	*Build secure authentication systems by use of message authentication techniques.*
OCSC401A.3	*Understand a given ciphering algorithm and to analyze it.*
OCSC401A.4	*Examine the SSL or firewall based solution against security threats*
OCSC401A.5	*Learn ethical issues related to the misuse of computer security.*
OCSC401A.6	*Apply the crypto systems so far learned to building of information and network security mechanisms.*

UNIT-I

Course Introduction: Computer network as a threat, hardware vulnerability, software vulnerability, importance of data security.

Digital Crime: Overview of digital crime, criminology of computer crime.

Information Gathering Techniques: Tools of the attacker, information and cyber warfare, scanning and spoofing, password cracking, malicious software, session hijacking.

(12 Lectures)

UNIT-II

Risk Analysis and Threat: Risk analysis, process, key principles of conventional computer security, security policies, authentication, data protection, access control, internal vs external threat, security assurance, passwords, authentication, and access control, computer forensics and incident response. (12 Lectures)

UNIT-III

Introduction to Cryptography and Applications : Important terms, Threat, Flaw, Vulnerability, Exploit, Attack, Ciphers, Codes, Caeser Cipher, Rail-Fence Cipher, Public key

cryptography (Definitions only), Private key cryptography (Definition and Example), Digital Certificates. (14 Lectures)

Safety Tools and Issues : Firewalls, logging and intrusion detection systems, Windows and windows XP / NT security, Unix/Linux security, ethics of hacking and cracking. (10 Lectures)

Reference Books:

1. M. Merkow, J. Breithaupt, Information Security Principles and Practices, Pearson Education, 2005.
2. G.R.F. Snyder, T. Pardoe, Network Security, Cengage Learning, 2010.
3. A. Basta, W.Halton, Computer Security: Concepts, Issues and Implementation, Cengage Learning India, 2008.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for OCSE-401A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCSE401A.1	3	2	3	3	3	3	2	3	2	3	2	2	2	2	3	2	2	-
OCSE401A.2	3	2	3	3	3	3	2	3	2	3	2	2	2	2	3	2	2	-
OCSE401A.3	3	2	3	3	3	3	2	3	2	3	2	2	2	2	3	2	2	-
OCSE401A.4	3	2	3	3	3	3	2	3	2	3	2	2	2	2	3	2	2	-
OCSE401A.5	3	2	3	3	3	3	2	3	2	3	2	2	2	2	3	2	2	-
OCSE401A.6	3	2	3	3	3	3	2	3	2	3	2	2	2	2	3	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER IV
CODE: OCSC-402A
SUBJECT NAME: INFORMATION SECURITY LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

OCSC402A.1	*Demonstrate the use of Network tools.*
OCSC402A.2	*Perform encryption and decryption of Caesar cipher and Rail fence cipher.*
OCSC402A.3	*Analyze a remote machine using nmap/zenmap.*
OCSC402A.4	*Capture and modify a message using Burp proxy.*
OCSC402A.5	*Demonstrate sending of protected and digitally signed documents.*
OCSC402A.6	*Learn use of steganography tools.*
OCSC402A.7	*Write script for encryption and decryption of Caesar cipher and Rail fence cipher.*
OCSC402A.8	*Use gpg utility for signing and encrypting purposes.*

1. Demonstrate the use of Network tools: ping, ipconfig, ifconfig, tracert, arp, netstat, whois
2. Use of Password cracking tools: John the Ripper, Ophcrack. Verify the strength of passwords using these tools.
4. Perform encryption and decryption of Caesar cipher. Write a script for performing these operations.
5. Perform encryption and decryption of a Rail fence cipher. Write a script for performing these operations.
6. Use nmap/zenmap to analyse a remote machine.
7. Use Burp proxy to capture and modify the message.
8. Demonstrate sending of a protected word document.
9. Demonstrate sending of a digitally signed document.
10. Demonstrate sending of a protected worksheet.
11. Demonstrate use of steganography tools.
12. Demonstrate use of gpg utility for signing and encrypting purposes

Reference Books:

1. M. Merkow, J. Breithaupt, Information Security Principles and Practices, Pearson Education, 2005.
2. G.R.F. Snyder, T. Pardoe, Network Security, Cengage Learning, 2010.
3. A. Basta, W.Halton, Computer Security: Concepts, Issues and Implementation, Cengage Learning India, 2008.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for OCSE-402A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
OCSE402A.1	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	1	-
OCSE402A.2	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE402A.3	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE402A.4	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE402A.5	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE402A.6	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE402A.7	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-
OCSE402A.8	3	2	3	3	3	3	2	2	-	3	2	2	2	2	2	2	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Skill Enhancement Course in Physics (SECP)

Common for Semester- III & IV

(Choose any one SEC course and respective lab in each semester (III & IV)

B.Sc. (H) PHYSICS SEMESTER III&IV
CODE: SECP-01A
SUBJECT NAME: COMPUTATIONAL PHYSICS SKILLS
NO. OF CREDITS: 2

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
2	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

SECP01A.1 *Learn the basics of algorithms and flowcharts of FORTRAN programming language.*

SECP01A.2 *Understand the concepts of scientific programming in FORTRAN for the analysis of various scientific and engineering problems.*

SECP01A.3 *Examine the control statements in FORTRAN and solve physics problems using them.*

SECP01A.4 *Understand plotting in simple physics problems using Gnuplot.*

SECP01A.5 *Investigate graphically a set of data using Gnuplot along with identifying its limitations and applications.*

SECP01A.6 *Explore computational skills of numerical modelling and simulation using FORTRAN.*

Course will consist of hands-on training on Problem solving on Computers.

Unit-I

Introduction: Usage of linux as an Editor. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series. (6 Lectures)

Unit-II

Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems. (9 Lectures)

Unit-III

Control Statements: Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems. (9 Lectures)

Unit-IV

Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot. basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot. (6 Lectures)

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
3. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
4. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
5. Computational Physics: An Introduction, R. C. Verma, etal. New Age International Publishers, New Delhi(1999)
6. Elementary Numerical Analysis, K.E.Atkinson,3 r d Edn . , 2 007 , Wiley India Edition.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for SECP-01A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
SECP01A.1	3	1	2	1	1	1	2	2	1	3	2	-	2	2	2	3	3	3
SECP01A.2	3	2	3	3	3	3	2	2	1	3	2	-	2	2	2	3	3	3
SECP01A.3	3	1	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3
SECP01A.4	3	2	3	3	3	3	2	2	1	3	2	-	2	2	2	3	3	3
SECP01A.5	3	1	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3
SECP01A.6	3	2	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III&IV
CODE: SECP-02A
SUBJECT NAME: ELECTRICAL CIRCUITS AND NETWORK SKILLS
NO. OF CREDITS: 2

L	T	P		
2	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

SECP02A.1 *Learn basics of electrical circuits and their working principles.*

SECP02A.2 *Understand working theory of Generators/Transformers and AC and DC motors.*

SECP02A.3 *Learn the various passive components and their connections.*

SECP02A.4 *Examine electrical wiring and explore electrical protection techniques.*

SECP02A.5 *Analyze alternating current sourced electrical circuits.*

SECP02A.6 *Understand resistors, inductors and capacitors.*

UNIT-I
Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. (5 Lectures)

UNIT-II
Electrical Circuits: Basic electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money. (8 Lectures)

UNIT-III
Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.
Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters and motors. Speed & power of ac motor.
Solid-State Devices: Resistors, inductors and capacitors. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources. (9 Lectures)

UNIT-IV

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Relay protection device.

Electrical Wiring: Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Insulation. Solid and stranded cable. Preparation of extension board.

(8 Lectures)

Reference Books:

1. Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press A text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for SECP-02A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
SECP02A.1	3	2	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3
SECP02A.2	3	2	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3
SECP02A.3	3	2	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3
SECP02A.4	3	2	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3
SECP02A.5	3	2	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3
SECP02A.6	3	2	3	3	3	3	2	3	2	3	3	-	3	2	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III&IV
CODE: SECP-03A
SUBJECT NAME: BASIC INSTRUMENTATION SKILLS
NO. OF CREDITS: 2

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
2	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

SECP03A.1 *Learn the necessary working knowledge on accuracy, precision, resolution, range and errors/uncertainty in measurements.*

SECP03A.2 *Gain knowledge on the working and operations of multimeter.*

SECP03A.3 *Understand about digital instruments like voltmeter and milivoltmeter.*

SECP03A.4 *Understand the working, theory and applications of CRO for measurements.*

SECP03A.5 *Understand the concept of impedance bridges and Q-meters.*

SECP03A.6 *Learn about the block diagram and working of a digital meter and its various associated parameters.*

UNIT-I

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. (5 Lectures)

UNIT-II

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters. Block diagram ac millivoltmeter, specifications and their significance. (5 Lectures)

UNIT-III

Oscilloscope: Block diagram of basic CRO. CRT, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence. Time base operation, synchronization. Front panel controls. Specifications of CRO and their significance. Use for the measurement of voltage (dc and ac), frequency and time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: principle of working. (10 Lectures)

UNIT-IV

Impedance Bridges and Q-meters: Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram and working principles of a Q- Meter.

