DEPARTMENT OF PHYSICS

Four years B.Sc. (Honours) OBE Curriculum

for

Session: 2022-23, 2023-24 & 2024-25

Effective from

Session: 2022 - 2023

DEPARTMENT OF PHYSICS

FACULTY OF SCIENCE

COMILLA UNIVERSITY, CUMILLA

Bachelor of Science (Honours) in Physics
Curriculum
Sustaining OBE Compliance

Part A: Introduction

1. **Title of the Academic Program:**

   Bachelor of Science (Honours) Degree in Physics

2. **Name of the University:**

   Comilla University

3. **Vision of the University:**
   Vision:
   Comilla University is committed to empowering society, advancing development, promoting human welfare and sustainable planet

4. **Mission of the University:**

Mission: To meet its vision, Comilla University sets its mission-

1. To educate a wide variety of students through effective teaching-learning to achieve academic excellence.

2. To create an ambience for creative and innovative academic exercise through high quality research.

3. To undertake actions regarding collaboration which entails opportunities of long-term interaction with academia and industry for producing competent graduate at workplace.

4. To develop human potential to its fullest extent so that intellectually capable and socially responsible leaders can emerge in a range of profession.

Core Value: Comilla University is committed to nurture.

Integrity: The highest level of sincerity and moral, ethical, and professional conducts

Intellectual Curiosity: Insatiable thirst for knowledge to expand intellectual horizon, go beyond the comfort zone, and bring back wonders for development.

5. Name of the Program Offering Entity:

Department of Physics

6. Vision of the Program Offering Entity:

To produce next generation leading physicists and contribute to Bangladesh and the world.

7. Mission of the Program Offering Entity

1. To generate new idea by engaging in cutting-edge research and to promote academic growth by offering state-of-the-art undergraduate, postgraduate and doctoral programs.
2. To prepare the students for employment in various physics related areas and for pursuit of advanced degrees in physics/physics related subjects by educating them fundamental concepts, knowledge and laboratory techniques.
3. To develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.
4. To identify areas of specialization based on an informed perception of Bangladesh in regional and global needs upon which the department can concentrate.
5. To undertake collaborative national and international projects which can offer opportunities for long-term interaction with academia and industry.

8. Objectives of the Program Offering Entity:

- **Objectives of B.Sc. (Honours) Program in Physics are to**
  - Provide the students with fundamental and advanced knowledge of a broad spectrum of physics courses.
  - Provide the students with different practical, intellectual, computational, experimental, communication, analytical and transferable skills.
  - Create the facilities and environment in the department and to motivate and inspire the students to create deep interest in Physics, to develop broad and balanced knowledge and understanding of physical concepts, principles and theories of Physics.
  - Provide opportunities to the students to learn, design and perform experiments in the laboratories, gain an understanding of laboratory methods, analysis of observational data and report writing, and acquire a deeper understanding of concepts, principles and theories learned in the classroom through laboratory demonstration, computational methods and modeling.
  - Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics.
  - Prepare the students for pursuing the interdisciplinary and multidisciplinary research in Physics.
  - Emphasize the importance of Physics as the most important discipline for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment.
  - Enhance the collaboration with other universities and research centers in home and abroad.

9. **Name of the Degree:** B.Sc. (Hons.) in Physics

10. Description of the program:

The duration of the Bachelor (Hons.) degree program in Physics shall be four academic years divided into eight semesters. Each academic year is divided into two semesters to be called as 1st semester and 2nd semester. An academic semester is comprised of six months. For achieving Bachelor (Hons.) degree in Physics, a student requires to earn a total of 140 credit points successfully with a minimum CGPA of 2.25; and complete the program within six academic years from her/his 1st admission to the program. A student who fails to secure a minimum CGPA of 2.25 after completing eighth semester final examination but succeeds in securing a CGPA between 2.00 and 2.25 will be eligible for a Pass degree.

11. Graduate Attributes (based on need assessment)

Some of the characteristic attributes of a graduate in Physics are

Attibute-1: Disciplinary knowledge and skills

Capable of demonstrating comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in core areas of Physics-like Classical Mechanics, Quantum Mechanics, Thermodynamics, Statistical Mechanics, Electricity, Magnetism, Electromagnetic Theory, Wave Theory, Optics, Solid State Physics, Nuclear and Particle Physics, Astronomy and Cosmology etc.

Ability to use laboratory methods and modern instrumentation for designing and implementing new experiments in Physics, interdisciplinary/multidisciplinary research areas and industrial research.

Attribute-2: Skilled communicator

Able to transmit abstract concepts and complex information relating to all areas in Physics in a clear and concise manner through scientific report writing. Able to express complex relationships and information through graphical methods and proper tabulation. Capable of explaining complex processes through simulation and modeling. Able to express complex and technical concepts orally in a simple, precise and straightforward language for better understanding.

Attribute-3: Creative & critical thinker and problem solver

Able to employ creative and critical thinking and efficient problem solving skills in all the basic areas of Physics.

Attribute-4: **Sense of inquiry**

Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Physics and beyond. Planning, executing and reporting the results of theoretical or experimental investigation.

Attribute-5: Team worker/player

Capable of working effectively in diverse teams in both class room, laboratory, Physics workshop and industry, and field-based situations.

Attribute-6: Digitally Efficient

Capable of using computers for computational and simulation studies in Physics. Proficient in using appropriate software for numerical and statistical analysis of data, accessing and using modern e-library search tools. Able to locate, retrieves, and evaluates information from renowned Physics archives. Proficient in accessing observational and experimental data made available by renowned research laboratories for further analysis.

Attribute-7: Ethical awareness

The graduates should be capable of demonstrating the ability to think and analyze rationally with modern and scientific outlook and adopt unbiased objectives and truthful actions in all aspects of work. They should be capable of identifying ethical issues related to their work. They should be ready to appropriately acknowledge direct and indirect contributions received from all sources. They should be willing to contribute to the free development of knowledge in all forms. Further, unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, or not adhering to intellectual property rights should be avoided.

Attribute-8: Social, national and international perspective

The graduates should be able to develop a perspective about the significance of their knowledge and skills for social well-being and a sense of responsibility towards human society and the world. They should have a national as well as an international perspective about their work and career in the chosen field of academic and research activities.

Attribute-9: Lifelong learners

Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling in all areas of Physics.

12. Program Educational Objectives (PEOs):

PEO1	To produce graduates with advance knowledge in Physics who are able to apply theories and principles of Physics in the domain of research, industry, and development.
PEO2	To produce competent and creative graduates who are able to solve physics related problems within the national, global and sustainable development perspective.
PEO3	To produce graduates who are engaged in continuous pursuit of knowledge through gaining education and research with professional development activities.
PEO4	To produce graduates who are globally acceptable professionals for government, corporate and research organizations along with skills for entrepreneurial pursuits in multidisciplinary areas.
PEO5	To provide with value based and ethical leadership in the professional and social life.

13. Program Learning Outcomes (PLOs):

PLO1	***Knowledgeable***- Graduate will be able to acquire a fundamental/systematic understanding of the academic field of Physics, its different learning areas and applications in basic Physics.
PLO2	***Skillful***- Graduate will be able to attain skills in areas related to one's specialization area within the disciplinary/subject area of Physics, and current and emerging developments in the field of Physics.
PLO3	***Analyzer***- Graduate will be able to identify, analyze and formulate novel ideas to yield, substantial results in the fields of research utilizing the principles of Physics.
PLO4	***Problem solver***- Graduate will be able to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems. Identify and apply appropriate principles and methodologies to solve a wide range of problems associated with Physics.
PLO5	***Complex problem solving designer***- Graduate will be able to design a well-defined mathematical model to solve different types of Physics-related problems.
PLO6	***Innovative-*** Graduate will be able to develop creative thinking and innovative tools.
PLO7	***Digitally efficient***- Graduate will be able to achieve digital literacy skills to adapt evolving technologies, use computers for computational and simulation studies in Physics and stay competitive in a digitally driven job market.
PLO8	***Communicative***- Graduate will be able to disseminate ideas and information effectively both in oral and written ways to a range of audiences for a variety of purposes and contribute in a positive and collaborative manner in both class room, laboratory and in industry and field-based situations.
PLO9	***Individually and Team player with versatility***- Graduate will be able to be entrepreneurial, a capacity builder or academic leader.
PLO10	***Accountable and Ethical***- Graduate will be committed, accountable, responsible, and ethical.

14. Mapping mission of the university with PEOs:

PEOs	Mission-1	Mission-2	Mission-3	Mission-4
PEO1	3	2	1	-
PEO2	2	1	2	
PEO3	2	2	2	-
PEO4	1	1	1	2
PEO5	-	-	1	1

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

15. Mapping PLO with PEOs:

PEOs	**PEO-1**	**PEO-2**	**PEO-3**	**PEO-4**	**PEO-5**
PLO1	3		3	2	
PLO2		2	2		
PLO3	2		2	1	
PLO4		1	2		
PLO5		2	1		
PLO6		2	1		
PLO7				1	
PLO8			1	2	
PLO9				2	1
PLO10			1		2

16. Mapping Courses with the PLOs:

Course Code	Course Title	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
0533-111	Mechanics	3	2	2	2	2	3	1	-	-	-
0533-112	Vector Analysis	3	2	3	2	2	2	1	-	-	-
0533-113	Electricity and Magnetism	2	2	3	3	2	3	1	-	-	-
0533-114	Properties of Matter	2	3	3	3	3	3	-	-	-	-
0541-115	Mathematics-I (Algebra, Trigonometry and Geometry)	3	2	1	3	1	3	-	-	-	-
0531-116	Chemistry-I (Inorganic and Organic Chemistry)	3	2	2	-	-	2	-	2	-	-
0533-117	Physics Practical	3	2	2	3	1	-	-	-	-	-
0533-121	Heat and Thermodynamics	3	2	2	3	1	3	-	-	-	-
0533-122	Vibrations and Waves	3	2	2	3	3	2	-	-	-	-
0541-123	Mathematics-II (Calculus and Differential Equation)	3	2	2	3	1	3	-	-	-	-
0531-124	Chemistry-II (Physical chemistry)	3	2	3	1	-	2	-	-	-	-
0542-125	Introduction to Statistics	3	1	2	1	-	2	-	-	-	-

0533-126	Physics Practical	3	2	-	3	1	-	-	-	-	
0533-127	General Viva	3					1		3		
0533-211	Optics	3	2				2		3		
0533-212	Mathematical Methods in Physics	3	2	2	3	1	3				
0611-213	Computer Fundamentals and Numerical Analysis	3	2	2	3	1	3				
0231-214	Communicative English	3	2	2	3	1	3				
0533-215	Physics Practical	3	2	3	2	-	2				
0531-216	Chemistry Practical	2	3				3		1		
0542-217	Statistics Practical	1		2	1						
0533-221	Atomic and Molecular Physics	3	2	2					3		
0533-222	Classical Mechanics and the Special theory of Relativity	3	2	2	3	2	3				
0533-223	Astronomy and Cosmology	3	2	2	3	1	3				
0231-224	Communicative English Lab	3	2	2	3	1	3				
0611-225	Computer Programming Lab	3	2	2	3	2	3	1	1	1	
0533-226	Physics Practical	3	1	2	1		2				
0533-227	General Viva	3					1		3		
0533-311	Quantum Mechanics-I	3	3	2	3	1	3	-	-	-	-
0533-312	Classical Electrodynamics	3	3	2	3	1	2	-	-	-	-
0533-313	Electronics-I	3	1	3	2	-	-	-	-	-	1
0533-314	Statistical Mechanics	3	2	2	2	2	2	-	-	-	-
0223-315	Personal Skills Development and Professional Ethics	3	-	1	2	-	3	-	2	-	3
0533-316	Physics Practical	2	2	2	2	2	2	-	-	-	-
0533-321	Solid State Physics-I	3	2	3	2	2	2	2	-	-	-
0533-322	Nuclear Physics-I	3	1	2	3	-	1	2	1	-	-
0533-323	Electronics-II	3	2	3	2	1	1				
0314-324	Liberation War and Bangladesh Studies	-	-	3	-	1	-	-	3	-	1
0533-325	Physics Practical	2	2	2	2	2	2	-	-	-	-
0533-326	General Viva	3					1		3		
0533-411	Quantum Mechanics-II	3	3	3	3	3	3				
0533-412	Nuclear Physics-II	3	3	3	3		2				
0533-413	Digital Electronics	2	2	3	3	3	3	3			
0533-414	Plasma Physics	3	3	3	3	3	3				

0533-415	Physics Practical	3	2	3	3	3		3			
0533-421	Solid State Physics-II	3	2	3	3	3	3				
0533-422	Reactor Physics	3		3	3	3					
0533-423	Renewable Physics	3	3	3	2	2	3				
0533-424	Experimental Techniques in Physics	3	2	3	3	3	2				
0533-425	Physics Practical	3	3	3	3	3	3	3			
0533-426	General Viva	3					1		3		

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

QUALIFICATION FOR ADMISSION

Student passing the Higher Secondary Certificate (H.S.C) examination in science from an Education Board of Bangladesh or a recognized equivalent examination from home and abroad may be admitted to the program of Bachelor of Science with Honours in Physics in this University on such terms and conditions as may be determined by the University from time to time.

TOTAL CREDIT HOURS REQUIREMENT AND DURATION OF THE PROGRAM

To obtain B.Sc. (Hons.) degree in Physics, students will have to complete 140 credit hours with a minimum CGPA of 2.25. The program having 8 semesters normally extends over a period of **4 (four) academic years** and shall be completed by a student **in not more than 6 (six) academic years**.

DURATION OF THE ACADEMIC PROGRAM

The duration of the program shall be 4 (four academic years divided into 8 (eight) semesters. Each academic year is divided into two semesters to be called as 1st semester and 2nd semester.