Digital Instruments: Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles and block diagram of digital voltmeter. Principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution. (10 Lectures)

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co. Performance and design of AC machines - M G Say ELBS Edn.
2. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill. Logic circuit design, Shimon P. Vingron, 2012, Springer.
3. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
4. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for SECP-03A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
SECP03A.1	3	1	3	3	1	3	-	2	-	-	-	-	-	-	2	3	3	3
SECP03A.2	3	-	3	3	1	2	-	2	1	2	1	-	-	-	1	3	3	3
SECP03A.3	3	-	2	2	2	2	-	2	1	1	-	-	-	-	1	3	3	3
SECP03A.4	3	-	2	1	1	1	-	1	1	2	-	-	-	-	0	3	3	3
SECP03A.5	3	-	2	2	-	1	-	1	-	-	-	-	-	-	1	3	3	3
SECP03A.6	3	-	1	2	2	2	-	2	2	1	-	-	-	-	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III&IV
CODE: SECP-04A
SUBJECT NAME: COMPUTATIONAL PHYSICS SKILLS LAB
NO. OF CREDITS: 0

L	T	P		
0	0	2	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

SECP04A.1 *Use the basics of algorithms and flowcharts of FORTRAN programming language.*

SECP04A.2 *Perform computationally the various commands of FORTRAN programming language.*

SECP04A.3 *Solve computationally simple algebraic equations using FORTRAN.*

SECP04A.4 *Compile a frequency distribution and evaluate mean, standard deviation for a given set of experimental data.*

SECP04A.5 *Determine sum of finite series, area under a curve, matrix algebra and Fibonacci series using FORTRAN.*

SECP04A.6 *Examine equations of motion of a simple harmonic oscillator using FORTRAN and plot the output using Gnuplot.*

SECP04A.7 *Simulate projectile motion and motion of a particle in a central field using FORTRAN and visualize the output using Gnuplot.*

SECP04A.8 *Explore computational skills of numerical modelling and simulation using FORTRAN.*

Programming:

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using exp(x) series evaluated at x=1 (6 Lectures)

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization. (9 Lectures)

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
3. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
4. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
5. Computational Physics: An Introduction, R. C. Verma, etal. New Age International Publishers, New Delhi(1999)
6. Elementary Numerical Analysis, K.E.Atkinson,3 r d Edn . , 2 007 , Wiley India Edition.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for SECP-04A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
SECP04A.1	3	2	2	2	3	3	3	3	1	3	3	-	2	2	2	3	3	3
SECP04A.2	3	2	3	3	3	3	3	3	1	3	3	-	3	3	2	3	3	3
SECP04A.3	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP04A.4	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP04A.5	3	2	3	3	3	3	3	2	1	3	3	-	2	2	2	3	3	3
SECP04A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP04A.7	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP04A.8	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III&IV
CODE: SECP-05A
SUBJECT NAME: ELECTRICAL CIRCUITS AND NETWORK SKILLS LAB
NO. OF CREDITS: 0

L	T	P
0	0	2

SESSIONAL	: 15
FINAL EXAM	: 35
TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

SECP05A.1 *Understand the use of multimeter to measure AC and DC Voltage and Current, Resistance, and Power.*

SECP05A.2 *Examine series, parallel, and series-parallel combinations.*

SECP05A.3 *Verify Ohm's law using series, parallel, and series-parallel combinations.*

SECP05A.4 *Understand the working of DC Power sources, AC/DC generators, Inductance, capacitance, impedance and operation of transformers.*

SECP05A.5 *Understand the basics of Resistors, inductors and capacitors. Diode, rectifiers and filters.*

SECP05A.6 *Analyze response of inductors and capacitors with DC or AC sources.*

SECP05A.7 *Understand the basics of wiring-Star and delta connection.*

SECP05A.8 *Design extension board.*

At least 6 experiments from the following:

1. Use of multimeter to measure AC and DC Voltage and Current, Resistance, and Power.
2. Series, parallel, and series-parallel combinations
3. Ohm's law. Series, parallel, and series-parallel combinations.
4. DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.
5. Resistors, inductors and capacitors. Diode, rectifiers and filters. Components in Series or in shunt.
6. Response of inductors and capacitors with DC or AC sources
7. Basics of wiring-Star and delta connection.
8. Preparation of extension board.

Reference Books:

1. Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
2. A text book in Electrical Technology - B L Theraja - S Chand & Co.
3. A text book of Electrical Technology - A K Theraja
4. Performance and design of AC machines - M G Say ELBS Edn.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for SECP-05A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
SECP05A.1	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP05A.2	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP05A.3	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP05A.4	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP05A.5	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP05A.6	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP05A.7	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3
SECP05A.8	3	2	3	3	3	3	3	3	2	3	3	-	3	3	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III&IV
CODE: SECP-06A
SUBJECT NAME: BASIC INSTRUMENTATION SKILLS LAB
NO. OF CREDITS: 0

			SESSIONAL	: 15
L	T	P	FINAL EXAM	: 35
0	0	2	TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

SECP06A.1 *Learn the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.*

SECP06A.2 *Measure Q of a coil and its dependence on frequency, using a Q- meter.*

SECP06A.3 *Observe waveforms on the C.R.O. and to measure amplitude and frequency of the waveforms.*

SECP06A.4 *Study variation in current and voltage in a series and parallel LCR.*

SECP06A.5 *Measurement of R, L and C using a LCR bridge.*

SECP06A.6 *Understand distortion of a RF signal generator using distortion factor meter.*

SECP06A.7 *Measurement of time period, frequency, average period using universal counter.*

SECP06A.8 *Observe the limitations of a multimeter for measuring high frequency voltage and currents.*

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. Oscilloscope as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. To observe sine wave, square wave, triangular wave and ramp waveforms on the C.R.O. and to measure amplitude and frequency of the waveforms .
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using an Oscilloscope.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R,L and C using a LCR bridge/ universal bridge.
9. To study the variation in current and voltage in a series LCR circuit and hence determine the resonant frequency of the circuit
10. To study the variation in current and voltage in a parallel LCR circuit and hence determine the resonant frequency of the circuit
11. To study the effect of voltmeter resistance on voltage measurement.

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co. Performance and design of AC machines - M G Say ELBS Edn.
2. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill. Logic circuit design, Shimon P. Vingron, 2012, Springer.
3. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
4. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for SECP-06A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
SECP06A.1	3	-	3	2	2	1	3	-	-	1	-	-	-	-	2	3	3	3
SECP06A.2	3	-	3	3	1	2	3	-	-	1	-	-	-	-	1	3	3	3
SECP06A.3	3	-	2	2	2	3	2	-	-	1	-	-	-	-	2	3	3	3
SECP06A.4	3	-	3	3	1	3	3	-	-	1	-	-	-	-	2	3	3	3
SECP06A.5	3	-	2	3	1	2	3	-	-	1	-	-	-	-	-	3	3	3
SECP06A.6	3	-	3	2	2	1	3	-	-	1	-	-	-	-	-	3	3	3
SECP06A.7	3	-	3	2	1	-	2	-	-	1	-	-	-	-	-	3	3	3
SECP06A.8	3	-	3	1	2	-	3	-	-	1	-	-	-	-	-	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III&IV
CODE: SECP-07A
SUBJECT NAME: RENEWABLE ENERGY AND ENERGY HARVESTING
NO. OF CREDITS: 2

L	T	P		
2	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

SECP07A.1 Learn the fundamentals of renewable and other alternate energy sources.

SECP07A.2 Understand the principles of solar energy and its environmental impact.

SECP07A.3 Learn the basics of solar energy collection and storage.

SECP07A.4 Learn the basics and advances in Piezoelectric and hydroelectric energy.

SECP07A.5 Study the basics of wind energy and biomass energy.

SECP07A.6 Comprehend the use of renewable energy for various demands.

Unit-I

Introduction: Renewable energy and energy harvesting, Alternate Sources of energy and their limitations, Need of renewable energy, Non-conventional energy sources and their advantages.

Solar energy: Solar energy, its importance, storage of solar energy, applications of solar energy, solar water heater, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. **(8 Lectures)**

Unit-II

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric Energy harvesting applications, Human power.

Hydroelectric Energy Harvesting: Principal of water splitting, Working and fabrication of Hydroelectric Cell. Merits of green energy production through water splitting. Applications.

(8 Lectures)

Unit-III

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Biomass Energy harvesting: Harvesting of biomass, Biomass conversion technologies, **T**hermo chemical and biochemical processes; reaction kinetics; energy and mass balance equations; studies of processes and system design for gasification, pyrolysis and liquefaction of biomass.

(8 Lectures)

UNIT-IV

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion. **(6 Lectures)**

Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009.
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for SECP-07A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
SECP07A.1	3	2	3	3	3	3	3	3	1	3	3	1	2	2	3	3	3	3
SECP07A.2	3	2	3	3	3	3	3	3	1	3	3	1	2	2	3	3	3	3
SECP07A.3	3	2	3	3	3	3	3	3	1	3	3	1	2	2	3	3	3	3
SECP07A.4	3	2	3	3	3	3	3	3	1	3	3	1	2	2	3	3	3	3
SECP07A.5	3	2	3	3	3	3	3	3	1	3	3	1	2	2	3	3	3	3
SECP07A.6	3	2	3	3	3	3	3	3	1	3	3	1	2	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER III&IV
CODE: SECP-08A
SUBJECT NAME: RENEWABLE ENERGY AND ENERGY HARVESTING LAB
NO. OF CREDITS: 0

L	T	P
0	0	2

SESSIONAL : 15
FINAL EXAM : 35
TOTAL : 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

SECP08A.1 Learn the basics of renewable and other alternate energy sources.

SECP08A.2 Demonstrate the principles of solar energy and its environmental impact.

SECP08A.3 Understand the training modules of wind, ocean and geothermal energy.

SECP08A.4 Examine the working of Piezoelectric Energy Harvesting Devices.

SECP08A.5 Explore Electromagnetic Energy Harvesting Devices.

SECP08A.6 Analyze conversion of vibration to voltage using Piezoelectric Materials.

SECP08A.7 Analyze conversion of thermal energy to voltage using Thermoelectric Modules.

SECP08A.8 Comprehend the use of renewable energy for various demands

At least 6 experiments from the following:

1. Demonstration of Training modules on Solar energy.
2. Demonstration of Training modules on Wind energy.
3. Demonstration of Training modules on Ocean energy.
4. Demonstration of Training modules on Geothermal energy.
5. Demonstration of Piezoelectric Energy Harvesting Devices.
6. Demonstration of Electromagnetic Energy Harvesting Devices.
7. Conversion of Vibration to Voltage using Piezoelectric Materials.
8. Conversion of Thermal Energy into Voltage using Thermoelectric Modules.

Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for SECP-08A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
SECP08A.1	3	2	3	3	3	3	3	3	2	3	3	2	2	2	3	3	3	3
SECP08A.2	3	2	3	3	3	3	3	3	2	3	3	2	2	2	3	3	3	3
SECP08A.3	3	2	3	3	3	3	3	3	2	3	3	2	2	2	3	3	3	3
SECP08A.4	3	2	3	3	3	3	3	3	2	3	3	2	2	2	3	3	3	3
SECP08A.5	3	2	3	3	3	3	3	3	2	3	3	2	2	2	3	3	3	3
SECP08A.6	3	2	3	3	3	3	3	3	2	3	3	2	2	2	3	3	3	3
SECP08A.7	3	2	3	3	3	3	3	3	2	3	3	2	2	2	3	3	3	3
SECP08A.8	3	2	3	3	3	3	3	3	2	3	3	2	2	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Syllabus of B.Sc. (H) Physics

Semester V

Discipline Core Course (DCC)

B.Sc. (H) PHYSICS SEMESTER V
CODE: BPH-501A
SUBJECT NAME: QUANTUM MECHANICS AND APPLICATIONS
NO. OF CREDITS: 4

L	T	P		
			SESSIONAL	: 25
			FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH501A.1 *Interpret the wave function of a quantum particle and probabilistic nature of its location and subtler points of quantum phenomena.*

BPH501A.2 *Describe the quantum mechanical operators of position, momentum and energy and solve the commutation brackets of these.*

BPH501A.3 *Explain the time independent schrodinger equation, its solution and apply the same on problems like Gaussian wave packet.*

BPH501A.4 *Understand the behavior of quantum particle encountering a i) one dimensional square well potential, ii) potential barrier iii) simple harmonic oscillation.*

BPH501A.5 *Solve Schrodinger equation for radial wavefunction of non-relativistic hydrogen atom, for its spectrum and eigenfunctions.*

BPH501A.6 *Illustrate the theory of Angular Momentum and its application in quantum mechanics.*

Unit-I

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of

position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. (12 Lectures)

Unit-II

Time independent Schrodinger equation: Hamiltonian, stationary states and energy eigen values; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle. (12 Lectures)

Unit-III

General discussion of bound states in an arbitrary potential: continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; potential barrier, reflection and refraction; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle. (12 Lectures)

Unit-IV

Quantum theory of hydrogen-like atoms and Angular momentum: Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground and first excited states; Orbital angular momentum quantum numbers l and m; s, p, d shells. Electron angular momentum. Angular momentum quantization. Electron Spin and Spin Angular Momentum. Total angular momentum. Pauli spin matrices and their properties. (12 Lectures)

Reference Books:

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press
5. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
6. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-501A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH501A.1	3	3	3	3	3	2	2	3	2	3	3	-	2	-	3	3	3	1
BPH501A.2	3	3	3	3	3	1	2	3	3	3	3	-	3	-	3	3	3	1
BPH501A.3	3	3	3	3	3	2	2	3	2	2	2	-	2	-	3	3	2	1
BPH501A.4	3	3	3	3	3	2	3	3	3	2	2	-	2	-	3	3	3	1
BPH501A.5	3	3	3	3	3	1	2	3	2	2	2	-	2	-	3	3	3	1
BPH501A.6	3	3	3	3	3	1	2	3	3	2	3	-	3	-	3	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER V
CODE: BPH-502A
SUBJECT NAME: SOLID STATE PHYSICS
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH502A.1 *Understand the crystal structure of different materials and lattice dynamics.*

BPH502A.2 *Interpret the X ray diffraction pattern of unknown materials.*

BPH502A.3 *Explain the concept of phonons and lattice vibrations.*

BPH502A.4 *Understand the origin of bands in solids.*

BPH502A.5 *Understand the properties of dielectric and ferroelectric materials.*

BPH502A.6 *Describe the concept of superconductivity.*

Unit-I

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors.Lattice with a Basis– Central and Non-Central Elements.Symmetry Elements Unit Cell. Miller Indices. Reciprocal Lattice. Bravais Lattices, SC, BCC, FCC, HCP Types of Lattices. Crystal structures of NaCl, ZnS, Diamond. Brillouin Zones.
Diffraction of X-rays by Crystals. Bragg‟s Law. Laue conditions. Atomic and Scattering Factor SC, BCC, FCC, NaCl, ZnS, Diamond. (12 Lectures)

Unit-II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Einstein and Debye theories of specific heat of solids. T^3 law.
Electrons in Solids: Density of states (1-D,2-D,3-D), Elementary band theory:Kronig Penny model (no derivation; Qualitative description only). Band Gap., Effective mass, Hall Effect.
(12 Lectures)

Unit-III

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Curie‟s law, Weiss‟s Theory of Ferromagnetism and Ferromagnetic Domains, B-H Curve.Hysteresis, soft and hard material and Energy Loss.

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation.

(12 Lectures)

Unit-IV

Ferroelectric Properties of Materials: Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London‟s Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation) (12 Lectures)

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edn., 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edn., 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. Solid-state Physics, H.Ibach and H. Luth, 2009, Springer.
6. Solid State Physics, Rita John, 2014, McGraw Hill
7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-502A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH502A.1	3	1	2	3	3	2	1	3	1	1	2	1	1	1	1	3	2	2
BPH502A.2	3	1	2	2	3	2	1	3	1	2	3	1	1	1	1	3	2	2
BPH502A.3	3	1	2	3	3	2	1	3	1	1	2	1	1	1	1	3	2	2
BPH502A.4	3	1	2	2	3	3	1	2	1	1	3	1	1	1	1	3	2	2
BPH502A.5	3	1	2	3	3	3	1	2	1	1	2	1	1	1	1	3	2	2
BPH502A.6	3	1	2	3	3	3	1	2	1	1	2	1	1	1	1	3	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER V
CODE: BPH-503A
SUBJECT NAME: QUANTUM MECHANICS AND APPLICATIONS LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH503A.1 *Demonstrate experiments using Scilab to appreciate nuances involved in the theory of quantum mechanics.*

BPH503A.2 *Verify the correctness of solution of Schrodinger wave equation for Hydrogen atom.*

BPH503A.3 *Determine the solution of the radial part of Schrodinger equation for two electron system.*

BPH503A.4 *Solve the s-wave radial Schrodinger equation for Harmonic and Anharmonic oscillators.*

BPH503A.5 *Expose the solution of s-wave radial Schrodinger equation for the vibrations of hydrogen molecules in Morse potential.*

BPH503A.6 *Perform computational programming for formulation of Pauli's spin matrices and their product.*

BPH503A.7 *Simulate ground state energy of normal He atom.*

BPH503A.8 *Explore computational skills via evaluating commutation brackets of position, energy and momentum operators*

Use C/C^{++}/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state of the hydrogen atom.
2. Solve the s-wave radial Schrodinger equation for the first excited state of the hydrogen atom.
3. Solve the s-wave radial Schrodinger equation for harmonic oscillator.
4. Solve the s-wave radial Schrodinger equation for anharmonic oscillator.
5. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule.
6. Determine the angular momentum of Hydrogen like atoms.
7. Calculate the eigenvalues and eigenstates of simple harmonic oscillator.

8. Formulate Pauli's spin matrices and their products.
9. Estimate the ground state energy of two electron systems like He.
10. Evaluate the commutation brackets of position, energy and momentum operators.

Reference Books:

1. Schaum's outline of Programming with C++.J.Hubbard, 20 00, 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

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-503A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH503A.1	3	3	1	2	1	2	3	2	2	3	3	-	3	-	3	3	2	3
BPH503A.2	3	3	3	3	3	1	3	2	2	3	3	-	3	-	3	3	3	3
BPH503A.3	3	3	3	3	3	2	3	3	3	3	3	-	2	-	3	3	2	3
BPH503A.4	3	3	2	3	3	1	3	3	2	3	2	-	2	-	3	3	3	3
BPH503A.5	3	3	2	3	3	1	3	3	2	3	2	-	2	-	3	3	2	3
BPH503A.6	3	3	2	2	2	3	3	3	2	3	3	-	3	-	3	3	3	3
BPH503A.7	3	3	2	2	3	2	3	3	2	3	2	-	3	-	3	3	3	3
BPH503A.8	3	3	2	2	2	3	3	2	2	3	3	-	3	-	3	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER V
CODE: BPH-504A
SUBJECT NAME: SOLID STATE PHYSICS LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH504A.1 *Demonstrate experiments related to the dielectric properties of materials.*

BPH504A.2 *Verify the properties of magnetic materials like hysteresis in ferromagnetic materials.*

BPH504A.3 *Apply the knowledge of X ray diffraction and explore the different types of crystals.*

BPH504A.4 *Understand the properties of semiconductors using the experiments like hall effect and two probe methods.*

BPH504A.5 *Measure the Magnetic susceptibility of Solids.*

BPH504A.6 *Quantify the materials as magnetic, semiconductor, crystalline or amorphous.*

BPH504A.7 *Determine the Coupling Coefficient of a Piezoelectric crystal.*

BPH504A.8 *Examine change in resistance of a semiconductor with magnetic field.*

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 measure the Dielectric Constant of a dielectric Materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR) technique.
6. To determine the refractive index of a dielectric using SPR technique.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150^{o}C) by four-probe method and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.
11. To measure the resistivity of a semiconductor (Ge) with temperature by two-probe method and to determine its band gap.

12. Analysis of X-Ray diffraction data in terms of unit cell parameters and estimation of particle size.
13. Measurement of change in resistance of a semiconductor with magnetic field.

Reference 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.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-504A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH504A.1	3	1	2	3	3	2	1	3	1	1	2	1	1	1	1	3	2	2
BPH504A.2	3	1	2	2	3	2	1	3	1	2	3	1	1	1	1	3	2	2
BPH504A.3	3	1	2	3	3	2	1	3	1	1	2	1	1	1	1	3	2	2
BPH504A.4	3	1	2	2	3	3	1	2	1	1	3	1	1	1	1	3	2	2
BPH504A.5	3	1	2	3	3	3	1	2	1	1	2	1	1	1	1	3	2	2
BPH504A.6	3	1	2	3	3	3	1	2	1	1	2	1	1	1	1	3	2	2
BPH504A.7	3	1	2	3	3	3	1	2	1	1	2	1	1	1	1	3	2	2
BPH504A.8	3	1	2	3	3	3	1	2	1	1	2	1	1	1	1	3	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Elective Course in Physics (DECP)
Semester-V

Select any two papers and corresponding lab (if any)

B.Sc. (H) PHYSICS SEMESTER V
CODE: DECP-501A
SUBJECT NAME: ATOMIC AND MOLECULAR PHYSICS
NO. OF CREDITS: 6

L	T	P		
			SESSIONAL	: 25
			FINAL EXAM	: 75
5	1	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP501A.1 Understand the fundamental aspects of atomic Physics and X-ray spectra.

DECP501A.2 Understand the behavior of atoms in electric and magnetic fields.

DECP501A.3 Examine the construct of many electron atoms spectra.