An academic semester comprised of six months is distributed as follows:

i.	Class Teaching (actual class)	= 14 weeks
ii.	Preparation time for semester final examination	= 2 weeks
iii.	Semester final examination	= 3 weeks
	Total	**= 19 weeks**

NATURE OF THE COURSES AND SEMESTER-WISE CREDIT DISTRIBUTION

The program is an integrated one consisting of 35 theoretical (major and allied) courses, 12 practical courses and 4 general viva courses. The examination of general viva will be held at the end of each academic year (i.e., at the end of the 2nd semester of each academic year). The Semester-wise credits and marks distribution are as follows:

Year	Semester	No. of courses		Credits				Marks			
		Theoretical	Practical	Theoretical	Practical	Viva	Total	Theoretical	Practical	Viva	Total
First	First	06	01	18	3	--	21	600	100	--	700
	Second	05	01	15	3	1	19	500	100	50	650
Second	First	04	03	11	7	--	18	350	200	--	550
	Second	03	03	8	8	1	17	250	250	50	550
Third	First	05	01	15	3	--	18	500	100	--	600
	Second	04	01	12	3	1	16	400	100	50	550
Fourth	First	04	01	12	3	--	15	400	100	--	500
	Second	04	01	12	3	1	16	400	100	50	550
TOTAL		**35**	**12**	**103**	**33**	**4**	**140**	**3400**	**1050**	**200**	**4650**

Category of Courses

Area	Course Status	Course Title	Credit
Core Courses	**Theory (26)**	Mechanics	**80**
		Vector Analysis	
		Electricity and Magnetism	
		Properties of Matter	
		Heat and Thermodynamics	
		Vibrations and Waves	
		Optics	
		Mathematical Methods in Physics	
		Atomic and Molecular Physics	
		Classical Mechanics and the Special Theory of Relativity	
		Astronomy and Cosmology	
		Quantum Mechanics-I	
		Classical Electrodynamics	
		Electronics-I	
		Statistical Mechanics	
		Solid State Physics-I	
		Nuclear Physics-I	
		Electronics-II	
		Quantum Mechanics-II	
		Nuclear Physics -II	
		Digital Electronics	
		Plasma Physics	
		Solid State Physics-II	
		Reactor Physics	
		Renewable Physics	
		Experimental Techniques in Physics	
Core Courses	**Lab (08)**	Physics Practical (Lab for 1st Year 1st Semester)	**24**
		Physics Practical (Lab for 1st Year 2nd Semester)	
		Physics Practical (Lab for 2nd Year 1st Semester)	
		Physics Practical(Lab for 2nd Year 2nd Semester)	

		Physics Practical (Lab for 3rd Year 1st Semester)	
		Physics Practical(Lab for 3rd Year 2nd Semester)	
		Physics Practical (Lab for 4th Year 1st Semester)	
		Physics Practical(Lab for 4th Year 1st Semester)	
GED Courses	**Theory (09)**	Mathematics-I (Algebra, Trigonometry and Geometry)	**26**
		Chemistry-I (Inorganic and Organic Chemistry)	
		Mathematics-II (Calculus and Differential Equation)	
		Chemistry-II (Physical chemistry)	
		Introduction to Statistics	
		Computer Fundamentals and Numerical Analysis	
		Communicative English	
		Personal Skills Development and Professional Ethics	
		Liberation War and Bangladesh Studies	
GED Courses	**Lab (04)**	Chemistry Practical	**09**
		Statistics Practical	
		Communicative English Lab	
		Computer Programming Lab	

MEDIUM OF INSTRUCTION

The medium of instruction of B.Sc. (Hons.) in Physics Program is English.

CLASS HOURS (50 MINUTES EACH)

Theoretical and Practical courses are so designed as to be completed by the following class hours:

a. Theoretical courses of 2 credits in 28 class hours, 3 credits in 42 class hours and 4 credits in 56 class hours.
b. Practical courses of 2 credits in 14×2×2 class hours, 3 credits in 14×3×2 class hours and 4 credits in 14×4×2 class hours.

DEGREE RQUIREMENTS

a. For B.Sc. (Hons.) in Physics a student is required to:

i. Earn required number of total credit points successfully;
ii. Earn a minimum CGPA of 2.25; and
iii. Complete the program within six academic years from her/his 1st admission to the program.

b. Award of B. Sc. Pass Degree:

i. A student who fails to secure a minimum CGPA of 2.25 after completing eighth semester final examination but succeeds in securing a CGPA between 2.00 and 2.25 will be eligible for a B. Sc. Pass Degree.

EXAMINATION ENTRY REQUIREMENTS

A student will be allowed to take part in Semester final examination if s/he fulfills the following conditions:

a. If the student has registered for the concerned semester in due time.
b. If s/he has the required percentage of attendance in each course lecture.
c. If the student has paid all dues (registration fees/tuition fees/other charges) applicable to university administration/residential hall administration etc.
d. If the student has not been instructed by the Disciplinary Board/Examination Disciplinary Committee to refrain from taking part in the examination.

IMPROVEMENT OF GRADE

Only the removal of 'F' (Fail) in any course shall be allowed. Removal of 'F' in any course is permitted for sitting in the final examination only for two (2) times in subsequent two semesters excluding the regular examination. In such cases results shall be one grade down (unless the result is a "D" grade) in tabulation and calculation of CGPA.

DROP OUT

a. If a student re-admitted twice in any semester fails to earn minimum required credits for promotion s/he shall be dropped out from the program.
b. If a student fails to earn required total credit points within six academic years since admissions, s/he will be dropped-out from the program and will no more be allowed to continue his/her studentship with other program.

RE-ADMISSION

a. A student failing to earn the requisite credit points for promotion from one semester to the next may seek re-admission with the following batch.

b. For re-admission a student shall have to apply within one month after the announcement of the result of the concerned semester.

CREDIT TRANSFER

No Credit transfer from any other program/University /Institutions to the Comilla University is allowed.

EVALUATION SYSTEM FOR THEORETICAL COURSES

a. Theoretical Course: Each theoretical course offered should be composed of either 50 or 100 marks (each 50 marks course consisting of 2 credit point). The proportion of the total marks of a particular course shall be distributed as follows:

Continuous Assessment /Before-Final Assessment		40%
Semester-Final Examination		60%
Total	=	100%

b. Continuous Assessment: Marks allocated for before-final assessment shall be distributed as follows:

i. ***Internal Evaluation:***

a) Mid-Semester examination (At least two mid-semester exams) = 20%

b) Class Test and/or Quiz and/or In-course and/or Sudden test and/or Tutorial and/or Assignment and/or Term paper preparation & presentation/ Case study and/or Practical and/or Field work = 10%-15%

c) Class Attendance = 10%-5%

Total = 40%

ii. ***Class Attendance:*** The marks allocated for class attendance shall be given as following proportions:

Attendance	**Marks**
90% and above	**100%**
85% to less than 90%	**90%**
80% to less than 85%	**80%**
75% to less than 80%	**70%**
70% to less than 75%	**60%**
65% to less than 70%	**50%**
60% to less than 65%	**40%**
Less than 60%	**00%**

EVALUATION SYSTEM FOR LABORATORY COURSES

Credit specification:

Different credits will be assigned to laboratory courses as mentioned in the syllabus of the department on the basis of importance. Two laboratory hours per week for the duration of 14 weeks will be considered as one (1) credit.

Laboratory Examination:

For laboratory courses students will evaluated in two phases. The marks distribution will be as follows:

Continuous Assessment:	**40%**
Attendance:	10%
Performance:	20%
Report Writing:	10%

Final Assessment:	**60%**
Evaluation on Experiments:	50%
Viva-voce:	10%

Detail distribution of Marks for the evaluation on experiment will be decided by the Examination Committee and the course teachers.

DETAILS OF THE COURSE DISTRIBUTION

The details course distribution for the execution of the B.Sc. (Hons.) in Physics program is given below:

First Year: Semester I

Course Code		Course Title	Credits	Full Marks
ISCED	Departmental			
0533- 111	PHY-111	Mechanics	3	100
0533- 112	PHY-112	Vector Analysis	3	100
0533- 113	PHY-113	Electricity and Magnetism	3	100
0533- 114	PHY-114	Properties of Matter	3	100
0541- 115	PHY-115	Mathematics-I (Algebra, Trigonometry and Geometry)	3	100
0531- 116	PHY-116	Chemistry-I (Inorganic and Organic Chemistry)	3	100
0533- 117	PHY-117	Physics Practical	3	100
		Total	**21**	**700**

First Year: Semester II

Course Code		Course Title	Credits	Full Marks
ISCED	Departmental			
0533- 121	PHY-121	Heat and Thermodynamics	3	100
0533- 122	PHY-122	Vibrations and Waves	3	100
0541- 123	PHY-123	Mathematics-II (Calculus and Differential Equation)	3	100
0531- 124	PHY-124	Chemistry-II (Physical chemistry)	3	100
0542- 125	PHY-125	Introduction to Statistics	3	100
0533- 126	PHY-126	Physics Practical	3	100
0533- 127	PHY-127	General Viva	1	50
		Total	**19**	**650**

Second Year: Semester I

Course Code		Course Title	Credits	Full Marks
ISCED	Departmental			
0533- 211	PHY-211	Optics	3	100
0533- 212	PHY-212	Mathematical Methods in Physics	3	100
0611- 213	PHY-213	Computer Fundamentals and Numerical Analysis	3	100
0231- 214	PHY-214	Communicative English	2	50
0533- 215	PHY-215	Physics Practical	3	100
0531- 216	PHY-216	Chemistry Practical	2	50
0542- 217	PHY-217	Statistics Practical	2	50
		Total	**18**	**550**

Second Year: Semester II

Course Code		Course Title	Credits	Full Marks
ISCED	Departmental			
0533- 221	PHY-221	Atomic and Molecular Physics	3	100
0533- 222	PHY-222	Classical Mechanics and the Special Theory of Relativity	3	100
0533- 223	PHY-223	Astronomy and Cosmology	2	50
0231- 224	PHY-224	Communicative English Lab	2	50
0611- 225	PHY-225	Computer Programming Lab	3	100
0533- 226	PHY-226	Physics Practical	3	100
0533- 227	PHY-227	General Viva	1	50
		Total	**17**	**550**

Third Year: Semester I

Course Code		Course Title	Credits	Full Marks
ISCED	Departmental			
0533- 311	PHY-311	Quantum Mechanics-I	3	100
0533- 312	PHY-312	Classical Electrodynamics	3	100
0533- 313	PHY-313	Electronics-I	3	100
0533- 314	PHY-314	Statistical Mechanics	3	100
0223- 315	PHY-315	Personal Skills Development and Professional Ethics	3	100
0533- 316	PHY-316	Physics Practical	3	100
		Total	**18**	**600**

Third Year: Semester II

Course Code		Course Title	Credits	Full Marks
ISCED	Departmental			
0533- 321	PHY-321	Solid State Physics-I	3	100
0533- 322	PHY-322	Nuclear Physics-I	3	100
0533- 323	PHY-323	Electronics-II	3	100
0314- 324	PHY-324	Liberation War and Bangladesh Studies	3	100
0533- 325	PHY-325	Physics Practical	3	100
0533- 326	PHY-326	General Viva	1	50
		Total	**16**	**550**

Fourth Year: Semester I

Course Code		Course Title	Credits	Full Marks
ISCED	Departmental			
0533- 411	PHY-411	Quantum Mechanics-II	3	100
0533- 412	PHY-412	Nuclear Physics-II	3	100
0533- 413	PHY-413	Digital Electronics	3	100
0533- 414	PHY-414	Plasma Physics	3	100
0533- 415	PHY-415	Physics Practical	3	100
		Total	**15**	**500**

Fourth Year: Semester II

Course Code		Course Title	Credits	Full Marks
ISCED	Departmental			
0533- 421	PHY-421	Solid State Physics-II	3	100
0533- 422	PHY-422	Reactor Physics	3	100
0533- 423	PHY-423	Renewable Energy Physics	3	100
0533-424	PHY-424	Experimental Techniques in Physics	3	100
0533- 425	PHY-425	Physics Practical	3	100
0533- 426	PHY-426	General Viva	1	50
		Total	**16**	**550**

TEACHING STRATEGY

Popular strategies are Lecture, Visualization, Case method, Discussion, Active learning (Apply what students are learning), Cooperative learning (small groups work together for achieving a common goal), Integrating technology, Inquiry-based instruction, Behaviour management.

DETAILS OF THE COURSE CONTENT

First Year First Semester

Course Title: Mechanics

Course Code: 0533-111 [PHY-111] **Credit Hour: 03**

(a) Rationale/Course Summary

This course is designed to give students the theoretical insights of the motion and reason behind the motion of a single particle and that of a system of particles. To support the theories, this course covers a range of practical examples that allow students to understand different physical processes happening around in nature as well as in everyday life. Mechanical problem-solving various mathematical tools/ techniques introduced in this course will give the students further a strong basis for designing and solving advanced level kinematics and dynamics related problems.

(b) Course content

1. **Kinematics and Particle Dynamics:** Concept of motion and frame of reference, Equation of motion, Tangential and normal components of acceleration in a plane, Projectile motion, Uniform Circular motion, Newton's laws of motion, Concept of mass and force, Frictional forces and their laws.
2. **Work, Energy and Power:** Work done by constant and variable forces, Kinetic and potential energies, Work-Energy theorem, Conservative and non-conservative forces, One dimensional forces depending on position only, two and three dimensional conservative systems, Principle of conservation of energy.
3. **Conservation of Linear Momentum:** Centre of mass, Motion of a system of particles and its linear momentum, Conservation of linear momentum for a system of particles, Application of the momentum principle in the cases of rocket propulsion and collision phenomena.
4. **Rotational Kinematics:** Rotational motion, Rotational quantities as vectors, Rotation with constant angular acceleration, Relation between linear and angular kinematics of a particle in circular motion, Centripetal force and centrifugal force, Application of Centripetal and Centrifugal force.
5. **Rotational Dynamics:** Torque and angular momentum, Kinetic energy of rotation and rotational inertia (moment of inertia), Rotational dynamics of rigid body, Parallel and perpendicular axes theorem, Calculation of moment of inertia, Application of moment of inertia, Conservation of angular momentum.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Have clear ideas on motion, reference frame, conservative- and non-conservative forces, linear and angular momenta and their conservation, torque, inertia, and other relevant quantities that help to understand/ explain physical processes involving motion.

CLO-2: Understand and explain the motion of a single particle and that of a many particles system in one-, two-, and three dimensions, and correlate the knowledge with concurrent technologies.

CLO-3: Understand the factor(s) responsible for causing or restrict the motion of a body and hence can take the measures accordingly.

CLO-4: Understand different fundamental laws, principles, and theories that govern different types of physical phenomena involved in mechanics and apply them to solve different mechanical problems in everyday life.

CLO-5: Know how to apply the knowledge of mechanics to deal with different physical systems, and hence to develop new ideas that will help creating new knowledge and technologies.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	2	1	-	-	-	-	1	-	-	-
CLO-3	2	-	-	2	-	-	-	-	-	-
CLO-4	-	-	2	3	-	-	-	-	-	-
CLO-5	-	1	-	-	1	2	-	-	1	2

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-2	Lecturing, Discussion and Student Activities	Presentation and Summative Exam
CLO-3	Lecturing and Discussion	Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Interactive Discussion and Student Activities	Quiz

Course Title: Vector Analysis

Course Code: 0533-112 [PHY-112] **Credit Hour: 03**

(a) Rationale/Course Summary

This course will introduce students to a number of mathematical techniques that are required in all areas of physics. It can also serve as a base for future physics courses. Analytical and advanced method from the fundamental theorem of vector will be provided to allow for the analysis of the various theorems being investigated.

(b) Course content

1. **Vectors and Scalars:** Vector and Scalar quantities, Vector addition and subtraction, Scalar multiplication, Null and Unit vectors, Rectangular unit vectors, Components of vectors, Scalar field and Vector field.
2. **Scalar and Vector Product:** Scalar and vector products of two vectors, Angle between two vectors, Physical significance of dot and cross product of vectors, Triple product, Reciprocal sets of vectors.
3. **Vector Differentiation:** Vector differentiation, Ordinary derivatives of vector-valued functions, Space curve, Motion: velocity and acceleration, Partial derivatives of vectors, Vector differential operators/nabla, Directional derivatives, Gradient, Divergence and Curl of a vector, Physical significance of gradient, divergence and curl, Laplacian operators, Uses of Vectors of Operators.
4. **Vector Integration and Theorem:** Vector integration, Ordinary integrals of vector valued functions, Line integrals, Surface integrals, Volume integrals, Gauss's divergence theorem, Green's theorem in the plane and Stokes' theorem.
5. **Coordinate System:** Spherical, polar and cylindrical coordinate systems – unit vectors and vector components in spherical and cylindrical systems, Special orthogonal coordinate systems, Surface and volume element and Del and Laplacian operators in polar and cylindrical coordinates.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course, students will be able to

CLO-1: Gather sound knowledge of scalar &vectors quantities, scalar & vectors product, and then combine these operations to define certain triple products.

CLO-2: Understand conceptual ideas of co-ordinate system, vector differentiation & integration, theorem and vector & scalar product.

CLO-3: Solve problems related to Gradient, Divergence and Curl of a vectors using different vectors operators.

CLO-4: Describe different integrations, such as vector integrations, line integral, surface integral, volume and multiple integrals.

CLO-5: Select and apply appropriate theorem and principle for solving problems and explain them by using the language of mathematics.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-	-	-
CLO-3	-	1	-	3	-	-	-	-	-	-
CLO-4	-	-	2	-	2	3	2	-	-	-
CLO-5	-	-		2	2	2	2	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Electricity and Magnetism

Course Code: 0533-113 [PHY-113] **Credit Hour: 03**

(a) Rationale/Course Summary

Electricity and Magnetism/Electromagnetism is a branch of physics involving the study of the electromagnetic force, a type of physical interaction that occurs between electrically charged particles. The electromagnetic force usually exhibits electromagnetic fields such as electric field, magnetic fields and light, and is one of the four fundamental interactions in nature. The knowledge of AC and DC circuits will be provided to analyze the different network theorems.

(b) Course content

1. **Electrostatics:** Coulomb's Law, Gravitational force and electrical force, Electric field, Point charge in an electric field, Dipole in an electric field, Electric flux, Gauss's law and it's applications, Potential and field strength, Potential due to a point charge, Potential due to a dipole, Electric potential energy, An insulated conductor, Electrostatic generator, Equipotential surface.

2. **Capacitors and Dielectrics:** Capacitance- its calculation, Capacitance with dielectric, Parallel plate capacitor with dielectric, Dielectrics: an atomic view, Dielectric and Gauss's law, Electric vectors, Energy stored in a charged capacitor.

3. **Current and Resistance:** Current and Current density, Ohm's law, Drift speed and charge carrier, Resistances, Resistivity and conductivity, Resistivity - an atomic view, Energy transfer in an electric circuit, Electromotive force and potential difference, Kirchhoff's laws, Single loop and multi loop circuits, RC circuits.

4. **Magnetic fields and Interactions:** Magnetic force, Magnetic induction and magnetic effects of currents, Biot-Savart law and its applications, Ampers' law and its applications. Magnetic force on a charge and on current, Torque on a current loop, Moving coil galvanometer, The Hall effect.

5. **Electromagnetic Induction and Inductance:** Faraday's law of electromagnetic induction, Lenz's law, Motional emf, Self and mutual Inductance, LR circuit, Energy and energy density stored in a magnetic field.

6. **Direct Current and Circuits:** RC, RL, LC and RLC circuits with dc source, Series and Parallel RLC circuits, their analysis and application.

7. **Alternating Current and Circuits:** Alternating voltage and current and their graphical representation, R.M.S value of an AC voltage applied to resistors; capacitors and inductors, AC current and voltage in series RL and in series RC circuits, LCR circuits, Power dissipation in an AC circuit, Transformer, The simple AC generators, RC, RL, LC & RLC circuits with dc and ac sources, Series and parallel RLC circuits and their analysis and application.

8. **Network Theorem:** Superposition theorem, Reciprocity theorem, Maximum power transfer theorem, Thevenin's theorem, Norton's theorem, Application of network theorem in practical circuits.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Gather sound knowledge about charge and electricity and understand the nature of the electric and magnetic fields and investigate the interactions between them.

CLO-2: Describe the effect of conduction on electricity, effect of dielectric and Gauss's laws in capacitors and describe how electromagnetic fields and interactions effect in nature and able to attain skills in electromagnetism.

CLO-3: Able to analyze different fundamental laws, to calculate electric power dissipated in circuit and formulate noble ideas in electromagnetic fields.

CLO-4: Solve problems related to electromagnetic circuits and different network theorems and able to develop creative thinking and innovative ideas related to electromagnetism.

CLO-5: Able to update themselves in the current developments and discoveries related to electricity and magnetic fields and interactions able to find out well defined solutions or mathematic model to solve different type of AC and DC circuits.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	2	2	-	-	-	-	-	-	-	-
CLO-2	-	2	-	-	-	-	-	-	-	-
CLO-3	-	-	3	-	-	-	-	-	-	-
CLO-4	-	-	-	3	2	6	-	-	-	-
CLO-5	-	-	-	-	5	3	1	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Lecturing and Discussion	Assignment and Summative Exam
CLO-3	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Properties of Matter

Course Code: 0533-114 [PHY-114] **Credit Hour: 03**

(a) Rationale/Course Summary

This course will introduce students to the fundamental properties of gravitation and elasticity. It enables us to know the properties of a fluid at rest and in motion. The course is regarded as a basic course for the students of physics. It provides the knowledge to see the elastic behavior of solids, adhesion between liquids and solids and the effects of a fluid on a body completely or partially immersed in it.

(b) Course content

1. **Gravitation:** Newton's law of motion, Kepler's laws of planetary motion, Gravitational attraction of a sphere, Determination of Gravitational constant, Mass and

density of the earth, Inertial and gravitational mass, Gravitational field, Gravitational potential energy, Escape velocity, Energy and orbits, Qualities of gravitation, The acceleration due to gravity, Variation in 'g', Measurement of the acceleration due to gravity, Application of Gravitational law, Satellite, Communication through Satellite.

2. **Elasticity:** Stress, Plane stress, Example of plane stress, Strain, Hook's law, Stress-strain diagram, Elastic hysteresis, Elastic modulus, Poision's ratio, Problems, Internal elastic potential energy, Relation between elastic constants, Torsion, Coil Spring, Determination of the elastic constants, The bending of beams, Cantilever, Variation of elasticity with temperature.

3. **Hydrostatics and Surface Tension:** Hydrostatic pressure, Change of pressure with elevation, Pascal's law, Hydrostatic paradox, Thrust on an immersed plane, Center of pressure, Equilibrium of floating bodies, Surface tension and surface energy, Pressure difference across a surface film, Adhesive and cohesive forces, Molecular theory of surface tension, Capillarity, Angle of contact and its measurement, Experimental determination of surface tension variation of surface tension with temperature.

4. **Hydrodynamics and Viscosity:** General concepts of fluid flow, Streamlines, Equation of continuity, Bernoulli's equation, Applications of Bernoulli's equation and equation of continuity, Viscosity, Coefficient of viscosity, Critical velocity and Reynold's number, Poiseuille's formula and its correction, Stokes law, Measurement of viscosity, Variation of viscosity with temperature and pressure.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Gather complete knowledge of properties of matter and describe the theory of gravitation, Newton's law of motion, Kepler's laws of planetary motion, elastic behavior of materials, and cantilever.

CLO-2: Describe the hydrostatic paradox, causes of the surface tension, pressure difference across a surface film, distinguish between adhesive & cohesive forces, effect of various factors on surface tension, capillary principle to calculate capillary rise or fall in a given tube and distinguish between surface tension and surface energy.

CLO-3: Explain and use Pascal's principle, equation of continuity, Bernoulli's equation, Poiseuille's equation, viscosity for analyzing and solving the problem in various situations of physics.

CLO-4: Solve problems related to calculations involving gravitation, elasticity for the different type of materials, surface tension, capillarity, rate of flow of liquid, coefficient of viscosity and Poiseuille's formula.

CLO-5: Development of critical thinking and problem-solving skills through the application of mathematical techniques and physical principles to solve complex problems in properties of matter.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	2	3	-	2	-	-	-	-	-	-
CLO-2	-	-	-	3	1	2	-	-	-	-
CLO-3	-	-	3	-	2	1	-	-	-	-
CLO-4	-	1	2	-	3	-	-	-	-	-
CLO-5	-	-	-	2	1	3	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Mathematics-I (Algebra, Trigonometry and Geometry)

Course Code: 0541-115 [PHY-115] **Credit Hour: 03**

(a) Rationale/Course Summary

Algebra, Trigonometry and Geometry are the foundations of mathematics. It plays an important role in engineering, physics and other discipline. This course is designed to provide some useful and applicable ideas on set theory, Inequalities, Algebraic and trigonometric series, Geometrical problem can be solved by algebra and algebraic problem can be solved by geometry.

(b) Course content

Algebra:

1. **Elements of set theory:** Sets and subsets, Set operations, Cartesian product, Relations, order relation, equivalence relation, functions, images and inverse images, Injective, Surjective and bijective functions, inverse functions.
2. **Theory of equations:** Synthetic division, number of roots of polynomial equations, relations between roots and coefficients, Descarte's rule of signs, symmetric functions of roots.
3. Summation of series, convergence and divergence of series, inequalities.

Geometry:

Coordinate geometry of two dimensions, General equations of the second degree, Pair of straight lines, Reduction of standard forms of the equation of circle, Parabola, Ellipse, Hyperbola, Pole and polars.

Trigonometry:

De Moivre's theorem and its applications, Hyperbolic functions, Summation of series including hyperbolic series.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Gather sound knowledge about the image and inverse image of elements of two sets, make comparison between sets and establish relation between two sets.

CLO-2: Learn to solve problems related to summation of series, convergence and divergence of series, Inequalities.

CLO-3: Description about the coordinate geometry of two dimensions pair of straight lines and identification of Parabola, Ellipse, Hyperbola and pole and polars.

CLO-4: Realization and explanation of the nature of trigonometric series and hyperbolic functions to formulate new mathematical ideas.

CLO-5: Development of critical thinking and problem-solving skills using the application of the De Moivre's theorem to solve several equations.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-	-	-
CLO-3	2	1	-	-	-	-	-	-	-	-
CLO-4	-	-	2	-	-	3	-	-	-	-
CLO-5	-	-	-	2	1	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Chemistry-I (Inorganic and Organic Chemistry)

Course Code: 0531-116 [PHY-116] **Credit Hour: 03**

(a) Rationale/Course Summary

This course serves distinct purposes in understanding and manipulating different types of compounds and their behavior. While inorganic chemistry focuses on elements other than carbon and their diverse properties, organic chemistry is centered around carbon-containing compounds that are integral to life and offer extensive synthetic possibilities. Both branches collectively contribute to advancements in various scientific and industrial domains.

(b) Course content

1. **Atomic Structure:** Atomic theory of matter, Elementary idea on Atomic Structure, Elementary idea on nucleus, Electronic Configuration of Elements, Fundamental particles.
2. **Periodic Classification of Elements:** Modern Periodic Table, Periodic Classification of Elements, Correlation of Periodic Classification with Electronic Configuration; Investigation on some Periodic Properties, Atomic Radius, Ionic Radius, Covalent Radius, Ionization Potential, Electron Affinity, Electronegativity.
3. **Group Study of Elements:** Alkali Metals, Alkaline Earth metals, Halogens, Transition Elements, Occurrence, Oxidation states and bond types, Physical and chemical properties
4. **Chemical Bond:** Different Types of Chemical Bonding, Hybridization of Atomic Orbitals and Shapes of Molecules, Molecular Orbitals, Bond Length and Bond Strength, Bond order, Ionic, Covalent, Coordinate, metallic bonds.
5. **Acid and bases:** Arrhenius, Bronsted-Lowry and Lewis concept, Self-Ionization of water; pH-A measure of acidity; The relationship between conjugate acid-base ionization constant; Molecular structure and strength of acids and bases; Hard and soft acids and bases

6. **Oxidation and reduction**: Electronic concept of oxidation-reduction; Oxidation number and oxidation state; Balancing oxidation-reduction equations; half-reaction method; Strengths of oxidizing and reducing agents; Oxidation-reduction potential.

7. **Aliphatic and Aromatic Compounds:** Nomenclature of Organic Compounds, Preparation and Properties of Alcohols, Halides, Aldehydes, Ketones, Aromaticity, Orientations, Preparations and Properties of Benzene, Phenol, Nitrobenzene and Aniline, Elementary Idea on Alicyclic and Heterocyclic Compounds.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Gather a clear outline of the knowledge and skills by studying inorganic and organic Chemistry.

CLO-2: Describe the structure and properties of inorganic and organic compounds including their electronic structure, bonding, and reactivity.

CLO-3: Compare between different organic and inorganic compounds.

CLO-4: Apply knowledge of reaction mechanisms to predict the outcomes of various organic reactions.

CLO-5: Apply inorganic and organic compounds in industry, medicine and environment.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	2	-	-	-	-	-	-	-	-
CLO-2	2	-	2	-	-	-	-	-	-	-
CLO-3	2	-	-	-	-	-	-	-	-	-
CLO-4	-	-	-	-	-	2	-	-	-	-
CLO-5	-	-	-	-	-	-	-	2	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Discussion and Student Activities	Assignment and Summative Exam

CLO-5	Discussion and Student Activities	Assignment and Summative Exam

Course Title: Physics Practical

Course Code: 0533-117 [PHY-117] **Credit Hour: 03**

(a) Rationale/Course Summary

This course will introduce students with advanced research techniques in various branches of physics experiment and improve their skills to solve problems in practical physics. In this course, students will learn to operate compound pendulum, flywheel, Searle's apparatus, capillary tube, spinal spring and Joule's calorimeter and will be able to use specialized apparatus safely.

(b) Course content

List of Experiment

1. Determination of acceleration due to gravity **'g'** by means of a Compound Pendulum.
2. Determination of moment of inertia of a flywheel about its axis of rotation.
3. Determination of rigidity modulus of a wire by dynamic method.
4. Determination of the spring constant and effective mass of a given spiral spring and hence to calculate the rigidity modulus of the material of the spring.
5. Determination of Young's modulus (Y) of material of a wire by Searle's apparatus.
6. Determination of surface tension of water at room temperature by capillary tube method.
7. Determination of surface tension of mercury.
8. Determination of the coefficient of viscosity of water by capillary tube method.
9. Determination of the specific heat of a liquid by the method of cooling.
10. Determination of the value of J, the mechanical equivalent of heat by electrical method.

(c) Course Learning Outcomes (CLOs)

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

CLO-1: Achieve experimental knowledge about acceleration due to gravity, moment of inertia, various elastic modulus, surface tension, viscosity and the mechanical equivalent of 'J'.

CLO-2: Solve different experimental problems related to Properties of matter, Elasticity, Fluid mechanics and Heat & thermodynamic.

CLO-3: Realization of basic principles of compound pendulum, flywheel, Searle's apparatus, capillary tube, spinal spring and Joule's calorimeter.

CLO-4: Familiarize basic laws of Properties of matter, Elasticity, Fluid mechanics and Heat & thermodynamic.

CLO-5: Learning how to write scientific (or technical) reports and papers.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	1	-	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-	-	-
CLO-3	-	-	2	-	-	-	-	-	-	-
CLO-4	-	2	2	2	-	-	-	-	-	-
CLO-5	-	-	3	2	1	-	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Heat and Thermodynamics

Course Code: 0533-121[PHY-121] **Credit Hour: 03**

(a) Rationale/Course Summary

This course will introduce students to the basic laws of heat and thermodynamics. It may be regarded as a fundamental course for the students of physics. From experimental, mathematical and conceptual ideas students can gain the general consequences of the principles that apply to any system regardless of the microscopic detail.