DECP501A.4 Understand the rotational and vibrational spectra of molecular structure.

DECP501A.5 Learn the Raman effect for structure determination of molecules.

DECP501A.6 Learn the fundamentals of Lasing action and explore the applications of lasers.

Unit-I
Basics of atomic theory, X-rays and Atomic spectra
Determination of e/m of the Electron, Thompson, Helical Focussing method. Thermionic Emission, Dussmann's equation; **X-rays :-** Ionizing Power, Bohr Atomic Model, Critical Potentials, X-rays-Spectra: Continuous and Characteristic X-rays, Moseley Law.
Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. (12 Lectures)

Unit-II

Atomic spectra in the presence of external fields: Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.
Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).
Many Electron Atomic Spectra: Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.). (18 Lectures)

Unit-IV

Molecular Spectra

Derivation of Rotational Energy levels, Selection Rules and Pure Rotational Spectra of a Molecule. Derivation of Vibrational Energy Levels, Selection Rules and Vibration Spectra. Rotation-Vibration Energy Levels, Selection Rules and Rotation-Vibration Spectra. Determination of Internuclear Distance. (15 Lectures)

Unit-V

Raman effect and Lasers

Raman Effect :- Quantum Theory of Raman Effect. Characteristics of Raman Lines. Stoke's and Anti-Stoke's Lines. Complimentary Character of Raman and infrared Spectra.
Lasers :- Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. (15 Lectures)

Reference Books:

1. Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book Company, 1987)
2. Atomic physics by J.B.Rajam & foreword by Louis De Broglie.(S.Chand & Co., 2007).
3. Atomic Physics by J.H.Fewkes & John Yarwood. Vol. II (Oxford Univ. Press, 1991).
4. Physics of Atoms and Molecules, Bransden and Joachein.
5. Molecular Spectroscopy, Banwell.
6. Optoelectronics by Ghatak and Thyagarajan.
7. Principles of Lasers by Svelto.
8. Atomic and Molecular Physics by Raj Kumar.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-501A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
DECP501A.1	3	3	3	3	3	3	2	3	2	2	2	-	3	-	2	2	2	2
DECP501A.2	3	3	3	3	3	3	2	3	2	3	3	-	2	-	2	2	2	3
DECP501A.3	3	3	3	3	3	3	2	3	2	3	2	-	3	-	2	2	3	3
DECP501A.4	3	3	3	3	3	3	3	3	2	2	2	-	2	-	2	2	3	2
DECP501A.5	3	3	3	3	3	3	3	3	2	2	2	-	2	-	3	3	2	2
DECP501A.6	3	3	3	3	3	3	2	3	2	2	2	-	2	-	2	2	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER V
CODE: DECP-502A
SUBJECT NAME: EXPERIMENTAL TECHNIQUES
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP502A.1 Understand the basics of measurements and error analysis.

DECP502A.2 Learn the fundamentals of transducers and industrial instruments.

DECP502A.3 Examine the working of digital multimeter and impedance bridges.

DECP502A.4 Understand the theory and working of various vacuum systems.

DECP502A.5 Portray the sources of noise in measurement system.

DECP502A.6 Design sensors using transducers and industrial instrumentation.

Unit-I

Measurements: Accuracy and precision. Significant figures. Error and uncertainty analysis. Types of errors: Gross error, systematic error, random error. Statistical analysis of data (Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square) and curve fitting. Gaussian distribution.

Signals and Systems: Fluctuations and Noise in measurement system. S/N ratio and Noise figure. Noise in frequency domain. Sources of Noise: Inherent fluctuations, Thermal noise, Shot noise, 1/f noise

Shielding and Grounding: Methods of safety grounding. Energy coupling. Grounding. Shielding: Electrostatic shielding. Electromagnetic Interference. (12 Lectures)

Unit-II

Transducers & industrial instrumentation (working principle, efficiency, applications): Static and dynamic characteristics of measurement Systems. Generalized performance of systems, Zero order first order, second order and higher order systems. Electrical, Thermal and Mechanical systems. Calibration. Qualitative difference between Transducers and sensors.Types

of sensors (Physical, Chemical and Biological), Characteristics of Transducers.Transducers as electrical element and their signal conditioning. Temperature transducers: RTD, Thermistor, Thermocouples, Semiconductor type temperature sensors (AD590, LM35, LM75) and signal conditioning. Linear Position transducer: Strain gauge, Piezoelectric. Inductance change transducer: Linear variable differential transformer (LVDT), Capacitance change transducers. Radiation Sensors: Principle of Gas filled detector, ionization chamber, scintillation detector.

(16 Lectures)

Unit-III

Digital Multimeter: Comparison of analog and digital instruments. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy and resolution of measurement.

Impedance Bridges and Q-meter: Block diagram and working principles of RLC bridge. Q-meter and its working operation. Digital LCR bridge. (10 Lectures)

Unit-4

Vacuum Systems: Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system- Chamber with roughing and backing, Mechanical pumps (Rotary and root pumps), Diffusion pump & Turbo Molecular pump, Ion pumps, Pumping speed, throughput, Pressure gauges (Pirani, Penning, ionization, cold cathode). (10 Lectures)

Reference Books:

1. Experimental Methods for Engineers, J.P. Holman, McGraw Hill
2. Introduction to Measurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt. Ltd.
3. Transducers and Instrumentation, D.V.S. Murty, 2nd Edition, PHI Learning Pvt. Ltd.
4. Instrumentation Devices and Systems, C.S.Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill
5. Electronic circuits: Handbook of design & applications, U.Tietze, Ch.Schenk, Springer

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-502A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP502A.1	3	1	3	3	3	3	1	3	1	2	2	-	1	1	2	3	3	2
DECP502A.2	3	1	3	3	3	3	1	3	1	2	2	-	1	1	2	3	3	2
DECP502A.3	3	1	3	3	3	3	2	3	2	2	3	-	2	2	3	3	3	3
DECP502A.4	3	1	3	3	3	3	1	3	1	2	2	-	1	1	2	3	3	2
DECP502A.5	3	1	3	3	3	3	2	3	2	2	3	-	2	2	3	3	3	3
DECP502A.6	3	1	3	3	3	3	2	3	2	2	3	-	2	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER V
CODE: DECP-503A
SUBJECT NAME: LINEAR ALGEBRA & TENSOR ANALYSIS
NO. OF CREDITS: 6

L	T	P		
5	1	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP503A.1 *Learn the basic properties of the linear vector space such as linear dependence and independence of vectors, change of basis, isomorphism and homomorphism, linear transformations and their representation by matrices.*

DECP503A.2 *Learn the basic properties of matrices, the different types of matrices and their correspondence to physical quantities, e.g, operators in quantum mechanics.*

DECP503A.3 *They should also learn how to find the eigen-values and eigenvectors of matrices.*

DECP503A.4 *Learn some basic properties and different types of tensors.*

DECP503A.5 *Understand the transformation properties of tensors under coordinate transformations.*

DECP503A.6 *Understand physical examples of tensors such as moment of inertia tensor, energy momentum tensor, stress tensor, strain tensor etc.*

UNIT-I

Linear Vector Spaces Abstract Systems: Binary Operations and Relations. Introduction to Groups and Fields. Vector Spaces and Subspaces. Linear Independence and Dependence of Vectors. Basis and Dimensions of a Vector Space. Change of basis. Homomorphism and Isomorphism of Vector Spaces. Linear Transformations. Algebra of Linear Transformations. Non-singular Transformations. Representation of Linear Transformations by Matrices.

(12 Lectures)

UNIT-II

Matrices, Addition and Multiplication of Matrices: Null Matrices. Diagonal, Scalar and Unit Matrices. Upper-Triangular and Lower-Triangular Matrices. Transpose of a Matrix. Symmetric

and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew-Hermitian Matrices. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices & their properties. Trace of a Matrix. Inner product of vectors.

Eigen-values and Eigenvectors: Finding Eigen – values and Eigen vectors of a Matrix. Diagonalization of Matrices. Properties of Eigen-values and Eigen Vectors of Orthogonal, Hermitian and Unitary Matrices. Cayley-Hamiliton Theorem(Statement only).Finding inverse of a matrix using Cayley-Hamiltion Theorem. Solutions of ordinary second order differential equations and Coupled Linear Ordinary Differential Equations of first order. Functions of a Matrix. (18 Lectures)

UNIT-III

Transformation of Co-ordinates and fundamentals of Tensors. Einstein's Summation Convention. Relation between Direction Cosines. Tensors. Algebra of Tensors. Sum, Difference and Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Invariant Tensors : Kronecker and Alternating Tensors. Association of Antisymmetric Tensor of Order Two and Vectors.

Cartesian Tensors: Vector Algebra and Calculus using Cartesian Tensors : Scalar and Vector Products, Scalar and Vector Triple Products. Differentiation. Gradient, Divergence and Curl of Tensor Fields. Tensor notation of Laplacian operator. Proof of Vector Identities involving scalar and vector products and vector identities involving Del operator under Tensor notation. Isotropic Tensors (Definition only). Tensorial Character of Physical Quantities. Moment of Inertia Tensor. Stress and Strain Tensors : Symmetric Nature. Elasticity Tensor. Generalized Hooke"s Law. (18 lectures)

UNIT-IV

General Tensors Transformation of Co-ordinates. Minkowski Space. Contravariant & Covariant Vectors. Contravariant, Covariant and Mixed Tensors. Kronecker Delta and Permutation Tensors. Algebra of Tensors. Sum, Difference & Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Metric Tensor. (12 Lectures)

Reference Books:

1. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber and F.E.Harris,1970, Elsevier.
3. Modern Mathematical Methods for Physicists and Engineers, C.D. Cantrell, 2011, Cambridge University Press.
4. Introduction to Matrices & Linear Transformations, D.T. Finkbeiner, 1978, Dover Pub.
5. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-503A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP503A.1	3	-	3	3	2	-	-	-	2	1	-	-	-	-	1	3	2	-
DECP503A.2	3	-	3	3	2	-	-	-	3	2	-	-	-	-	1	3	2	-
DECP503A.3	3	-	3	2	3	-	-	-	2	1	-	-	-	-	1	3	2	-
DECP503A.4	3	-	3	3	2	-	-	-	3	-	-	-	-	-	-	3	2	-
DECP503A.5	3	-	3	3	3	-	-	-	2	1	-	-	-	-	-	3	2	-
DECP503A.6	3	-	3	2	2	-	-	-	3	1	-	-	-	-	-	3	2	-

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER V
CODE: DECP-504A
SUBJECT NAME: EXPERIMENTAL TECHNIQUES LAB
NO. OF CREDITS: 2

			SESSIONAL	: 15
L	T	P	FINAL EXAM	: 35
0	0	4	TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP504A.1 *Determine output characteristics of a linear variable differential transformer (LVDT).*

DECP504A.2 *Analyze the characteristics of a Thermostat and determine its parameters.*

DECP504A.3 *Calibrate Semiconductor type temperature sensor and Resistance Temperature Device (RTD).*

DECP504A.4 *Create vacuum in a small chamber using a mechanical (rotary) pump and measure the chamber pressure using a pressure gauge*

DECP504A.5 *Compare noise in cables of different types (co-axial, single shielded, double shielded, without shielding).*

DECP504A.6 *Design and analyze the Clippers and Clampers circuits using junction diode.*

DECP504A.7 *Measure Q of a coil and influence of frequency, using a Q-meter.*

DECP504A.8 *Plot and analyze the frequency response of a microphone.*

At least 06 experiments each from the following:

1. Determine output characteristics of a LVDT & measure displacement using LVDT
2. Measurement of
   (a) Strain using Strain Gauge,
   (b) level using capacitive transducer.
   (c) distance using ultrasonic transducer
3. To study the characteristics of a Thermostat and determine its parameters.
4. Calibrate Semiconductor type temperature sensor (AD590, LM35, LM75) and Resistance Temperature Device (RTD).
5. Create vacuum in a small chamber using a mechanical (rotary) pump and measure the chamber pressure using a pressure gauge.

6. Comparison of pickup of noise in cables of different types (co-axial, single shielded, double shielded, without shielding) of 2m length, understanding of importance of grounding using function generator of mV level & an oscilloscope.
7. To design and study the Sample and Hold Circuit.
8. Design and analyze the Clippers and Clampers circuits using junction diode
9. To plot the frequency response of a microphone.
10. To measure Q of a coil and influence of frequency, using a Q-meter.

Reference Books:

1. Electronic circuits: Handbook of design and applications, U.Tietze and C.Schenk, 2008, Springer
2. Basic Electronics:A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1990, Mc-Graw Hill
3. Measurement, Instrumentation and Experiment Design in Physics & Engineering, M.Sayer and A. Mansingh, 2005, PHI Learning.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for DECP-504A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP504A.1	3	2	3	3	3	3	2	3	1	2	3	1	2	2	2	3	3	3
DECP504A.2	3	2	3	3	3	3	2	3	1	2	3	1	2	2	2	3	3	3
DECP504A.3	3	2	3	3	3	3	2	3	1	2	3	1	2	2	2	3	3	3
DECP504A.4	3	2	3	3	3	3	2	3	1	2	3	1	2	2	2	3	3	3
DECP504A.5	3	2	3	3	3	3	2	3	1	2	3	1	2	2	2	3	3	3
DECP504A.6	3	2	3	3	3	3	2	3	1	2	3	1	2	2	2	3	3	3
DECP504A.7	3	2	3	3	3	3	2	3	1	2	3	1	2	2	2	3	3	3
DECP504A.8	3	2	3	3	3	3	2	3	1	2	3	1	2	2	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER V
CODE: DECP-505A
SUBJECT NAME: BIOLOGICAL & MEDICAL PHYSICS
NO. OF CREDITS: 6

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
5	1	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP505A.1	*Learn the basics of living cells, biological systems and their scaling laws.*
DECP505A.2	*Understand the energy storage and growth mechanisms in the human body.*
DECP505A.3	*Examine the molecular motion in cells by studying the diffusion processes and transport along microtubules.*
DECP505A.4	*Analyze the brain structure and various evolution models in organisms.*
DECP505A.5	*Understand the physical concepts of the human body related to the optical system like eye, electrical signals and acoustic systems.*
DECP505A.6	*Explore the physics of various diagnostic systems and their effect on the human body.*

UNIT-I

Overview: The boundary, interior and exterior environment of living cells. Processes: exchange of matter and energy with environment, metabolism, maintenance, reproduction, evolution. Self-replication as a distinct property of biological systems. Time scales and spatial scales. Allometric scaling laws. (12 Lectures)

UNIT-II

Molecules of life: Metabolites, proteins and nucleic acids. Their sizes, types and roles in structures and processes. Transport, energy storage, membrane formation, catalysis, replication, transcription, translation, signaling. Typical populations of molecules of various types present in cells, their rates of production and turnover. Energy required to make a bacterial cell. Small genetic circuits and signaling pathways (overview only).

Molecular motion in cells: Random walks and applications to biology: Diffusion; models of macromolecules. Entropic forces: Osmotic pressure; polymer elasticity. Chemical forces: Self assembly of amphiphiles. Molecular motors: Transport along microtubules. (18 Lectures)

UNIT-III

Brain structure: neurons and neural networks. Brain as an information processing system. At the level of an ecosystem and the biosphere: Foodwebs. Feedback cycles and self sustaining ecosystems.

Evolution: The mechanism of evolution: variation at the molecular level, selection at the level of the organism. Models of evolution. The concept of genotype-phenotype map. Examples.

(15 Lectures)

UNIT-IV

Physics of The Body: Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. Optical system of the body: Physics of the eye. Electrical system of the body: Physics of the nervous system, Electrical signals and information transfer. Physics of cardiovascular system. Basics of CPR.

Physics of Diagnostic And Therapeutic Systems: Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography. Therapeutic nuclear medicine: Interaction between radiation and matter Dose and isodose in radiation treatment. Medical Instrumentation: Basic Ideas of Endoscope and Cautery, Sleep Apnea and Cpap Machines, Ventilator and its modes.

(15 Lectures)

Reference Books:

1. Biological Physics: Energy, Information, Life; Philip Nelson (W H Freeman &Co, NY, 2004)
2. Physical Biology of the Cell (2nd Edition); Rob Phillips et al (Garland Science, Taylor & Francis Group, London & NY, 2013)
3. An Introduction to Systems Biology; Uri Alon (Chapman and Hall/CRC, Special Indian Edition, 2013) Evolution; M. Ridley (Blackwell Publishers, 2009, 3rd edition)
4. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978)
5. Basic Radiological Physics Dr. K.Thayalan- Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
6. Christensen‟s Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
7. Physics of the human body, Irving P. Herman, Springer (2007).
8. Physics of Radiation Therapy: F M Khan - Williams and Wilkins, 3rdedition (2003)
9. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
10. Handbook of Physics in Diagnostic Imaging: R.S.Livingstone: B.I. Publication Pvt Ltd.
11. The Physics of Radiology-H E Johns and Cunningham.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-505A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP505A.1	3	-	2	2	2	3	-	1	1	-	-	-	-	-	-	3	2	1
DECP505A.2	3	-	2	2	2	3	-	1	1	-	1	-	-	-	-	3	2	1
DECP505A.3	3	1	3	3	3	3	1	2	1	2	2	-	2	-	1	3	3	2
DECP505A.4	3	1	3	3	3	3	1	2	1	2	2	-	2	-	2	3	3	2
DECP505A.5	3	-	3	3	3	3	1	2	1	2	2	-	2	-	1	3	3	2
DECP505A.6	3	1	3	3	3	3	2	3	1	2	2	-	2	-	2	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER V
CODE: DECP-506A
SUBJECT NAME: ASTRONOMY & ASTROPHYSICS
NO. OF CREDITS: 6

L	T	P		
5	1	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP506A.1	*Learn the basics of the Astronomical scale and complete life cycle of a star.*
DECP506A.2	*Explore astronomical techniques involving detectors and optical telescopes.*
DECP506A.3	*Understand characteristics features of the Sun and stellar spectra.*
DECP506A.4	*Learn about Galaxies and basics of Milky way Galaxies.*
DECP506A.5	*Understand Black Body Approximation, H R Diagram and Luminosity Classification in stellar spectra.*
DECP506A.6	*Analyze large scale structure & the law for expanding universe.*

UNIT-I

Astronomical Scales: Astronomical Distance, Mass and Time, Scales, Brightness,Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature. Basic concepts of positional astronomy: Celestial Sphere, Measurement of Time, Apparent Solar Time, Equation of time, Basic Parameters of Stars: Determination of Distance by Parallax Method; Brightness, Determination of Temperature and Radius of a star; Determination of Masses from Binary orbits; Hertzsprung-Russell Diagram.

(15 Lectures)

UNIT-II

Astronomical techniques: Basic Optical Definitions for Astronomy (Magnification of Light Gathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows), Optical Telescopes (Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and Their Use with Telescopes (Types of Detectors, detection Limits with Telescopes). Physical principles: Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein).

(15 Lectures)

UNIT-III

The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere.Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology). The solar family (Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets.

Stellar spectra and classification Structure (Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification)

The milky way : Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Stars and Star Clusters of the Milky Way, Properties of and around the Galactic Nucleus. (15 Lectures)

UNIT-IV

Galaxies: Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies (The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and Lenticular Galaxies (Bulges, Disks, Galactic Halo) The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms.

Large scale structure & expanding universe: Cosmic Distance Ladder (An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables), Hubble's Law (DistanceVelocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter).