(b) Course content

1. **Concept of Temperature and Heat Transfer**: Concept of temperature, Thermal expansion, Seebeck effect, Thermocouple, Newton's law of cooling, Heat capacities, Conduction, Thermal conductivity and thermal diffusivity, Rectilinear flow of heat, Experimental measurements of thermal conductivity for a good and bad conductor, Heat conduction through composite walls, Convection.
2. **Kinetic Theory of Gases**: Fundamental assumption of kinetic theory of gases, Equation of state of an ideal gas, RMS velocity, Equipartition of energy, Translational kinetic energy, Mean free path, Maxwell's theory of distribution of velocities,

Brownian motion, Degrees of freedom & Molar Specific Heats, Van der Waals' Equation of state, Transport phenomena.

1. **Thermodynamics**:

(a) Laws of Thermodynamics: Zeroth law of thermodynamics, Thermal equilibrium, Internal Energy, Heat and work, Isothermal and adiabatic processes, Work done by expanding gases, Statement of first law of thermodynamics and applications, Second law of thermodynamics, Reversible and irreversible processes, Heat engines, Efficiency of heat engines, Carnot's cycle, Carnot's theorem, The Thermodynamic temperature scale, Concept of entropy, Change of entropy in reversible and irreversible processes, Entropy and second law of thermodynamics, Entropy and disorder, Principle of the increase of entropy, Third law of thermodynamics.

(b) Thermodynamic Functions: Enthalpy, Helmholtz and Gibbs free energies, Maxwell's thermodynamic relations, Specific heat equations, Chemical Potential.

(c) Phase Transition and Application: Classification of phase transition, Clausius-Clapeyron equation, Gibbs Phase rule.

4. **Radiation**: Black body radiation, Emissive and absorptive powers, Kirchhoff's law, Stefan-Boltzmann's Law, Wien's displacement law, Rayleigh-Jean's law, Planck's quantum hypothesis.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Acquire a thorough understanding of concept of temperature, thermocouple, Newton's law of cooling, thermal conductivity and diffusivity, measurement techniques of thermal conductivity, heat transfer techniques.

CLO-2: Describe the fundamental assumption of kinetic theory of gases, different types of kinetic energy, mean free path, Maxwell's theory of distribution of velocities, Brownian motion, degrees of freedom, Van der Waals' equation of state, transport phenomena.

CLO-3: Explain the principles and laws of heat and thermodynamics, how heat flow arises from entropy and how entropy limits the efficiency of engines, working process of different heat engines and their thermal efficiency, Maxwell's thermodynamic relations.

CLO-4: Demonstrate and explain the concept of heat transformation during phase's changes and black body radiation, different laws of blackbody radiation and its applications.

CLO-5: Advanced thinking and problem-solving skills are used to analyze and interpret real life thermodynamic system.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-	-	-
CLO-3	-	1	-	2	-	-	-	-	-	-
CLO-4	1	-	2	-	-	-	-	-	-	-
CLO-5	-	-	-	2	1	3	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Vibrations and Waves

Course Code: 0533-122 [PHY-122] **Credit Hour: 03**

(a) Rationale/Course Summary

Vibrations and waves are closely related. However, there is a difference between vibration and waves. This course includes a study of free vibrations (Simple harmonic motion), damped and force vibrations, super position of periodic wave motions, recording and reproduction of sound and general idea of acoustics.

(b) Course content

1. **Free Vibration**: Simple Harmonic motion (SHM), Mathematical representation; Boundary conditions, Velocity, Acceleration and their phase relationship, Energy of a harmonic oscillator, Physical and torsional pendulums, Plasma vibration.
2. **Damped and Forced Vibration:** Damping forces, Types of damping, Logarithmic decrement, Relaxation time and quality factor, Electromagnetic damping, Forced oscillation, Examples of resonances.

3. **Waves**: Transverse and Longitudinal waves, Speed of a traveling wave in stretched string, Energy and power of a traveling wave, Standing waves and Resonance.

4. **Superposition of Periodic Motion:** Principle of superposition, Interference of waves, Superimposed vibration of equal and different frequencies, Combinations of two SHM's, Lissajous' figures.

5. **Sound Waves and Acoustics**: Propagation and speed of sound in fluid and solid media, Musical sound, Beats, Doppler effect, Infrasonics and Ultrasonics, Recording and reproduction of sound, General idea of acoustics.

6. **Vibrations**: Vibrations of string, Membranes, bars, plates and air-column, Sonometer, Melde's experiment, Rectangular and circular membranes, Transverse and longitudinal vibration of rod, Air-columns in cylindrical pipes, Organ pipes.

(c) Course Learning Outcomes (CLOs)

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

CLO-1: Gather sound knowledge of periodic motion and SHM. Mathematical representation of SHM;

CLO-2: Use energy conversation in solving for parameters of an oscillating system.

CLO-3: Explain the behavior of a damped oscillator including the effects of different degrees of damping.

CLO-4: Describe wave motion and explain the main characteristics of the general wave equation. And also describe superposition of two travelling waves and explain the phenomenon of resonance. Including Combinations of two SHM's, Lissajous' figures.

CLO-5: Explain the role of pressure and displacement in a sound wave and use the equation for Doppler shift of frequency.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	2	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-	-	-
CLO-3	-	2	1	-	-	-	-	-	-	-
CLO-4	-	-	2	-	3	2	-	-	-	-
CLO-5	-	-	2	2	1	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz

CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Mathematics-II (Calculus & Differential Equation)

Course Code: 0541-123 [PHY-123] **Credit Hour: 03**

(a) Rationale/Course Summary

In physics, we frequently calculate quantities that depend on many variables (such as temperature, velocity, position etc.). Generally, these quantities are expressed by partial differentiation and Integration. This course will introduce students to these complex relationships to solve the problems of different aspect of physics and other relevant subjects. The course can also serve as a base for future physics courses.

(b) Course content

1. **Differential Calculus:** Functions of real variable, Domain and ranges, Graphs of functions, Limits and continuity and derivatives, Physical meaning of derivative of a function, Differentiation of functions, Successive differentiation, Partial differentiation, Statement of Rolle's theorem and mean value and Taylor's theorem, Expansion in power series, Taylor series. Functions of two and three variables, Partial and total derivatives.
2. **Integral calculus:** Physical Meaning of integration, Indefinite integrals, Definition of definite integral as the limit of sum, Definite integrals, Elementary reduction formulae, Formulae for length of plane curves, Plane areas and areas of surfaces of revolutions, Volumes of solids of revolutions.
3. **Differential Equations:** Solutions of ordinary differential equations of first and second order, Solutions by the method of vibration of parameters and undetermined coefficients.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Explain the basic concepts of differential equation and integral calculus and their importance in modern physics and real-world context.

CLO-2: Achieve and demonstrate the core concepts of functions and their derivatives.

CLO-3: Demonstrate and compare the features of various models, theorem and equations to explain various physical systems.

CLO-4: Perform calculations on line, surface, volume and multiple integrals.

CLO-5: Implement the gained knowledge of differential and integral calculus to solve the real-life physical problems.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CLO-2	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CLO-3	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CLO-4	**-**	**-**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
CLO-5	**-**	**-**	**-**	**2**	**1**	**2**	**-**	**-**	**-**	**-**

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Assignment and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Chemistry-II (Physical Chemistry)

Course Code: 0531-124 [PHY-124] **Credit Hour: 03**

(a) Rationale/Course Summary

Physical chemistry provides a foundational understanding of the fundamental principles that govern the behavior of matter and energy in chemical systems. It is essential for explaining and predicting a wide range of phenomena in physical chemistry, including, chemical equilibrium, chemical kinetics and catalysis, colligative properties and finally electrochemistry.

(b) Course content

1. **Chemical Equilibria:** Law of Mass Action, Effects of Temperature, Pressure and Concentration on Chemical Equilibria, Relationship between K_p, K_c and K_r.
2. **Phase Equilibrium:** Phase, component, degrees of freedom and their equilibria, phase rule and its thermodynamics, triple point, thermodynamics of phase change; Henry's law; Nernst distribution law; association and dissociation. One component system; Solid-liquid-vapour equilibria of water, CO_2, Sulphur and Phosphorus.

3. **Chemical Kinetics and Catalysis:** Order and Molecularity, Rate Equations for zero, first and second order reactions, Determination of Order of Reactions, Arrhenius Equation and Energy of Activation, Collision Theory of Catalysis.

4. **Colligative Properties:** Roult's Law, Elevation of Boiling Point, Depression of Freezing Point, Osmotic Pressure, Determination of Molecular Weight of Non-Volatile Substances.

5. **Electrochemistry:** Electrolyte, Electrolytic Conductance, Ionic Mobility and Transport Number, Elementary Idea on Electrode Potential, Ostwald's Dilution Law, Common Ion Effects, Solubility and Solubility Product, Concepts of Activity and Activity Coefficient.

6. **Thermochemistry:** Exothermic and endothermic reaction; heat of reactions; temperature effect on heat of reaction, heat of formation; heat of solution; heat of combustion; heat of sublimation; heat of neutralization; standard forms of heats; calculation of enthalpy of reaction; Thermochemical laws; Kirchhoff's equation; bond energy; lattice energy.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Obtain clear idea about chemical equilibrium, acids and bases and the processes occurring in solution.

CLO-2: Analyze quantitatively kinetics of reactions involving mechanisms which are consecutive and competitive, as well as more complex mechanisms.

CLO-3: Describe and understand the colligative properties of chemical substances.

CLO-4: Gather elementary idea on Electrochemistry and Thermochemistry.

CLO-5: Apply advanced physical chemistry principles to research problems, critically analyze scientific literature, and design experiments involving molecular behavior.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	**PLO-2**	**PLO-3**	**PLO-4**	**PLO-5**	**PLO-6**	**PLO-7**	**PLO-8**	**PLO-9**	**PLO-10**
CLO-1	3	-	-	-	-	-	-	-	-	
CLO-2	-	2	3	-	-	-	-	-	-	-
CLO-3	2	2	-	-	-	-	-	-	-	-
CLO-4	2	-	-	-	-	-	-	-	-	-
CLO-5	1	2	3	-	-	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	**Assessment Strategy**
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Lecturing and Discussion	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Assignment and Summative Exam

Course Title: Introduction to Statistics

Course Code: 0542-125 [PHY-125] **Credit: 03**

(a) Rationale/Course Summary

The rationale of this course is to introduce students to the fundamental concepts involved in using sample data to make inferences about populations. Included is the study of measures of central tendency and dispersion, finite probability distributions, statistical inferences from large and small samples linear regression, and correlation. This course also provides students with skills for proficiency in statistics and the opportunity to learn to communicate and reason statistically.

(b) Course content

1. Elementary Statistics:

i) Statistics: Meaning and scope, Nature of statistical data, Attributes and variables, Discrete and continuous variables, Method of data collection, Frequency distribution, Graphs and diagrams.

ii) **Measures of Central Tendency:** Arithmetic mean, Geometric mean, Harmonic mean, Median, Mode, Quartiles, Decites, Percentiles.

iii) **Measures of Dispersion:** Bivariate data, Meaning of dispersion, Absolute measure, Relative measure, Range, Standard Deviation, Mean deviation, Quartile deviation, Coefficient of dispersion, Coefficient of variation, Skewness and kurtosis.

iv) **Regression and Correlation:** Relationship between variables, Fitting of simple linear regression, Simple correlation, Multiple correlation, and Multiple regression.

2. **Theory of Probability:** Meaning and definition of probability, Apriori and a posteriori probability, Experiment, Sample space and event, Theorems of total, compound and conditional probability, Random variables, Probability functions, Expectation of random variable, Concepts of Binomial, Poisson and Normal distribution.

3. **Sampling Technique:** Simple random sampling, Stratified random sampling and systematic sampling.

4. **Tests of Significance:** Type -1, Type -11 level of significance, Size of the test, Power of the test, Tests of means, Variance, Correlation coefficient and regression coefficient.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course, students will be able to

CLO-1: Collect statistical data and explain various types of graphs and diagrams.

CLO-2: Learn about different types of statistical mean and explain standard deviation and mean deviation etc.

CLO-3: Know about random variables and probability functions. Be able to explain normal and Poisson distributions.

CLO-4: Learn about different types of statistical sampling techniques.

CLO-5: Explain the size and power of statistical tests.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	1	-	-	-	-	-	-	-	-
CLO-2	2	-	2	1	-	-	-	-	-	-
CLO-3	2	-	2	1	-	-	-	-	-	-
CLO-4	1	1	2	1	-	2	-	-	-	-
CLO-5	1	-	2	-	-	-	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used.

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	**Assessment Strategy**
CLO-1	Discussion and Student Activities	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Presentation, Quiz, and Summative Exam
CLO-3	Lecturing, Discussion and Student Activities	Mid-Term, Quiz, and Summative Exam
CLO-4	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-5	Lecturing and Discussion	Mid-Term and Summative Exam

Course Title: Physics Practical

Course Code: 0533-126 [PHY-126] **Credit Hour: 03**

(a) Rationale/Course Summary

This practical course serves as a sort of revision exercises of Electricity, Heat & thermodynamics and Vibration & Waves. In this course, students will learn to operate Searle's apparatus, Potentiometer, Post office box, meter bridge, Lest apparatus and work with meld's experiment

(b) Course content

List of Experiment

1. Determination of the resistance of a galvanometer by half- deflection method.
2. Comparison of the e.m.f. of two cells with a potentiometer.
3. Determination of the value of unknown resistance and verification of the laws of series and parallel resistances using a P.O. Box.
4. Determination of the specific resistance of a wire using a metre bridge.
5. Determination of the value of low resistance by the method of fall of potential.
6. Study of the variation of the frequency of a tuning fork with the length of a sonometer (*n-l* curve) under given tension and hence determination of the unknown frequency of a tuning fork.
7. Verification of the laws of transverse vibration of strings and determination of the frequency of a tuning fork by Melde's experiment.
8. Determination of thermal conductivity of a bad conductor by Lees method.
9. Determination of thermal conductivity of a good conductor by Searle's apparatus.
10. Determination of the internal resistance of a cell by Potentiometer.

(c) Course Learning Outcomes (CLOs)

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

CLO-1: Gather experimental knowledge for Searle's apparatus, Potentiometer, Post office box, meter bridge, Lest apparatus and work with meld's experiment.

CLO-2: Solve different experimental problems related to Electricity, Heat & thermodynamics and Vibration & Waves.

CLO-3: Describe basic principles of potentiometer and functions of Meter Bridge; Calibrate voltmeter and ammeter by potentiometer.

CLO-4: Familiarize basic laws of series and parallel resistances by means of post office box.

CLO-5: Write scientific (or technical) reports and papers.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	1	-	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-	-	-
CLO-3	-	-	2	-	-	-	-	-	-	-
CLO-4	-	2	2	2	-	-	-	-	-	-
CLO-5	-	-	3	2	1	-	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Optics

Course Code: 0533-211 [PHY-211] **Credit Hour: 03**

(a) Rationale/Course Summary

The main rationale of optics is to understand how light behaves and how it interacts with matter, including reflection, refraction, diffraction, and interference. This course will contribute significantly to our fundamental understanding of the universe. Overall, the rationale of optics is to understand the behavior of light and its interaction with matter in order to develop new technologies and deepen our understanding of the natural world.

(b) Course content

1. **Interference:** Nature of light, Wave theory of light, Huygen's principle, Superposition of waves, Phase velocity and group velocity, Young's experiment, Coherent sources; Fresnel's biprism, Loyd's mirror, Michelson's interferometer, Interference in thin films; Colour of thin films, Newton's rings, Febry-perot interferometer.
2. **Diffraction:** Diffraction, Fraunhoffer and Fresnel diffraction, Single slit, Double slit and multiple-slit diffraction phenomenon, Diffraction grating, Spectrometer, Dispersive and Resolving powers of grating, Crystal diffraction – Bragg's law, Fresnel half period zone, Fresnel diffraction due to a straight edge, Cornu's Spiral, Fresnel's integrals.

3. **Polarization:** Polarization of light, Polarizing sheet, Polarization by reflection, Polarization by double refraction, Brewster's law, optical axis, Half-wave and quarter-wave plates, Nicol prism, optical activity, Polarimeter, Plane, Circular and Elliptical polarization.

4. **Fiber Optics:** Glass and Plastics-their characteristics, Basic Structure and Classification of Fibers, Index Profile, Core and Cladding, Principle of light propagation through optical fibers, Losses in Fiber, Fiber Cables, Optical Fiber Communication.

5. **Laser:** Fundamental Principle, Spontaneous and Stimulated emission, Einstein's relation, Population inversion, Optical feedback, Types of lasers: Ruby, He-Ne, CO_2, Semiconductor Laser, Laser Applications.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Explain the properties of light, including its wave and particle nature, and spectral properties.

CLO-2: Explain optical phenomena such as interference diffraction, polarization and birefringence in terms of the wave model.

CLO-3: Apply optics in areas such as telecommunications, medicine, and engineering.

CLO-4: Describe principle of lasers and specific laser systems, and able to apply this knowledge to various practical applications.

CLO-5: Communicate effectively about optical concepts and their applications through written reports, oral presentations, and group discussions.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	2	-	-	-	-	-	-	-	-	-
CLO-3	1	2	-	-	-	-	-	-	-	-
CLO-4	-	-	-	-	-	2	-	-	-	-
CLO-5	-	-	-	-	-	-	-	3	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz

CLO-2	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Assignment and Summative Exam
CLO-5	Discussion and Student Activities	Assignment and Summative Exam

Course Title: Mathematical Methods in Physics

Course Code: 0533-212 [PHY- 212] **Credit Hour: 03**

(a) Rationale/Course Summary

Mathematical techniques in physics refer to the development of mathematical methods for application to difficulties in physics. This course is to provide knowledge of mathematical models of physical problems from classical and quantum physics. Upon completion of the course the student would be able to understand the basic theory of vector and tensor analysis, functions of complex variables, elements of distribution theory and Fourier series.

(b) Course content

1. **Differential Equations:** Power series solutions about singular points, Solutions of partial differential equations by the method of separation of variables, Laplace's equations.
2. **Special Functions:** Gamma and beta functions, Bessel functions, Orthogonal functions, Legendre, Laguerre and Hermite polynomials, Recurance relation, Fourier series and integrals, Fourier and Laplace transforms, Introduction to hypergeometric functions.
3. **Theory of Matrices:** Types of matrices (unitary, hermitian. Symmetric etc.), Determinant of a square matrix, Equivalence, Adjoint and inverse of a square matrix, Liner equations, Linear transformations: Similarity transformations.
4. **Theory of Complex Variables:** Complex functions, Analytic functions, Cauchy Riemann equations, Cauchy's integral theorem, Cauchy's integral formula, Taylor expansion, Lorentz theorem, Differentiation of complex functions, Residue theorem, Evaluation of definite integrals.
5. **Tensor Analysis:** Definition, Addition, Multiplication and contraction of tensors, Differentiation of tensors, Covariant and contravariant tensors.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Gather sound knowledge of problems related to differential equations of various types.

CLO-2: Describe the nature of special functions and their recurrence relations.

CLO-3: Solve problems related to complex numbers and variables

CLO-4: Explain the nature of Fourier expansion and use Fourier transforms to understand tensors.

CLO-5: Development of critical thinking and problem-solving skills through the application of tensor and its basic operations.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CLO-2	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**-**
CLO-3	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CLO-4	**-**	**-**	**2**	**-**	**-**	**3**	**-**	**-**
CLO-5	**-**	**-**	**-**	**2**	**1**	**2**	**-**	**-**

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Assignment and Summative Exam
CLO-5	Discussion and Student Activities	Assignment and Summative Exam

Course Title: Computer Fundamentals and Numerical Analysis

Course Code: 0611-213 [PHY-213] **Credit Hour: 03**

(a) Rationale/Course Summary

This course introduces computer concepts, including fundamental functions and operations of the computer. Topic includes identification of hardware components, basic computer operations, security issues and use of software applications. Upon completion, students should be able to demonstrate and understand the role and functions of computers and use the computer to solve problems.

(b) Course content

1. **Introduction to Computer:** Basic organization of a computer: CPU, Types of Computer, History of Computer, Generation of Computer, Data, Information and Codes, Microcomputer basics, Organization of a microcomputer.

2. **Input/output Device:** I/O interfaces, Keyboard, Reading Devices, Pointing devices, Scanning devices, Monitor (CRT, LCD), Printer, Audio interface system, Modem.
3. **Memory Unit:** Classification of memory, Memory hierarchy, General properties of Memory devices, Main memory: RAM, ROM, Register in CPU, Secondary memory: Hard disk, Optical disk, Flash memory.
4. **Software and Operating System:** Introduction and Classification, System Software, Application software, Low- and High-level languages, Language Translator.
5. **Application Packages:** Introduction to word processor, Data base, Spread sheet, Power point.
6. **Networking:** Computer communication, Basic concepts of LAN, WAN, Internet, Workstation and Server, Transmission media, WWW, E-mail.
7. **Roots of Equations:** Bisection methods, False-Position method, Newton-Raphson method, Numerical Integration: Trapezoidal rule, Simpson's rules, Ordinary Differential Equations, Runge-Kutta methods with different orders, Interpolation: Linear interpolation.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Identify the basic elements required in a computer system.
CLO-2: Gather complete knowledge about a computer system.
CLO-3: Describethe role of the computer for personal and professional uses.
CLO-4: Produce electronic documents using various software applications.
CLO-5: Describe and understand Bisection method and Numerical method works behind a computer system.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	3	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-
CLO-3	-	1	-	-	-	-	-	-
CLO-4	-	-	2	-	-	3	-	-
CLO-5	-	-	-	2	1	2	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam

CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Communicative English

Course Code: 0231-214 [PHY-214] **Credit Hour: 02**

(a) Rationale/Course Summary

The development of EFL reading and writing skills as applied to a wide range of materials is prerequisite for the graduates to thrive in both academic and professional levels.

(b) Course content

1. **Grammar:**
   - Subject/Verb/Agreement
   - WH questions
   - Use of Modals
   - Preposition
   - Suffix and Prefix
   - Gerund and Participles
   - Phrase and Clause
   - Sentence structure
2. **Reading:**
   - Skimming and Scanning; Extensive and Intensive reading, comprehending, extracting main ideas
   - Understanding text organization
   - Understanding form, voice, tone, and style
   - Vocabulary development to deal with unfamiliar words and language variation, using dictionary
   - Summarizing and Paraphrasing
3. **Writing:**
   - Paragraph: Topic sentence, supporting details, Linking words, coherence and continuity, terminator
   - Essay: Title, introduction and thesis statement, supporting paragraphs, cohesion, conclusion
   - Patterns of writing: Narration, description, illustration, definition, comparison and contrast, division and classification, causal analysis, process, argument, persuasion, etc.
   - Writing job application and CV

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO 1: Create grammatically different types of sentences;

CLO 2: Identify reading strategies and techniques as well as be familiar with various types of texts and purposes of reading;

CLO 3: Infer meaning of new vocabulary from the surrounding context;

CLO 4: Identify information and key ideas of the texts and summarize and paraphrase the texts. Write focused, coherent, organized, and grammatically correct compositions and critical essays;

CLO 5: Write job application and CV; develop their ability as critical readers and writers.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	-	-	-	-	-	-	-	**2**
CLO-2	-	-	-	-	-	-	-	**3**
CLO-3	-	-	-	-	-	-	-	**3**
CLO-4	-	-	-	-	-	**2**	-	**3**
CLO-5	-	-	-	**2**	**1**	**2**	-	**3**

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Physics Practical

Course Code: 0533-215 [PHY-215] **Credit Hour: 03**

(a) Rationale/Course Summary

This course introduces the methods for conducting physics experiments including the acquisition, analysis and physical interpretation of experimental data. This course aims to motivate students towards learning by doing and sharpen students' power of observation. Students will be able to acquire, analyze and synthesize experimental data by using ballistic galvanometer, condenser, inductor, capacitor, resistor etc.

(b) Course content

List of Experiment

1. Determination of logarithmic decrement of a Ballistic galvanometer and critical damping resistance.
2. Determination of absolute capacitance of a condenser using a ballistic galvanometer.
3. To investigate the voltage current relationship for a simple inductive circuit and hence to determine the inductance.
4. To investigate the voltage current relationship for an a.c. capacitor circuit and hence to determine the capacitance.
5. To study the variation of capacitive reactance with frequency.
6. To study the variation of inductive reactance with frequency.
7. Determination of resonance frequency of LCR series and parallel circuits.
8. To study the variation of mutual inductance between two coils with distance of separation between them.
9. Determination of self-inductance of a coil by Rayleigh's method.
10. Determination of the refractive index of a liquid by pin method using a plano convex lens.

(c) Course Learning Outcomes (CLOs)

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

CLO-1: Gather practical knowledge of the basic principles pertaining to Electricity, Magnetism and optics.

CLO-2: Use proficiently various electrical measuring instruments such as multimeters, ammeters to make accurate measurements of voltage, current, and resistance in electrical circuits.

CLO-3: Demonstrate fundamental concepts in electricity and optics including reactance, resonance, inductance, refraction and image formation by lens etc.

CLO-4: Design, build, and analyze electrical circuits, both simple and complex, to solve practical problems, and demonstrate an understanding of circuit components and their behavior.

CLO-5: Analyze experimental data, draw conclusions, and interpret results accurately, while also considering sources of error in measurements.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	**3**	-	-	-	-	-	-	-
CLO-2	-	**2**	-	-	-	-	-	-
CLO-3	-	**2**	-	-	-	-	-	-
CLO-4	-	-	**2**	**2**	-	**2**	-	-
CLO-5	-	-	**3**	-	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Chemistry Practical

Course Code: 0531-216 [PHY-216] **Credit Hour: 02**

(a) Rationale/Course Summary

This course allows students to develop skill in the synthesis of different classes of organic and inorganic compounds; analysis of samples with single and multiple components, determination of the kinetic and thermodynamic properties of molecules. This course will provide the practical demonstration of experimental techniques of volumetric analysis and redox titration.

(b) Course content

1. Calibration of volumetric glass wares.
2. Determination of standard solution (NaOH, Na_2CO_3, $H_2C_2O_4$).
3. Standardization of approximately 0.1NHCl by titration with standard 0.1NNaOH (acid-base to titration).
4. Standardization of 0.1NHCl by standard 0.1N Na_2CO_3 solution.
5. Heat of solution calorimetrically.
6. Heat of neutralization calorimetrically.
7. Determination of Ni as dimethylglyoxime complex.
8. Determination of SO_4^{2-} as Barium sulphate.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Conduct an investigation of the experiments individually and collaboratively following proper lab technique (e.g., correctly handling chemicals, using equipment, disposing of waste, etc.) and assess safety considerations and obey safety rules.

CLO-2: Calibrate the volumetric glassware's.

CLO-3: Determine the standard solution and standardization of a solution.

CLO-4: Determine Ni as dimethylglyoxime Complex and SO_4^{2-} as Barium sulphate.

CLO-5: Based on results, suggest changes to the procedure or its components in order to optimize precision and accuracy, keeping in mind what can be investigated within the scope of the laboratory with available resources.

CLO-6: Communicate information, results, claims, and analysis (e.g., about the procedure in relation to the data and results) in multiple formats (e.g., orally, graphically, textually, mathematically)

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	2	3	-	-	-	-	-	-	2	-
CLO-2	2	3	-	-	-	-	-	-	-	-
CLO-3	2	3	-	-	-	-	-	-	-	-
CLO-4	2	3	-	-	-	-	-	-	-	-
CLO-5	-	-	-	-	-	3	-	-	-	-
CLO-6	-	-	-	-	-	-	-	8	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO-1	Demonstration and Conduct the laboratory	Quiz
CLO-2	Demonstration and Conduct the laboratory	Mid-Term and Summative Exam
CLO-3	Demonstration and Conduct the laboratory	Mid-Term and Summative Exam
CLO-4	Demonstration and Conduct the laboratory	Mid-Term and Summative Exam
CLO-5	Conduct the laboratory and Student activities	Mid-Term and Summative Exam
CLO-6	Conduct the laboratory and Student activities	Assignment

Course Title: Statistics Practical

Course Code: 0542-217 [PHY-217] **Credit Hour: 02**

(a) Rationale/Course Summary

Statistics is an introductory course for students in physics. It is a computer based course, in which students will learn not only the principles and methods of statistical analysis, but also put these into practice using a range of real world data sets.

(b) Course content

List of Experiment

Representation of data by tables, Graphs and charts, Condensation of data, Measures of location, Dispersion, Skewness and Kurtosis, Measures of location by graphical methods, Least square estimation of parameters, Correlation regression, Rank correlation.

(c) Course Learning Outcomes (CLOs)

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

CLO-1: Construct frequency distribution, use appropriate graph for a particular or data set and interpret the results.

CLO-2: Find different measures of a central tendency and dispersion of a set of data.

CLO-3: Fit regression line after estimating parameter and then interpret the result's perfectly and compute correlation and interpret the result.

CLO-4: Determine the shape characteristics of a distribution and interpret the result.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	1	-	1	-	-	-	-	-
CLO-2	-	-	2	1	-	-	-	-
CLO-3	1	-	1	-	-	-	-	-
CLO-4	1	-	-	-	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Class room Discussion	Lab performance
CLO-2	Problem Solving Activities	Report, Summative measure (Final Exam)
CLO-3	Problem Solving Activities	Report, Summative measure (Final Exam)
CLO-4	Problem Solving Activities	Report, Summative measure (Final Exam)

Course Title: Atomic and Molecular Physics

Course Code: 0533-221 [PHY-221] **Credit Hour: 03**

(a) Rationale/Course Summary

Atomic and molecular physics is a fundamental area of study in physics that explores the behavior and properties of atoms and molecules, which are the building blocks of matter. This course typically covers a wide range of topics, including the electronic structure of atoms and molecules, the interaction of atoms and molecules with electromagnetic radiation, the properties of gases, and the behavior of atoms and molecules in solids and liquids.