(15 Lectures)

Reference Books:

1. Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
2. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing.
3. The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University Science Books.
4. Fundamentals of Astronomy (Fourth Edition), H. Karttunen et al. Springer.
5. K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002.
6. Baidyanath Basu, 'An introduction to Astrophysics', Second printing, Prentice -Hall of India Private limited, New Delhi,2001.
7. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-506A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
DECP506A.1	3	1	2	2	2	2	1	3	1	2	2	-	2	1	2	3	3	1
DECP506A.2	3	1	2	2	2	2	1	3	1	2	2	-	2	1	2	3	3	1
DECP506A.3	3	1	2	2	2	2	1	3	1	2	2	-	2	1	2	3	3	1
DECP506A.4	3	1	2	2	2	2	1	3	1	2	2	-	2	1	2	3	3	1
DECP506A.5	3	1	2	2	2	2	1	3	1	2	2	-	2	1	2	3	3	1
DECP506A.6	3	1	2	2	2	2	1	3	1	2	2	-	2	1	2	3	3	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Syllabus of B.Sc. (H) Physics

Semester VI

Discipline Core Course (DCC)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: BPH-601A
SUBJECT NAME: ELECTROMAGNETIC THEORY
NO. OF CREDITS: 4

L	T	P		
			SESSIONAL	: 25
			FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH601A.1 *Understand the concepts of electrical circuits and network theorems.*

BPH601A.2 *Solve the problems in direct current circuits using the basics of network theorems.*

BPH601A.3 *Learn the concepts of electrostatics and magnetostatics.*

BPH601A.4 *Analyze the problems of electrostatics and magnetostatics in matter.*

BPH601A.5 *Expertise the behaviour of dielectrics and magnetic materials in the presence of external electric fields and magnetic fields respectively.*

BPH601A.6 *Understand the concept of electromagnetic induction.*

UNIT-I

Maxwell Equations: Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. Momentum Density and Angular Momentum Density. (10 Lectures)

UNIT-II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave

propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence) (18 Lectures)

UNIT-III

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. (10 Lectures)

UNIT-IV

Wave Guides: Planar optical wave guides. Wave equations for circular and rectangular hollow waveguides. TE, TM and TEM modes in rectangular wave guides. Condition of continuity at interface. Concept of cutoff frequency. Phase and group velocity of guided waves.

Optical Fibres: Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres. (10 Lectures)

Reference Books:

1. Introduction 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. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
7. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
8. Electromagnetic field theory fundamentals, B.Guru and H.Hiziroglu, 2015, Cambridge University Press
9. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 2010, Wiley
10. Principle of Optics, M. Born and E. Wolf, 6th Edn., 1980, Pergamon Press
11. Optics, A. Ghatak, 5th Edn., 2012, Tata McGraw Hill Education.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-601A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
BPH601A.1	3	1	3	3	3	2	1	3	1	2	1	-	2	1	2	3	3	1
BPH601A.2	3	1	3	3	3	2	1	3	1	2	1	-	2	1	2	3	3	2
BPH601A.3	3	1	3	3	3	2	1	3	1	1	1	-	1	1	2	3	3	1
BPH601A.4	3	1	3	3	3	2	1	3	1	2	1	-	2	1	2	3	3	2
BPH601A.5	3	1	3	3	3	2	1	3	1	2	1	-	2	1	2	3	3	2
BPH601A.6	3	1	3	3	3	2	1	3	1	2	1	-	2	1	2	3	3	1

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: BPH-602A
SUBJECT NAME: STATISTICAL MECHANICS
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH602A.1 *Understand the concepts of microstate, macrostate, ensemble, phase space, thermodynamic probability and partition function.*

BPH602A.2 *Understand the combinatorial studies of particles with their distinguishably or indistinguishably nature and conditions which lead to the three different distribution laws e.g. Maxwell-Boltzmann distribution, Bose-Einstein distribution and Fermi-Dirac distribution laws of particles and their derivation.*

BPH602A.3 *Comprehend and articulate the connection as well as dichotomy between classical statistical mechanics and quantum statistical mechanics.*

BPH602A.4 *Apply the classical statistical mechanics to derive the law of equipartition of energy and specific heat, classical radiation laws of black body radiation. Wien's law, Rayleigh Jeans law, ultraviolet catastrophe and Saha ionization formula.*

BPH602A.5 *Understand the Gibbs paradox, equipartition of energy and concept of negative temperature in two level system.*

BPH602A.6 *Calculate the macroscopic properties of degenerate photon gas using BE distribution law and understand Bose-Einstein condensation law, the concept of Fermi energy and Fermi level.*

Unit-I

Classical Statistics: Macrostate and Microstate, Phase Space, Elementary Concept of Ensemble, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic properties of a system, Classical Entropy Expression, Gibbs Paradox, Sackur-Tetrode equation, Law of Equipartition of Energy (with proof)– Applications to Specific

Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. (14 Lectures)

Unit II

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. (10 Lectures)

Unit III

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. (10 Lectures)

Unit IV

Theory of Radiation: Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Radiation Pressure. Kirchhoff‟s law. Stefan-Boltzmann law: Thermodynamic proof. Wien‟s Displacement law. Wien‟s Distribution Law. Saha‟s Ionization Formula. Rayleigh-Jean‟s Law. Ultraviolet Catastrophe. Spectral Distribution of Black Body Radiation. Planck‟s Quantum Postulates. Planck‟s Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien‟s Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien‟s Displacement law from Planck‟s law. (14 Lectures)

Reference Books:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
4. An Introduction to Statistical Mechanics & Thermodynamics, R.H.Swendsen, 2012, Oxford Univ. Press
5. Statistical Physics , F. Mandl, 2nd Edn., 2003, Wiley
6. Introductory Statistical Mechanics, R. Bowley and M. Sanchez, 2nd Edn., 2007, Oxford Univ. Press
7. A treatise on Heat, M. N. Saha and B.N. Srivastava.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for BPH-602A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
BPH602A.1	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3	2	2
BPH602A.2	3	3	3	3	2	3	2	3	3	2	3	3	3	3	3	3	2	2
BPH602A.3	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3	2	2
BPH602A.4	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3	2	2
BPH602A.5	3	3	2	3	2	3	2	2	3	2	3	3	3	2	3	3	2	2
BPH602A.6	3	3	2	3	2	3	2	2	3	2	2	3	3	2	3	3	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: BPH-603A
SUBJECT NAME: ELECTROMAGNETIC THEORY LAB
NO. OF CREDITS: 2

			SESSIONAL	: 15
L	T	P	FINAL EXAM	: 35
0	0	2	TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH603A.1 *Determine the wavelength and velocity of ultrasonic waves in a liquid and refractive index of liquid/glass by total internal reflection.*

BPH603A.2 *Verify Malus's law, Stefan's law of radiation and Brewster's law.*

BPH603A.3 *Analyze elliptically polarized Light by using a Babinet's compensator.*

BPH603A.4 *Predict the specific rotation of sugar solution using Polarimeter.*

BPH603A.5 *Understand the reflection, refraction and polarization of microwaves.*

BPH603A.6 *Determine Boltzmann constant using V-I characteristics of PN junction diode.*

BPH603A.7 *Find Numerical Aperture of an Optical Fibre.*

BPH603A.8 *Understand polarization of light by reflection and determine the polarizing angle for air-glass interface.*

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 the Brewster's angle.

Reference 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. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-603A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH603A.1	3	2	3	3	3	3	2	3	1	2	1	1	2	2	2	3	3	3
BPH603A.2	3	2	3	3	3	3	2	3	1	2	1	1	2	2	2	3	3	3
BPH603A.3	3	2	3	3	3	3	2	3	1	1	1	1	2	2	2	3	3	3
BPH603A.4	3	2	3	3	3	3	2	3	1	2	1	1	2	2	2	3	3	3
BPH603A.5	3	2	3	3	3	3	2	3	1	2	1	1	2	2	2	3	3	3
BPH603A.6	3	2	3	3	3	3	2	3	1	2	1	1	2	2	2	3	3	3
BPH603A.7	3	2	3	3	3	3	2	3	1	2	1	1	2	2	2	3	3	3
BPH603A.8	3	2	3	3	3	3	2	3	1	2	1	1	2	2	2	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: BPH-604A
SUBJECT NAME: STATISTICAL MECHANICS LAB
NO. OF CREDITS: 2

L	T	P		
0	0	2	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

BPH604A.1 *Study and understand 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 using simulation.*

BPH604A.2 *Understand and plot Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distribution function of N number of particles.*

BPH604A.3 *Understand Planck's law for Black Body radiation and compare it with Rayleigh-Jeans Law at large and small wavelength for a given temperature.*

BPH604A.4 *Study and comprehend Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature.*

BPH604A.5 *Verify Stefan's Law of radiation and determine Stefan's constant.*

BPH604A.6 *Design and perform some experiments to determine Boltzmann' Constant.*

BPH604A.7 *Determine the Planck's constant using light emitting diodes.*

BPH604A.8 *Plot the distribution of relativistic and non-relativistic bosons and fermions as a function of energy, both at high and low temperature particles.*

At least 6 experiments from the following:

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.
e) Computation and study of mean molecular speed and its dependence on particle mass.
f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed

2. Computation of the partition function Z(β) for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics:

a) Study of how Z(β), average energy <E>, energy fluctuation ΔE, C_v, depend upon the temperature, total number of particles N and the spectrum of single particle states.
b) Ratios of occupation numbers of various states for the systems considered above.
c) Computation of physical quantities at large and small temperature T and comparison of various statistics at large and small temperature T.

3. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at large and small wavelength for a given temperature.

4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases.

5. Plot the following functions with energy at different temperatures

a) Maxwell-Boltzmann distribution
b) Fermi-Dirac distribution
c) Bose-Einstein distribution

6. Plot the distribution of particles w.r.t. energy (dN/dε versus ε) 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.

Laboratory based Experiments

7. To determine the Planck's constant using LEDs of at least 4 different colours.
8. To verify the Stefan`s law of radiation and to determine Stefan's constant.
9. To determine Boltzmann constant using I-V characteristics of PN junction diode.

Reference Books:

1. ElementaryNumericalAnalysis, K.E.Atkinson, 3rd Edn. 2007, WileyIndiaEdition
2. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
3. Introduction to Modern Statistical Mechanics, D.Chandler, Oxford University Press, 1987
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6. Statistical and Thermal Physics with computer applications, Harvey Gould and Jan Tobochnik, Princeton University Press, 2010.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for BPH-604A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
BPH604A.1	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3	2	2
BPH604A.2	3	3	3	3	2	3	2	3	3	2	3	3	3	3	3	3	2	2
BPH604A.3	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3	2	2
BPH604A.4	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3	3	2	2
BPH604A.5	3	3	2	3	2	3	2	2	3	2	3	3	3	2	3	3	2	2
BPH604A.6	3	3	2	3	2	3	2	2	3	2	2	3	3	2	3	3	2	2
BPH604A.7	3	3	2	3	2	3	2	2	3	2	2	3	3	2	3	3	2	2
BPH604A.8	3	3	2	3	2	3	2	2	3	2	2	3	3	2	3	3	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Discipline Elective Course in Physics (DECP)
Semester-VI

Select any two papers and corresponding lab (if any)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: DECP-601A
SUBJECT NAME: NUCLEAR AND PARTICLE PHYSICS
NO. OF CREDITS: 6

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
5	1	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP601A.1 *Interpret the general facts and fundamental properties of nucleus.*

DECP601A.2 *Illustrate the various nuclear models such as Liquid drop model, Nuclear shell model, Fermi gas model etc. and their roles in explaining the ground state properties of nuclei.*

DECP601A.3 *Describe the nuclear decays and nuclear reactions along with their occurrence probabilities.*

DECP601A.4 *Explain the basic interaction mechanisms for charged particles and electromagnetic radiation and explain the working principles behind detectors and their characteristic properties with respect to energy resolution, efficiency etc.*

DECP601A.5 *Describe the principles and basic constructions of particle accelerators such as the Van-de-Graaff generator, cyclotron, betatron and synchrotron.*

DECP601A.6 *Acquire a thorough understanding of the fundamental interactions, elementary particles, the classifications of particles: leptons, hadrons (baryons and mesons), conservation laws and quarks models for elementary particles.*

Unit-I

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density, nuclear matter density, binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/Z plot, angular momentum, parity, magnetic moment, electric quadrupole moment.

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure and the basic assumption of shell model (15 Lectures)

Unit-II

Radioactivity decay: (a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow's theory of α-decay factor, Geiger Nutt all 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

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, Coulomb scattering (Rutherford scattering).

(15 Lectures)

Unit-III

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter (photoelectric effect, Compton scattering, pair production), neutron interaction with matter.

Detector for Nuclear Radiations: Gas filled detectors: Basic principle, 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. (15 Lectures)

Unit-IV

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons (Principle, construction, working, advantages and disadvantages). .

Particle physics: Particle interactions (concept of different types of forces); basic features, types of particles and its families. Conservation Laws(energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness), concept of quark model.

(15 Lectures)

Reference Books:

1. Nuclear Physics by I. Kapelon.
2. Nuclear Physics by W.E. Burcham.
3. Nuclear Physics by Enge.
4. Atomic Nucleus by Evans.
5. Nuclear Physics by S. N. Ghoshal, First edition, S. Chand Publication, 2010.
6. Concepts of Nuclear Physics by Bernard L Cohen, Tata McGraw Hill Publication, 1974.
7. Introductory Nuclear Physics by Kenneth S, Krane, Wiley-India Publication, 2008
8. Radiation detection and measurement, G.F. Knoll, John Wiley & Sons, 2010.
9. Introduction to elementary particles by David J Griffiths, Wiley, 2008.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-601A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP601A.1	3	3	2	3	2	1	2	3	3	1	2	-	3	-	3	3	3	2
DECP601A.2	3	3	3	3	3	2	3	3	3	2	2	-	3	-	3	3	3	2
DECP601A.3	3	3	2	2	2	2	2	3	3	2	2	-	2	-	3	3	3	3
DECP601A.4	3	3	3	3	3	1	3	3	3	1	3	-	3	-	3	3	3	3
DECP601A.5	3	3	3	3	3	1	3	3	3	2	3	-	3	-	3	3	3	3
DECP601A.6	3	3	2	2	2	2	3	3	3	2	3	-	2	-	3	3	2	2

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: DECP-602A
SUBJECT NAME: NANO MATERIALS AND APPLICATIONS
NO. OF CREDITS: 4

			SESSIONAL	: 25
L	T	P	FINAL EXAM	: 75
4	0	0	TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP602A.1	*Understand the basics of Nano Science and Nano Technology*.
DECP602A.2	*Apply the Quantum Mechanics for Nanomaterials.*
DECP602A.3	*Learn the various Growth Techniques of Nanomaterials.*
DECP602A.4	*Use the Characterization Tools of Nanomaterials for research applications.*
DECP602A.5	*Aware about the optical properties of nanomaterials.*
DECP602A.6	*Understand the application of nanomaterial.*

Unit-I

NANOSCALE SYSTEMS: Density of states (1-D,2-D,3-D). Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods)**,** Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences.

(12 Lectures)

Unit-II

SYNTHESIS OF NANOSTRUCTURE MATERIALS: Top down and Bottom up approach, Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, Chemical vapor deposition (CVD).Sol-Gel. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods.

CHARACTERIZATION: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy. (12 Lectures)

Unit-III

OPTICAL PROPERTIES: Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence.

(12 Lectures)

Unit-IV

APPLICATIONS: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

(12 Lectures)

Reference books:

1. C.P.Poole, Jr. Frank J.Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.)
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)
3. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).
4. Introduction to Nanoelectronics, V.V. Mitin, V.A. Kochelap and M.A. Stroscio, 2011, Cambridge University Press.
5. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-602A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP602A.1	3	2	2	2	2	3	2	3	1	1	2	-	2	1	2	3	3	3
DECP602A.2	3	2	3	3	3	3	2	3	2	2	3	-	3	2	3	3	3	3
DECP602A.3	3	2	2	2	2	3	2	3	1	1	2	-	2	1	2	3	3	3
DECP602A.4	3	2	3	3	3	3	2	3	2	2	3	-	3	2	3	3	3	3
DECP602A.5	3	2	3	3	3	3	2	3	2	2	3	-	3	2	3	3	3	3
DECP602A.6	3	2	3	3	3	3	2	3	2	2	3	-	3	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: DECP-603A
SUBJECT NAME: PHYSICS OF DEVICES AND COMMUNICATION
NO. OF CREDITS: 4

L	T	P		
4	0	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP603A.1	*Understand the fabrication and study of advanced electronic device.*
DECP603A.2	*Learn the basics of IC fabrication process and various scales of IC fabrication.*
DECP603A.3	*Learn various electronic filters and Phase Locked Loop circuits.*
DECP603A.4	*Understand standards of communication the various communication systems.*
DECP603A.5	*Explore frequency modulation and demodulation.*
DECP603A.6	*Examine metal oxide semiconductor based devices like MOSFETs.*

Unit-I

Devices: Characteristic and small signal equivalent circuits of UJT and JFET. Metal-semiconductor Junction. Schottky diode, Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO_2-Si based MOS, C-V characteristics of MOS, MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, basic idea of CMOS.

(12 Lectures)

Unit-II

Processing of Devices: Basic process flow for IC fabrication. Crystal plane and orientation. Diffusion and implantation of dopants. Passivation. Oxidation Technique for Si. Contacts and metallization technique. Wet etching. Dry etching (RIE). Photolithography. Electron-lithography, Basic idea of SSI, MSI, LSI, VLSI and USI. (12 Lectures)

Unit-III

RC Filters: Passive-Low pass and High pass filters, Active (1st order butterworth) –Low Pass, High Pass, Band Pass and band Reject Filters.

Ph**ase Locked Loop (PLL):** Basic Principles, Phase detector (XOR and edge triggered), Voltage Controlled Oscillator (Basics, varactor). Lock and capture. Basic idea of PLL IC (565 or 4046).

Digital Data Communication Standards:

Serial Communications: RS232, Handshaking, Implementation of RS232 on PC, Universal Serial Bus (USB), USB standards, Types and elements of USB transfers. (12 Lectures)

Unit-IV

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. Frequency modulation and demodulation, basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK, PSK, FSK. (12 lectures)

Reference Books:

1. Physics of Semiconductor Devices, S.M.Sze and K.K.Ng, 3rd Edition 2008, John Wiley & Sons
2. Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000, PHI Learning Pvt. Ltd
3. Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt. Ltd
4. Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
5. Introduction to Measurements & Instrumentation, A.K.Ghosh, 3rd Edition, 2009, PHI Learning
6. Semiconductor Physics and Devices, D.A. Neamen, 2011, 4th Edition, McGraw Hill
7. PC based instrumentation; Concepts and Practice, N. Mathivanan, 2007, Prentice-Hall of India.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-603A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP603A.1	3	2	2	2	2	3	2	3	1	1	2	-	2	1	2	3	3	3
DECP603A.2	3	2	2	2	2	3	2	3	1	1	2	-	2	1	2	3	3	3
DECP603A.3	3	2	2	2	2	3	2	3	1	1	2	-	2	1	2	3	3	3
DECP603A.4	3	2	3	3	3	3	2	3	2	2	3	-	3	2	3	3	3	3
DECP603A.5	3	2	3	3	3	3	2	3	2	2	3	-	3	2	3	3	3	3
DECP603A.6	3	2	3	3	3	3	2	3	2	2	3	-	3	2	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: DECP-604A
SUBJECT NAME: NANO MATERIALS AND APPLICATIONS LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP604A.1	*Synthesize metal or semiconductor nanoparticles by chemical route.*
DECP604A.2	*Analyze XRD pattern of nanomaterials and estimate particle size.*
DECP604A.3	*Prepare composite of carbon nanotubes CNTs with other materials.*
DECP604A.4	*Grow quantum dots by thermal evaporation.*
DECP604A.5	*Prepare disc of ceramic of a compound using ball milling, pressing and sintering.*
DECP604A.6	*Fabricate thin film of nanoparticles by spin coating (or chemical route).*
DECP604A.7	*Prepare thin film capacitor and measure capacitance as a function of temperature or frequency.*
DECP604A.8	*Fabricate PN diode by diffusing Al over the surface of N-type Si and analyze its V-I characteristic.*

At least 06 experiments from the following:

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. Analysis of XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. To prepare composite of CNTs with other materials.
7. Growth of quantum dots by thermal evaporation.
8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.

10. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.
11. Fabricate a PN diode by diffusing Al over the surface of N-type Si and study its V-I characteristic.