(b) Course content

1. **Particle Properties of Waves:** Particles and waves in nature, Electromagnetic radiation, Photoelectric effect and its important features, Compton effect, Pair Production and Pair annihilation, Concept of light, Photons and gravity, Black holes, X-rays, Production of X-rays and continuous characteristics of X-ray, X-ray diffraction.
2. **Wave Properties of Particles:** De Broglie's hypothesis, Phase velocity and group velocities of matter waves, Particle diffraction, Davisson-Germer experiment, Heisenberg's uncertainty principle.
3. **Atomic Structure:** Thomson model of atom, alpha-particle scattering experiment and Rutherford model, Nuclear dimensions, electron orbit, Atomic spectra, Bohr atom model, Energy levels and spectra, Atomic excitation, Frank-Hertz experiment, Nuclear motion and reduced mass, Energy levels of Hydrogen like atoms.
4. **Quantum Concept and Detailed Atomic Structure:** Schrodinger equation, four quantum numbers, Normal Zeeman effect, Stern-Gerlach experiment, Electron Spin, Fine Structure and anomalous Zeeman effect, Pauli exclusion principle and the periodic table, Vector atom model, L-S and j-j coupling, Many-electron atoms and atomic spectra.
5. **Molecular Physics:** Molecular bonds, Electron sharing, H_2 molecule ion, H_2 molecule, Complex molecules, Rotational and Vibrational energy levels, Electronic spectra of molecules, Types of spectra, Raman effect.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Explain the basic principles of atomic and molecular physics, including the electronic structure of atoms and molecules, atomic and molecular spectra, and the interaction of atoms and molecules with electromagnetic radiation.

CLO-2: Describe De Broglie's hypothesis with examples, the concept of light photons, and X-productions and its applications.

CLO-3: Explain the atomic structure, Zeeman effect, and atomic spectra based on quantum concept

CLO-4: State and explain the key properties of many electron atoms and the importance of the Pauli Exclusion Principle.

CLO-5: Communicate effectively about atomic and molecular physics concepts and research, both orally and in writing.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	2	1	-	-	-	-	-	-	-	-
CLO-3	-	2	-	-	-	-	-	-	-	-
CLO-4	-	2	2	-	-	-	-	-	-	-
CLO-5	-	-	-	-	-	-	-	3	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Assignment and Summative Exam

Course Title: Classical Mechanics and the Special Theory of Relativity

Course Code: 0533-222 [PHY-222] **Credit Hour: 03**

(a) Rationale/Course Summary

This course introduces the physics behind of the most useful features of Lagrangian mechanics and best use of Hamiltonian mechanics along with suggests a link to quantum mechanics. Its focus is on the essential link between the Newtonian, Lagrangian. This is an excellent course for the students who are interested in science research.

(b) Course content

1. **Review of Newtonian Mechanics:** Introductory concepts of Newtonian mechanics, Equation of motion, Conservation laws for a system of particles, Degree of freedom and Constraints, Generalized coordinates and generalized forces, D' Alembert's Principles and Lagrange's equation.
2. **Lagrangian Mechanics:** Lagrange equation of motion for holonomic constraints, Variational Method, Euler-Lagrange Equations of Motion, Hamilton's principle,

Derivation of Lagrange's equation from Hamilton's principle, Extension of Hamilton's principle to non-conservative and non-holonomic system.

3. **Motion Under Central Forces:** Reduction of two body central force motion system to one-body problem, Reduced mass, Elliptic orbit, Keplerian motion, Scattering in a central force field: Rutherford formula.

4. **Rigid Body Motion:** Kinematics and dynamics of rigid bodies, Orthogonal transformation, Euler's angles, Euler's equation of motion for solving rigid body problems, Symmetric top.

5. **Hamiltonian Mechanics and Canonical Transformations:** Principles of least action, Hamiltonian equations of motion, Examples, Canonical coordinates, Canonical transformation, Generating Function, Lagrange and Poisson's Bracket.

6. **Special Theory of Relativity:** Inertial Frame of Reference, Michelson and Morley experiment, Galilean transformations, Basics Postulates, Lorent\transformations, Length contraction and time dilation.

7. **Relativistic Mechanics:** Mass and momentum, Relativistic energy, Equivalence of mass and energy, Momentum-energy four vector, Relativistic force law.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Define and explain the basic mechanical concepts related to discrete and continuous mechanical systems including Newtonian, Lagrangian and Hamiltonian mechanics, also gather knowledge on fundamental concepts of relativity.

CLO-2: Describe the nature of the system of particles and two body central force problems considering basics mechanical equations.

CLO-3: Explain the elementary ideas of rigid bodies, and acquire the knowledge of rigid kinematics and dynamics considering fundamental ideas of matrix representations.

CLO-4: Solve problems related to fundamental mechanical systems adopting Lagrangian and Hamiltonian equations of motion along with their associated formulations and relativity.

CLO-5: Applications of mathematical methods and scientific principles to tackle challenging issues in Classical Mechanics and Relativity will help students develop their analytical thinking and problem-solving abilities.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	3	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-
CLO-3	2	-	-	-	2	-	-	-
CLO-4	-	-	2	-	2	3	-	-

CLO-5	**1**	**-**	**-**	**2**	**-**	**2**	**-**	**-**

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Assignment and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Astronomy & Cosmology

Course Code: 0533-223 [PHY-223] **Credit Hour: 02**

(a) Rationale/Course Summary

This course will introduces students with small scale structure as well as large scale structure of the universe such as stars, planets, galaxies and the universe as a whole. It will provide students with knowledge of modern techniques, theory and observational results in Astronomy and Cosmology. In particular, students can gain the ideas of modern cosmology and understand the physical principles of Astronomy that underlie even the newest discoveries.

(b) Course content

1. **Introduction:** Modern astronomy, Astronomical coordinates, Rough scales of the astronomical universe, Contents of the universe.
2. **Stars:** Properties of stars, Formation of stars, The end states of stars, Chandrosekhar's limit, White dwarfs, neutron stars, The sun as a star, Surveying the solar system, The interior of the sun, The sun's outer layers, The source of energy of the sun.
3. **Galaxies :** Formation and classification of galaxies, Cosmic rays, The milky way system, Spiral structure, Density wave theory, Active galaxies, Peculiar galaxies and quasars; Clusters of galaxies.
4. **Expansion of the Universe:** Red shifts, Hubble's law regarding expansion of the universe, Age of the universe.
5. **Big Bang Theory and Cosmology:** Static cosmological models, Expanding cosmological models and the Big bang theory, Black hole, Schwarzschild radius.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Describe and explain astronomy and cosmology according to both theoretical and observational view, fundamental objects in the universe such as formation &

evaluation of stars, galaxies, solar systems, other cosmic objects and cosmological models.

CLO-2: Identify binary stars and describe the associated processes occurring in our galaxy and other galaxies.

CLO-3: Explain the Hubble's law and the Big Bang theory.

CLO-4: Demonstrate and explain the concept of heat transformation during phase's changes and black body radiation, different laws of blackbody radiation and its applications.

CLO-5: Apply appropriate techniques and principles for solving a range of problems in astronomy & cosmology.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CLO-2	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**-**
CLO-3	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CLO-4	**-**	**-**	**2**	**-**	**-**	**3**	**-**	**-**
CLO-5	**-**	**-**	**-**	**2**	**1**	**2**	**-**	**-**

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Communicative English Lab

Course Code: 0231-224 [PHY-224] **Credit Hour: 02**

(a) Rationale/Course Summary

This course will teach students how to talk and listen in English through practice. Given that learning a language aims to combine the development of four skills, it is crucial to give these language skills adequate attentions as they are being learned. English listening and speaking proficiency is more likely to be attained through exposure to real-world circumstances. This

course is expected to enable the learners to acquire minimum competence in basic English listening and speaking skills.

(b) Course content

1. **Speaking:**

(a) Speaking in different contexts: Everyday life, academic and business situations.

(b) **Different modes of interaction:** Free conversation, group discussion, formal and informal presentation, public speaking.

(c) **Useful language functions:** Introducing, definition, description, argumentation, asking information, question-answer, explaining direction, agreeing-disagreeing, polite remarks, socialization.

(d) **Pronunciation drills:** Understanding and applying standard pronunciation, practicing English phonemes and sound pairs, understanding and applying stress & intonation.

(e) **Nonverbal communication:** Body language, eye contact and facial expression.

2. **Listening:**

(a) Listening for comprehension
(b) Listening for general information
(c) Listening for specific information
(d) Listening for understanding English phonemes
(e) Listening for understanding sound pairs & standard pronunciation
(f) Listening for understanding stress and intonation
(g) Listening for note taking from sources in various contexts
(h) Listening for understanding English varieties

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO 1: Remember the different aspects and tasks of listening and speaking skills.

CLO2: Elucidate the various facets of utterances made by native and non-native English speakers and how they relate to speaking English.

CLO 3: Analyze the elements of standard and proper pronunciation, stress, and intonation in the listening inputs and speaking tasks in English.

CLO 4: Apply the learning components as they practice speaking and listening in English for various contexts and goals.

CLO 5: Demonstrate better competence and confidence in English communication through the effective development of English listening and speaking skills.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	-	-	-	-	-	-	-	**3**
CLO-2	-	-	-	-	-	-	-	**3**
CLO-3	-	-	-	-	-	**2**	-	**3**

CLO-4	-	-	-	-	-	-	-	**3**
CLO-5	-	-	-	-	-	**1**	-	**3**

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Computer Programming Lab

Course Code: 0611-225[PHY-225] **Credit Hour: 03**

(a) Rationale/Course Summary

This course is designed to give students practical operational knowledge on various aspects of computer applications. In addition to performing different academic jobs including writing a report, analyzing experimental data, and performing a power point presentation, this course also facilitates students to learn and practically work with high level programming language-C in solving and/or explaining physics theories as well as experiments and/or relevant issues in a well-equipped laboratory. The knowledge achieved in this course should work as a strong basis for the students' survival in the contemporary scientific world, and will certainly promote their analytical and critical thinking ability.

(b) Course content

Group A: Computer Basics

1. Study the basic organization of Microcomputer and introduction to Operating System.
2. Word processing: An introduction to Microsoft Word
3. Spread Sheet analysis: An introduction to Microsoft Excel.
4. PowerPoint Presentation: An introduction to Microsoft PowerPoint presentation.

Group B: Programming with C

5. Introduction to C: Compiling, Debugging and Running.
6. Study and Implementation of Branching. Looping Control Statements
7. Study and Implementation of Function: Argument Passing and recursive function.
8. Study and Implementation of Array and Strings.
9. Working with data files: Opening files in Read, Write and Append mode.

Group C: Programming for Numerical Analysis with C

10. Study and Implementation of Linear Algebra and Nonlinear Algebraic Equations.
11. Study and Implementation of Linear and Cubic-Spline Interpolation.
12. Study and Implementation of Curve Fitting: Linear and Polynomial Regression.
13. Study and Implement of Numerical Differentiation.
14. Study and Implement of Numerical Integration-
    a. Trapezoidal Rule.
    b. Simpson's Rule.
15. Study and Implement of Ordinary Differential Equation.
16. Study and Implement of Runge-Kutta Method.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Achieve sufficient knowledge on the organization and operational details of a computer system

CLO-2: Write a scientific report (e.g., texting, formatting, data analysis, etc) and make it presentable to the scientific community.

CLO-3: Write programs using different data types, operators and expressions in C language, and perform their compiling and debugging.

CLO-4: Design and implement programs involving decision structures, loops, arrays, structures and unions, pointers and functions and solve them.

CLO-5: Apply the knowledge on C language to solve and/or analyze different numerical problems, and develop new programs as problem solving tools.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	2	-	-	-	-	-	-	-
CLO-2	-	2	-		-	-	-	-	-	-
CLO-3	-	2	-	2	-	-	-	-	-	-
CLO-4	-	-	2	2	2	2	-	1	1	-
CLO-5	-	-	2	3	2	3	1	-	1	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Laboratory Discussion and Student Activities	Quiz
CLO-2	Laboratory Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing, Laboratory Discussion and Student Activities	Mid-Sem and Summative Exam
CLO-4	Lecturing, Laboratory Discussion and Student Activities	Mid-Sem and Summative Exam
CLO-5	Lecturing, Laboratory Discussion and Student Activities	Summative Exam

Course Title: Physics Practical

Course Code: 0533-226 [PHY-226] **Credit Hour: 03**

(a) Rationale/Course Summary

The rationale of this course is to introduce students to the experimental observation of phenomenon related to physical optics. Experiments related to interference, diffraction and polarization of light is discussed in this course. Moreover, the measurement of refractive indices of various substances are also included here.

(b) Course content

List of Experiment

1. Determination of the radius of curvature of a plano-convex lens and the wavelength of sodium light by Newton's rings method.
2. Determination of wavelength of sodium light by means of Fresnel's biprism.
3. Determination of the Cauchy's constant and the resolving power of a prism using a spectrometer.
4. Determination of dispersive power of a plane diffraction grating.
5. Determination of resolving power of a plane diffraction grating.
6. Determination of the wavelength of different spectral lines using plane diffraction grating.
7. Determination of the refractive index of a glass prism by a spectrometer
8. Determination of specific rotation of the plane of polarization of light by sugar solution using a polarimeter.
9. Measurement of the thickness of a paper and a wire by means of interference fringes in air wedge.

NB: Course teacher/s may include/exclude experiments depending on the availability of experimental facilities.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course, students will be able to

CLO-1: Gather practical knowledge of the basic principles pertaining optics.

CLO-2: Demonstrate various phenomena of optics such as interference, diffraction and polarization.

CLO-3: Determine the radius of curvature of a Plano-convex lens and the wave length of sodium light by Newton's rings method.

CLO-4: Determine unknown wavelength by various optical method.

CLO-5: Measure the dispersive and resolving power of a plane diffraction grating.

CLO-6: Determine the refractive index of a glass prism by a spectrometer.

CLO-7: Analyze experimental data, draw conclusions, and interpret results accurately, while also considering sources of error in measurements.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8
CLO-1	3	1	-	-	-	-	-	-
CLO-2	2	3	-	-	-	-	-	-
CLO-3	-	3	-	2	-	-	-	-
CLO-4	-	3	-	2	-	2	-	-
CLO-5	-	3	-	2	-	-	-	-
CLO-6	-	3	-	2	-	-	-	-
CLO-7	-	2	3	-	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Quantum Mechanics-I

Course Code: 0533-311 [PHY-311] **Credit Hour: 03**

(a) Rationale/Course Summary

Introduction of quantum concept beyond classical to students develops though this course. Quantum mechanics will be generalized to a broad range of systems from matter to photons. This course is required for the physics major, the theoretical physics major and is recommended for those intending to do the honors year in physics.

(b) Course content

1. **Physical Basis:** Failure of Classical Mechanics and emergence of Quantum Mechanics, Bohr atom model and old quantum theory, Shortcoming of old quantum theory, Wave particle duality, Correspondence principle.
2. **Basic Concepts of Quantum Mechanics:** Concept and Physical postulates of quantum mechanics, Operators, State function and state vector space, Eigenvalue equations, Basis vectors, Measurement in quantum mechanics and expectation values, Eigenfunctions, Orthogonality and the sharing of eigen function sets.
3. **Schrodinger Wave Equation:** Development of Schrodinger wave equation (Time dependent and time-independent), Significance of wave function, Probability current density, Expectation value and Ehrenfest's theorem, Time variation of expectation values.
4. **One-Dimensional Problems:** Particle in a box, Step potential, Potential barrier, Tunneling, Alpha particle decay, Rectangular potential well, Square-well potentials, Linear harmonic oscillators.
5. **Spherically Symmetric System:** Schrodinger equation for spherically symmetric potentials, Solution of Schrodinger equation for Hydrogen atom, Spherical harmonics, Three-Dimensional square well potential, Parity, Angular momentum.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Identify and explain experimental results which are incompatible with classical physics and which is required for the development of a quantum theory of matter and light.

CLO-2: Describe wave function and apply operations on it to obtain information about a particle's physical properties.

CLO-3: Solve the Schrödinger equation to obtain wave functions for some basic, physically important types of potential in one dimension.

CLO-4: Gather the technique of separation of variable to solve problems in more than one dimension.

CLO-5: Describe the system of spherically symmetric potential and the Schrodinger equation for hydrogen atom.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-	-	-
CLO-3	-	1	-	-	-	-	-	-	-	-
CLO-4	-	-	2	-	-	3	-	-	-	-
CLO-5	-	-	-	2	1	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Classical Electrodynamics

Course Code: 0533-312 [PHY-312] **Credit Hour: 03**

(a) Rationale/Course Summary

The rationale of electrodynamics is to provide a theoretical framework for understanding and predicting the behavior of electromagnetic phenomena. This includes the behavior of charged particles in electric and magnetic fields, the propagation of electromagnetic waves through space, and the interaction of electromagnetic radiation with matter. This course will provide a foundation for the development of technologies that rely on these phenomena, such as electronics, communications, and power generation.

(b) Course content

1. **Maxwell's Equation:** Maxwell's electromagnetic equations, Electromagnetic energy, Poynting vector, the wave equation, Plane wave solution in conducting and non conducting media, Potential calculation.
2. **Application of Maxwell's Equation:** Boundary conditions on the field vectors, Reflection and refraction of electromagnetic waves at the boundary of non conducting media, Reflection from a conducting plane, Total internal reflection.

3. **Wave Propagation between Parallel Conducting Plates:** Propagation between parallel conducting plates, Wave guides, Cavity resonators, Propagation of electromagnetic waves in ionized gaseous medium, Radiation from a half –wave antenna.

4. **Radiation from an Accelerated Charge:** Scalar and vector potentials**,** Lienard Wiechert potentials, Field of a charge in uniform motion, Fields of an accelerated charge, Radiation at low velocities, Radiation from an oscillating dipole.

5. **Dispersion:** Dispersion in media, Lorentz's equation, Dispersions equations, normal and anomalous dispersion.

6. **Scattering:** Scattering cross section, Scattering by an individual free electron, Scattering by a bound electron, Rayleigh scattering, Thomson scattering, Resonance scattering, Blueness of the sky, ocean and glaciers.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Gather sound knowledge of electrodynamics and understand the fundamental principles of classical electromagnetism, including Maxwell's equations and the laws of electrostatics and magnetostatics.

CLO-2: Solve problems related to electric and magnetic fields, including the calculation of electric potential, electric and magnetic fields, and electromagnetic waves.

CLO-3: Describe the nature of electromagnetic wave and its propagation through different media and interfaces.

CLO-4: Explain the nature of electromagnetic power emitted by various sources and design simple electromagnetic devices.

CLO-5: Development of critical thinking and problem-solving skills through the application of mathematical techniques and physical principles to solve complex problems in electrodynamics.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	-	2	-	3	-	-	-	-	-	-
CLO-3	-	1	-	-	-	-	-	-	-	-
CLO-4	-	-	2	-	-	3	-	-	-	-
CLO-5	-	-	-	2	1	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Electronics-I

Course Code: 0533-313 [PHY-313] **Credit Hour: 03**

(a) Rationale/Course Summary

Electronics is the discipline dealing with the development and application of devices and systems involving the flow of electrons in a vacuum in gaseous media and its semiconductors. This course is expected to give familiarization of various electronic components, electronic circuits and applications.

(b) Course content

1. **Introduction to Electronics:** Electronics vs. electricity, Vacuum diode, Triode, n and p type semiconductors.
2. **Semiconductor Diode:** p-n junction, forward and reverse bias, I-V characteristics, Ge- and Si-diodes, Avalanche and Zener breakdown, PIV rating, Load line and Q-point, Maximum current and power dissipation rating, Reverse recovery time, Zener diode, Zener diode as a voltage stabilizer, LED.
3. **Rectification and Filter Circuits:** Half-wave rectifier, Full-wave rectifier, Filter circuits, Capacitor filter, L-section filter, Pi-section filter.
4. **Transistor and its characteristics:** npn and pnp configurations, Transistor action; CB, CE and CC configuration, Load line and operating points, cut-off and saturation, Transistor as a switch, Transistor biasing, Voltage divider bias.
5. **Transistor Amplifier:** Classification of amplifiers, Single stage and multi-stage transistor amplifiers, R-C coupled and transformer coupled amplifiers, Power amplifier, Class A, Class B and Class C amplifiers, Push-pull amplifier.
6. **Feedback amplifiers and Oscillators:** Feedback: Principles, Characteristics, Voltage feedback, Current feedback, Negative and Positive feedback, Frequency response, Oscillators: Condition for sustained oscillation, Colpitt's oscillator, Hartley oscillator, Phase shift oscillator, Wein bridge oscillator and Crystal oscillator.
7. **Basic Operational Amplifier:** Ideal OP-amp, Inverting and non-inverting Op-amp, Summer, Integrator, Differentiator, Sign changer.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Remember and understand the academic field of physics, its different applications area.

CLO-2: Realize and apply the theoretical knowledge in different problems.

CLO-3: Identify the basic sequential components and their application in modern device: Rectifier, Amplifier, and Oscillator.

CLO-4: Solve problems related to transistor Q-point analysis, Operation amplifier and their circuit analysis.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3									
CLO-2		1								
CLO-3			3							
CLO-4				2						1
CLO-5										

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Statistical Mechanics

Course Code: 0533-314 [PHY-314] **Credit Hour: 03**

(a) Rationale/Course Summary

This course will introduce students to the basic and advanced topics of statistical mechanics with a strong focus on its applications in different aspects of physics. It makes a relation between macroscopic and microscopic quantities. The course may be regarded as a basic course for the students of physics.

(b) Course content

1. **Statistical and Thermodynamic System:** Statistical systems, Macroscopic and microscopic states; Entropy, probability and relation between them; Thermodynamic functions and their equilibrium conditions.
2. **Ensembles:** Phase space and phase trajectory; Density distribution in phase space; Liouville's Theorem and its consequence; Ensembles; Ensemble average Microcanonical Ensemble, Canonical Ensemble and Grand canonical ensemble; use of the ensembles; Gibbs Paradox.
3. **Classical Statistics:** The partition functions; derivation of partition functions for ideal gas; Monatomic ideal gas; the principle of euipartition of energy; specific heat capacity of a diatomic gas; specific heat capacity of sollids; harmonic oscillator.
4. **Identical Particles and Maxwell-Boltzmann Statistics:** Identical particles and their symmetry, Statistical distribution function; Maxwell-Boltzmann statistics, Evolution of constants in the M-B distribution law; Maxwell's law of distribution of velocities and its application.
5. **Bose-Einstein Statistics:** Energy and pressure of the gas, Gas degeneracy, Photon, Phonon, Bose-Einstein condensation, Thermal properties of Bose-Einstein gas, Liquid Helium.
6. **Fermi-Dirac Statistics:** Velocity, speed and energy distribution functions, Degenerate Fermi gas, Fermi energy and low temperature limit, Theory of white dwarf stars.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Define and comprehend fundamental mechanical concepts in classical and quantum statistical mechanics covering thermodynamics, statistical systems, and distribution laws of identical particles.

CLO-2: Evaluate and describe the fundamental theories, concepts and postulates of statistical mechanics and derive relations between thermodynamically quantities through the formula and conceptual ideas of statistical mechanics.

CLO-3: Demonstrate and explain how classical particles behave in various energy states in different thermodynamic conditions.

CLO-4: Quantum statistical concepts and their distribution principles are used to show and explain the behavior of identical particles in different energy levels.

CLO-5: Apply the proper theoretical, analytical, and practical techniques to solve issues and advance their knowledge in the area of interest.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	2	-	-	-	-	-	-	-
CLO-2	1	2	-	2	-	-	-	-	-	-

CLO-3	-	1	-	2	-	-	-	-	-	-
CLO-4	-1	-	2	2	2	-	-	-	-	-
CLO-5	-	-	-	2	1	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term, Assignment and Summative Exam
CLO-3	Lecturing, Discussion and Student Activities	Mid-Term, Assignment and Summative Exam
CLO-4	Lecturing and Discussion	Mid-Term Summative Exam
CLO-5	Lecturing and Discussion	Summative Exam

Course Title: Personal Skills Development and Professional Ethics

Course Code: 0223-315[PHY-315] **Credit Hour: 03**

(a) Rationale/Course Summary

A growing body of evidence has shown that, although equipped with theoretical knowledge, most physics graduates lack skills that are essential for being efficient and productive members of the workforce. These set of skills have been collectively called “transferable skills” and may include effective oral- and written-communication skills, critical-thinking skills, effective team working, ability to use data acquisition systems, and data manipulation and analytical skills. A survey of educational journals shows that some physics departments have started to address this issue and have included various critical thinking as well as communication-skills courses in their undergraduate curricula. For physics professional to know and practice the personal behaviors and professional ethical issues and societal challenges derived are very important for the professionalism.

(b) Course content

1. **Introduction:** Definition of ethics and morality, relativist and absolute visions of ethics, difference between believes, behavior and aims of moral values, personal and social ethics
2. **Profession and Ethics:** Introduction to Professional Ethics for physicists and Professionalism, Professional Conduct and Ethics

3. **Interpersonal Relations:** Interpersonal Behavior, Formation of Personal Attitudes, Language and Communication, Motivations and Emotions, Public Opinion

4. **Social Ethics:** Aristotle Nsicomachean Ethics (selection), Doing One's Duty, Creating Ourselves, Hearing the Feminine Voice

5. **Introduction to Organizational Behavior:** Organizational Disciplines and topics, Psychological Perspective, Social-Psychological Perspectives

6. **Individual Differences:** Personality and its factors, Personality dimensions and social learning, Intelligence

7. **Ethics for Research and Scientific Communication:** Plagiarism and improper authorship; falsification of data; misappropriation of the ideas of others; non-disclosure of information; misrepresentation of scientific experiments, funds or other resources; misrepresentation of qualifications; the violation of generally accepted research practices.

8. **Commitment to Society:** Roles and commitments of physicists professionals and the ethical issues involved to serve society. False Qualifying and certifying of consumer products, physical safety measures, wastage and wastage management issues, etc.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Define and realize the of ethics, morality, ethical judgment, freedom of the will, and role of ethics in professional development

CLO-2: Describe and classify the individual attitude and organizational behavior

CLO-3: Identify, discuss and relate basic ethical terminology and concepts to ethical problems in Physics related professions and professionalism

CLO-4: Follow and implement the acquired knowledge of ethical skills in practical situations

CLO-5: Debate and recognize conflicts in an ethical way at national and international level.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1						1				3
CLO-2								2		
CLO-3				2		2				
CLO-4	3									
CLO-5			1			2				

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecture, PPT, Demonstration	Class test (Short Q and MCQ)
CLO-2	Lecture, Demonstration, Discussion	Quiz, assignment
CLO-3	Lecture, animated VDO clips, Question-Answer session	Class test (Short Q and MCQ)
CLO-4	Lecture, Group discussion	Essay type test.
CLO-5	Lecture, presentation, Journal article reviews, problem analysis	Essay type test, problem solving

Course Title: Physics Practical

Course Code: 0533-316 [PHY-316] **Credit Hour: 03**

(a) Rationale/Course Summary

This subject develops and applies the fundamentals of electronic technology in order to extend the understanding of electronic devices that are part of the technologies surrounding us.

(b) Course content

List of Experiment

1. (a) Familiarization of an oscilloscope.

(b) Calibration of a cathode ray tube for both d. c. and a. c. sources.

(c) Measurement of an unknown frequency and also phase angle between two a. c. sources using cathode ray tube.

2. To study the frequency response of a LCR series circuit and determination of Q-factor.
3. To study the frequency response of a LCR parallel circuit and determination of Q-factor.
4. Construction of a full-wave bridge rectifier and studying the filtering action of a capacitor.
5. To draw the characteristics curves of a p-n junction (semiconductor diode).
6. Studying the output and transfer characteristics of a p-n-p (or n-p-n) transistor in common emitter circuit.
7. Measurement of unknown frequency using phase angle between two AC sources using CRO.
8. Studying the characteristics of a series resonance circuit.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Achieve the basic principle of CRO as well as demonstrate and measure various electronic parameters and wave pattern.

CLO-2: Arrange the LCR series and parallel circuits and validation of the frequency response along with the determination of Q-factor.

CLO-3: Construction of full-wave bridge rectifier using pn-junction diode and verify the rectifying and filtering action.

CLO-4: Explain the basic nature of semiconductor junction devices and investigate their output characteristics.

CLO-5: Implementing CRO studying the characteristics of series resonance circuit and determine unknown frequency.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	1	2	2	1	-	-	-	-	-	-
CLO-2	2	1	2	1	-	2	-	-	-	-
CLO-3	1	2	1	2	-	2	-	-	-	-
CLO-4	1	1	2	1	2	2	-	-	-	-
CLO-5	2	2	2	1	2	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term, Assignment and Summative Exam
CLO-3	Lecturing, Discussion and Student Activities	Mid-Term, Assignment and Summative Exam
CLO-4	Lecturing and Discussion	Mid-Term Summative Exam
CLO-5	Lecturing and Discussion	Summative Exam

Course Title: Solid State Physics I

Course Code: 0533-321 [PHY-321] **Credit Hour: 03**

(a) Rationale/Course Summary

Solid State Physics-I provides with the students the basic knowledge on the different classifications of solids and the relevant established principles. Starting from being familiarized with the basic structures, this course allows students to understand and hence to analyze the physical as well as the fundamental/ inherent properties of solids from the qualitative and quantitative perspectives. Based on the theoretical background students are then introduced with relevant different applications and various problems solving techniques.

(b) Course content

1. **The Crystal Structure:** The crystalline state of solids, Unit cell and Bravais lattices, Symmetry operations, Crystal planes and Miller indices, Different crystal structures; Diffraction of X-rays by crystal, Laue equations and Bragg's law, Experimental diffraction methods, Laue method, Rotating crystal method and Powder methods, Reciprocal lattice.
2. **Bonds in Crystal:** Interatomic forces and crystal bonding, Ionic crystal, Calculation of electrostatic energy, Madelung constant & Bulk modulus, Covalent crystals, Crystals of inert gases, Van-der Waal & Repulsive interactions, metal crystals and Hydrogen bonded crystals.
3. **Lattice Vibrations:** Vibrations of monoatomic linear lattice, Vibrations of diatomic linear lattice, Phonon, Phonon momentum, Enumeration of normal modes, Lattice specific heat, Einstein and Debye models, Lattice thermal resistivity, Normal and Umklapp processes.
4. **Free Electron Theory of Metal:** Energy levels and density of states in one dimension, Free electron gas in three dimensions, Heat capacity of the electron gas, Electrical conductivity and Ohm's law, Hall effect, Thermal conductivity of metals, Wiedemann-Franz law.
5. **Defects in Solids:** Point defects in crystals, Schottky defects, Frenkel defects, Lattice vacancies, Colour centres, Various types of dislocation.
6. **Dielectric Properties:** Macroscopic electric field, Local electric field at an atom, Staticdielectric constant, Electronic, Ionic and Orientational, polarizabilities, Clausius-Mossotti relation, Pyro, Piezo and Ferroelectricity, Electromechanical Transducer.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Have sufficient knowledge on crystalline solids and their theoretical formation. Demonstrate basic structure and atomic/molecular arrangements in solids through X-ray diffraction.