Reference Books:

1. C.P.Poole, Jr. Frank J.Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company).
3. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for DECP-604A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP604A.1	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP604A.2	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP604A.3	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP604A.4	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP604A.5	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP604A.6	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP604A.7	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP604A.8	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: DECP-605A
SUBJECT NAME: PHYSICS OF DEVICES AND COMMUNICATION LAB
NO. OF CREDITS: 2

L	T	P		
0	0	4	SESSIONAL	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP605A.1	*Design and analyze the Clippers and Clampers circuits, power supply using bridge rectifier, and active low and high pass filters.*
DECP605A.2	*Analyze the output characteristics of junction field effect transistor and metal oxide semiconductor field effect transistor.*
DECP605A.3	*Understand amplitude modulation using transistor.*
DECP605A.4	*Design an Astable multivibrator of given specifications.*
DECP605A.5	*Understand characteristics of a Uni-junction Transistor and design a simple Relaxation Oscillator*
DECP605A.6	*Design analog pulse modulation techniques and Pulse code modulation using ICs.*
DECP605A.7	*Analyze lock and capture range of Phase-locked loop.*
DECP605A.8	*Simulate electronic circuits and devices using SPICE/MULTISIM.*

At least 06 experiments each from section-A and section-B:

Section-A:

1. Design and analyze the Clippers and Clampers circuits using junction diode
2. To design a power supply using bridge rectifier and study effect of C-filter.
3. To design the active Low pass and High pass filters of given specification.
4. To design the active filter (wide band pass and band reject) of given specification.
5. To study the output and transfer characteristics of a JFET.
6. To design a common source JFET Amplifier and study its frequency response.
7. To study the output characteristics of a MOSFET.
8. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
9. To design and study an Amplitude Modulator using Transistor.
10. To design PWM, PPM, PAM and Pulse code modulation using ICs.

11. To design an Astable multivibrator of given specifications using transistor.
12. To study a PLL IC (Lock and capture range).
13. To study envelope detector for demodulation of AM signal.
14. Study of ASK and FSK modulator.
15. Glow an LED via USB port of PC.
16. 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 electronic circuits and devices***

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 1^{st} 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.
11. To study the characteristics of a Thermostat and determine its parameters.
12. Calibrate Semiconductor type temperature sensor (AD590, LM35, LM75) and Resistance Temperature Device (RTD).

Reference Books:

1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller,1994, Mc-Graw Hill
2. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
3. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4^{th} edn., 2000, Prentice Hall.
5. Introduction to PSPICE using ORCAD for circuits& Electronics, M.H.Rashid,2003, PHI Learning.
6. PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India.

SUGGESTED WEB SOURCES:

1. Virtual Labs (vlab.co.in)

MODE OF TRANSACTION: Demonstration, E-tutoring, discussion; **LMS/ICT Tools:** Online Resources.

Mapping of CO and PO for DECP-605A

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2	PSO3
DECP605A.1	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP605A.2	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP605A.3	3	2	3	3	3	3	2	3	2	2	2	-	3	1	3	3	3	3
DECP605A.4	3	2	3	3	3	3	2	3	2	2	3	-	3	1	3	3	3	3
DECP605A.5	3	2	3	3	3	3	2	3	2	2	3	-	3	1	3	3	3	3
DECP605A.6	3	2	3	3	3	3	2	3	2	2	3	-	3	1	3	3	3	3
DECP605A.7	3	2	3	3	3	3	2	3	2	2	3	-	3	1	3	3	3	3
DECP605A.8	3	2	3	3	3	3	2	3	2	2	3	-	3	1	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

B.Sc. (H) PHYSICS SEMESTER VI
CODE: DECP-606A
SUBJECT NAME: CLASSICAL DYNAMICS
NO. OF CREDITS: 6

L	T	P		
5	1	0	SESSIONAL	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-A is compulsory and contains 10 questions each of 1.5 marks covering the entire syllabus. Part-B has 6 questions each of 15 marks and students are required to attempt any four questions from this part.

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

DECP606A.1	*Acquire insightful knowledge of the Newtonian and Lagrangian formulations of classical mechanics and their applications in appropriate physical problems.*
DECP606A.2	*Describe the Hamiltonian formulation and apply the same over various physical systems.*
DECP606A.3	*Evaluate Poisson and Lagrange Brackets and establish relationships between their properties.*
DECP606A.4	*Develop a deep understanding to tackle the problems of small oscillations.*
DECP606A.5	*Demonstrate the concept of motion of a particle under central force and apply advanced methods to deal with central force problems.*
DECP606A.6	*Use Hamilton-Jacobi theory for finding the solutions of various Classical systems.*

Unit-I
Lagrangian formulations
Degrees of freedom of a system, Generalized coordinates and velocities. Hamilton's principle, Lagrangian and Lagrange's equations of motion of one-dimensional simple harmonic oscillators, falling body in uniform gravity. Cyclic coordinates. Derivation of Lagrange's equations from Hamilton's principle, Principle of Least Action and its applications, Canonical Transformation.
(15 lectures)

Unit-II
Hamiltonian formulations: Hamiltonian. The physical significance of the Hamiltonian, Hamilton's equations of motion. Comparison of Newtonian, Lagrangian and Hamiltonian

mechanics. Applications of Hamiltonian mechanics: Hamiltonian for a simple harmonic oscillator, solution of Hamilton's equations for simple harmonic oscillations (1-D), particle in a central force field – conservation of angular momentum and energy. (15 Lectures)

Unit-III

Poisson bracket and theory of small oscillations

Poisson bracket, Poisson theorem, Poisson bracket and canonical transformation, Jacobi identity and its derivation, Lagrange bracket and its properties, the relationship between Poisson and Lagrange brackets and its derivation, the angular momenta and Poisson bracket, Liouville's theorem.

Small Amplitude Oscillations: Minima of potential energy and points of stable equilibrium, Theory of small oscillations: small amplitude oscillations about the minimum, normal modes of longitudinal simple harmonic oscillations (maximum 2 masses connected by 3 springs). Kinetic energy (T) and potential energy (V) in terms of normal co-ordinates. T and V matrices: finding eigen-frequencies and eigen-vectors using these matrices. Normal modes of frequencies and normal coordinates. (18 Lectures)

Unit-IV

Two-body central force problem and H-J theory

Two body central force problem: Reduction to the equivalent one body problem, the equation of motion and first integrals, classification of orbits, the Virial theorem, the differential equation for the orbit, integrable power law in time in the Kepler's problem, H-J Theory: H-J equation and their solutions. (12 Lectures)

Reference Books:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3 rdEdn. 2002,Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
3. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
4. Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
5. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press
6. Classical Mechanics, Tai L. Chow, CRC Press.
7. Classical Mechanics (3rd ed., 2002) by H. Goldstein, C. Poole and J. Safko
8. Classical Mechanics of particles and rigid bodies by K. C. Gupta.

SUGGESTED WEB SOURCES:

1. NPTEL :: Courses
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
3. https://swayam.gov.in/

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Mapping of CO and PO for DECP-606A

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**	**PO14**	**PO15**	**PSO1**	**PSO2**	**PSO3**
DECP606A.1	3	3	3	3	3	1	3	3	3	3	2	-	1	-	3	3	3	2
DECP606A.2	3	3	3	3	3	2	3	3	3	3	3	-	2	-	3	3	3	2
DECP606A.3	3	3	3	3	3	1	3	3	2	3	3	-	2	-	3	3	3	1
DECP606A.4	3	3	3	3	3	2	3	3	2	2	2	-	2	-	3	3	3	2
DECP606A.5	3	3	3	3	3	1	2	3	3	3	2	-	2	-	3	3	3	1
DECP606A.6	3	3	3	3	3	1	2	3	2	2	2	-	2	-	3	3	3	1

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Mapping of the subjects with the following:

S. No.	Course Name	Course Code	Employability	Entrepreneurship	Skill Development
1.	Mathematical Physics-I	BPH-101A	2	0	1
2.	Mechanics	BPH-102A	2	0	1
3.	Mathematical Physics-I Lab	BPH-103A	2	0	2
4.	Mechanics Lab	BPH-104A	2	1	2
5.	Electricity & Magnetism	BPH-201A	2	0	1
6.	Waves & Optics	BPH-202A	2	0	1
7.	Electricity & Magnetism Lab	BPH-203A	2	1	2
8.	Waves & Optics Lab	BPH-204A	2	1	2
9.	Mathematical Physics-II	BPH-301A	2	0	1
10.	Thermal Physics	BPH-302A	2	0	1
11.	Analog Systems & Applications	BPH-303A	2	1	2
12.	Mathematical Physics-II Lab	BPH-304A	2	0	2
13.	Thermal Physics Lab	BPH-305A	2	1	2
14.	Analog Systems & Applications Lab	BPH-306A	2	1	2
15.	Mathematical Physics-III	BPH-401A	2	0	1
16.	Elements of Modern Physics	BPH-402A	2	0	1
17.	Digital Systems & Applications	BPH-403A	2	1	2
18.	Mathematical Physics-III Lab	BPH-404A	2	0	2
19.	Elements of Modern Physics Lab	BPH-405A	2	1	2
20.	Digital Systems & Applications Lab	BPH-406A	2	1	2
21.	Computational Physics Skills	SECP-01A	2	2	3
22.	Electrical Circuits & Network Skills	SECP-02A	2	2	3
23.	Basic Instrumentation Skills	SECP-03A	2	2	3

24.	Computational Physics Skills Lab	SECP-04A	2	2	3
25.	Electrical Circuits & Network Skills Lab	SECP-05A	2	2	3
26.	Basic Instrumentation Skills Lab	SECP-06A	2	2	3
27.	Renewable Energy and Energy Harvesting	SECP-07A	3	2	3
28.	Renewable Energy and Energy Harvesting Lab	SECP-08A	3	2	3
29.	Quantum Mechanics & Applications	BPH-501A	2	0	1
30.	Solid State Physics	BPH-502A	2	0	1
31.	Quantum Mechanics & Applications Lab	BPH-503A	2	1	2
32.	Solid State Physics Lab	BPH-504A	2	1	2
33.	Atomic & Molecular Physics	DECP-501A	2	0	2
34.	Experimental Techniques	DECP-502A	3	2	3
35.	Linear Algebra & Tensor Analysis	DECP-503A	2	0	2
36.	Experimental Techniques Lab	DECP-504A	3	2	3
37.	Biological & Medical Physics	DECP-505A	2	2	2
38.	Astronomy & Astrophysics	DECP-506A	3	1	1
39.	Electromagnetic Theory	BPH-601A	2	0	2
40.	Statistical Mechanics	BPH-602A	2	0	1
41.	Electromagnetic Theory Lab	BPH-603A	2	1	2
42.	Statistical Mechanics Lab	BPH-604A	2	0	1
43.	Nuclear & Particle Physics	DECP-601A	2	0	2
44.	Nano Materials & Applications	DECP-602A	3	3	3
45.	Physics of Devices & Communication	DECP-603A	3	3	3
46.	Nano Materials & Applications Lab	DECP-604A	3	3	3
47.	Physics of Devices & Communication Lab	DECP-605A	3	3	3
48.	Classical Dynamics	DECP-606A	2	0	1

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)