CLO-2: Explain how properties of solids are strongly correlated with the crystal bonding and establish their mathematical interpretation.

CLO-3: Elucidate and hence to apply the phonon concept of lattice vibrations to derive different relevant theories and solve various mathematical problems.

CLO-4: Explain different models representing the classical and quantum aspects of thermal and electrical conductivity of solids along with numerical analyses.

CLO-5: Identify some specific microscopic and macroscopic properties of solids along with their applications.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10

CLO-1	**3**	**2**	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**-**
CLO-2	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**
CLO-3	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CLO-4	**-**	**-**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**
CLO-5	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Student Activities	Quiz
CLO-2	Lecturing and Student Activities	Presentation and Summative Exam
CLO-3	Lecturing and Interactive Discussion	Mid-Sem and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Sem and Summative Exam
CLO-5	Lecturing and Student Activities	Summative Exam

Course Title: Nuclear Physics-I

Course Code: 0533-322 [PHY-322] **Credit Hour: 03**

(a) Rationale/Course Summary

The rationale of this course is to introduce students to the various physical properties of nuclei. This includes the ground state properties like spin, parity, magnetic moment, electric moments, etc. and dynamic properties like nuclear reaction, cross-section, mean life *etc*. This course also provides a basic understanding of natural and artificial radioactivity and the interaction of various types of radiation through matter.

(b) Course content

1. **Basic Properties of Nuclei:** Nuclear size, radius, density; Magic and mirror nuclei; Packing fraction; Mass defect; Binding energy curve; Nuclear separation energy; Semi-empirical mass formula; Angular momentum, spin, and parity; Electric and magnetic moments of nuclei; Nuclear force-origin and characteristics.
2. **Radioactivity:** Radioactive decay laws; Half-life and mean life; Unit of radioactivity; Measurement of decay constant; Successive disintegration; Secular and transient equilibrium; Radioactive series; Artificial radioactivity; Radioisotopes: Production and uses; Radioactive dating.
3. **Radioactive Decay:** Alpha particle spectra and nuclear energy levels; Absorption of alpha particles: Range, stopping power, straggling; Range -energy relationship: Geiger-Nuttal law; Theory of alpha decay; Types of beta decay; Beta spectra and energy levels; Conservation of energy and momentum; Neutrino hypothesis; Fermi theory of beta decay;

Absorption of beta particles: Range-energy relationship; Gamma-ray spectra and energy levels; Gamma decay and its energy measurement; Theory of gamma emission; Mean lives for gamma emission; Internal conversion.

4. **Nuclear Reactions:** Types of nuclear reactions; Dynamics of reaction, Q-value equation, and threshold energy, Conservation of physical quantities in nuclear reactions; Nuclear cross-section; Compound nucleus hypothesis.

5. **Nuclear fission and fusion:** Fission and fusion processes; Energy release of fission process; Mass and energy distributions of fission fragments; Nuclear fission based on liquid drop model; Prompt and delayed neutrons; Chain reactions; Thermonuclear reaction in stars.

6. **Detectors and Accelerators:** Ionization chamber; Geiger-Mueller counter; Scintillation counter; Van de Graff accelerator; Cyclotron; Synchrotron.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course, students will be able to

CLO-1: Define the basic properties of the nucleus and nuclear force.

CLO-2: Describe the radioactive process by the radioactive decay laws and application of artificial radioisotopes.

CLO-3: Describe the theory of different types of radioactive decay such as alpha decay, beta decay, gamma decay, and solve related mathematical problems.

CLO-4: Explain the basic concepts of nuclear reactions & their conserved properties, and analyze the process of production of energy in a nuclear reactor and the Sun through nuclear fission and fusion processes respectively.

CLO-5: Explain the basic structure of different types of detectors and accelerators and how to use them to energize charged and uncharged particles and also to track and detect stable and unstable particles.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	-	-	-	-	-	-
CLO-2	3	1	-	3	-	-	-	-	-	-
CLO-3	2	1	1	2	-	-	-	-	-	-
CLO-4	2	1	2	1	-	-	-	-	-	-
CLO-5	1	-	2	-	-	1	2	1	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	**Assessment Strategy**

CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-4	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Presentation

Course Title: Electronics-II

Course Code: 0533-323 [PHY-323] **Credit Hour: 03**

(a) Rationale/Course Summary

Same as Electronics-1 students will be introduced to basic concepts in semiconductor theory and analog communication systems (AM, and FM). This course is expected to provide knowledge of various power Electronics components and its applications.

(b) Course content

1. **IC Fabrication Technique:** Integrated Circuit (IC) its advantages and disadvantages, IC Fabrication: Monolithic planar process, Fabrication schemes for resistance, diode, transistor and capacitor on silicon chip.
2. **Power Electronics:** SCR: Construction, V-I characteristics, Applications of SCR, UJT: Construction, V-I characteristics, Applications of UJT; Triac: Construction, Characteristics; Diac: Operation, Characteristics, Application of diac.
3. **Modulation and Detection:** Types of modulation, AM modulation, Modulation factor, Analysis of amplitude modulated wave, Plate modulated class C amplifier, Grid bias modulation, Demodulation, Linear diode detection, Linear develop detection, Discriminator Circuit.
4. **Radio Receiver and Transmitter :** Receiver Classification, AM receiver, TRF receiver, Heterodyne action, Super heterodyne receiver, FM receiver, Super heterodyne FM receiver, AVC and AFC system, Transmitter, AM transmitter, FM transmitter, Armstrong FM transmitter.
5. **Measuring Instruments and Appliances:** Simple concept of active and passive transducers and their applications, Analog and digital multimeters, Signal generators, Oscilloscope.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Know, understand and be able to state the basic concepts of semiconductor devices.

CLO-2: Describe the construction and working principle of SCR and UJT and its applications.

CLO-3: Realize and describe how to design a digital system using various methods.

CLO-4: Analyze and design simple circuits of Radio Receiver and Transmitter.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3									
CLO-2			3	2						
CLO-3		2				1				
CLO-4			2							1
CLO-5										

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Liberation War and Bangladesh Studies

Course Code: 0314-324[PHY-324] **Credit Hour: 03**

(a) Rationale/Course Summary

This course offers unique coverage on the founding of a new nation, Bangladesh, including language, power and religion and provides insights about economic, political, social and cultural developments of Bangladesh, Study of this course highlights multi-disciplinary narratives regarding nation's 50-year journey of socio-economic progress amid many contradictions and paradoxes. The issues of gender, ethnicity and governance will also be addressed in this course.

(b) Course content

1. **Introduction:** Identity of Bangladesh and its people, Bangladesh environment as delta, A region of multiple frontiers.
2. **Colonial Encounter:** From the Mughal empire to the British empire, British Colonial to Bengal, Aspects of Nationalist Politics during the Colonial Rule (1857-1947)
3. **Colonial conflicts:** Partition of India, Becoming East Pakistan, Pakistan Experiment, Language Movement and the Rise of Political Identity, Disparity and Quest for autonomy, Evaluation of Nationalism and Movement for Independence.

4. **Liberation war:** Six points movement, Elections of 1970, Liberation War, Birth of Country; Bangabandhu Sheikh Mujibur Rahman-The Father of the Nation, Imagining a new society, Early days of Bangladesh
5. **Constitution of Bangladesh:** Draft, Basic features and Amendments
6. **Socio-cultural situation Analysis:** National Education policy, Changing contexts and Emerging Realities of Bangladesh, Indicators of Educational Development, Health Policy in before Independence and modern Bangladesh
7. **Economic Growth of Bangladesh:** Concept on macro and micro economics: Overview of Bangladesh economy, Key driving factors behind the rapid growth Bangladesh economy

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Identify the specific stages from the ancient, medieval, colonial and post-colonial periods to current situation how Bangladesh came to be and what is today.

CLO-2: Articulate the roots regarding the war and birth of Bangladesh as independence.

CLO-3: Explain the development of political system, socio-economic conditions, Islamic propriety, Environmental conditions of pre and post-independence of Bangladesh through qualitative and quantitative analysis.

CLO-4: Compare and analyze the indicators regarding the development of social, cultural, economic, educational and political situation of Bangladesh with other nations.

CLO-5: Disseminate and communicate ideas and perception both in oral and written ways regarding the strategies to be taken in order to improve the indicator/factors for development of the state as emerging nation.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	LT	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	CI	-	-	1	-	-	-	-	-	-	-
CLO-2	C2	-	-	-	-	-	-	-	-	-	1
CLO-3	C2	-	-	-	-	1	-	-	-	-	-
CLO-4	C4	-	-	2	-	-	-	-	-	-	-
CLO-5	C4	-	-	-	-	-	-	-	3	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Student Activities	Quiz
CLO-2	Lecturing and Student Activities	Presentation and Summative Exam
CLO-3	Lecturing and Interactive Discussion	Mid-Sem and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Sem and Summative Exam
CLO-5	Lecturing and Student Activities	Summative Exam

Course Title: Physics Practical

Course Code: 0533-325 [PHY-325] **Credit Hour: 03**

(a) Rationale/Course Summary

The course involves experiments which illustrate the principles of nuclear physics and electronics. In this course students will learn to operate Geiger-Muller counter and will be able to manage various radioactive sources safely and applies the fundamentals of electronics technology in order to depend the understanding of electronic devices that are part of the technologies that surround us.

(b) Course content

List of Experiment

1. (a) Determination of a charge of an electron by Helmholtz coil.
   (b) To find the value of e/m for an electron.
2. To draw the characteristics curves for a Zener diode and to study it as a voltage regulator.
3. To study the frequency response characteristics of a RC high pass filter circuit.
4. To study the frequency response characteristics of a RC low pass filter circuit.
5. To determine the Plank's constant h by a photocell.
6. a)To determine the plateau curve and operating voltage of a Geiger-Muller counter.
   b) To determine the dead – time of a G – M tube.
7. Determination of the current voltage characteristics of an ionization chamber and the range of alpha particles.
8. Studying the absorption of gamma ray by matter and to determine the absorption co-efficient.
9. Determination of cell constant, 'a' and'd' spacing and indexing of X-ray diffraction photograph/pattern.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Handle Geiger-Muller (G-M) counter and hence can be able to determine plateau, dead time and operating voltage of it.

CLO-2: Observe the absorption of gamma ray by matter and determine the absorption co-efficient.

CLO-3: Adopting the principle of Helmholtz coil able to determine charge and e/m of electron.

CLO-4: Be able to explain the key areas in which atomic and nuclear physics effects everyday living.

CLO-5: Observe the frequency response characterization of a RC high and low pass filter circuit.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	1	2	2	1	-	-	-	-	-	-
CLO-2	2	1	2	1	-	2	-	-	-	-
CLO-3	1	2	1	2	-	2	-	-	-	-
CLO-4	1	1	2	1	2	2	-	-	-	-
CLO-5	2	2	2	1	2	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Mid-Semester and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Semester and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Semester and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Semester and Summative Exam
CLO-5	Discussion and Student Activities	Mid-Semester and Summative Exam

Course Title: Quantum Mechanics-II

Course Code: 0533-411 [PHY-411] **Credit Hour: 03**

(a) Rationale/Course Summary

Quantum Mechanics is one of the two foundational theories on which modern physics rest. This course introduces the basic theoretical concepts and formalism, including the wave

mechanics developed by Schrodinger and others and some aspects of the matrix formalism first developed by Heisenberg.

(b) Course content

1. **Matrix Formulation of Quantum Mechanics:** Matrix representation of operators, Wave functions and eigen value equations, Hilbert space, Normalization and orthogonality of wave functions in matrix form, Dirac's Bra and Ket notations, Diagonalization of a matrix.
2. **Quantum Electrodynamics:** Schrodinger, Heisenberg and Dirac pictures and their applications, Feynmann diagram.
3. **Approximation Methods in Quantum Mechanics:** Time dependent and time independent perturbation theory, Variational method, WKB approximation and their applications.
4. **Angular Momentum:** Angular momentum, Operator, Eigenvalues of the angular momentum operator, Spin angular momentum operator, Rotational operator, Eigenvalues and eigen vectors of angular momentum operators, Clebsch-Gordan co-efficient, Pauli exclusion principle and spin matrices.
5. **Scattering Theory:** Scattering cross-section, Partial wave expansion method, Differential equation of scattering, Phase shift analysis and its applications, Integral equation of scattering, Born approximation and its applications, Optical theorem.
6. **Identical Particles:** Symmetric and antisymmetric wave functions, Exclusion principle, Scattering of identical particles, Symmetries of two nucleon systems.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Explain the use of operators in a quantum mechanical formalism and the description of operators by matrix formulation.

CLO-2: Describe the quantum electrodynamics by Schrodinger, Heisenberg and Dirac pictures and their applications.

CLO-3: Model physical systems using common approximation methods for making dynamical calculations.

CLO-4: Describe the concepts of scattering theory and their applications by various approximation in physics

CLO-5: Gather knowledge about identical particle system and symmetric and anti-symmetric wave functions.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	-	-	2	-	-	-	-	-

CLO-2	-	**2**	**1**	**3**	-	-	-	-	-	-
CLO-3	-	**1**	-	**2**	**3**	-	-	-	-	-
CLO-4	-	-	**2**	**1**	-	**3**	-	-	-	-
CLO-5	-	-	-	**2**	**1**	**2**	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Nuclear Physics-II

Course Code: 0533-412 [PHY-412] **Credit Hour: 03**

(a) Rationale/Course Summary

The rationale of this course is to introduce students to the advanced concepts of nuclear physics and to familiarize students with the basic topics of elementary particle physics. This course includes bound two nucleon systems and associated nuclear properties, nuclear shell model to explain various ground state nuclear properties. Moreover, different types of nuclear reaction mechanisms are also included in this course.

(b) Course content

1. **Two-Nucleon Problem:** The central potentials, Ground state of the deuteron, Excited state of the deuteron, Neutron-proton scattering at low energy, scattering length, Spin-dependence of neutron-proton scattering, Effective range theory in n-p scattering, Coherent and incoherent attiring of low energy neutron, Meson theory of nuclear force.
2. **Nuclear Shell Model:** Introduction, Extreme single-particle model, Single particle potentials, spin-orbit potential, analysis of extreme shell model predictions-magic number, spin number; Single-particle model, Nordheim's rules, Schmidt's lines and magnetic moments, Configuration mixing.
3. **Nuclear Reaction:** Nuclear cross section, Partial wave analysis of nuclear cross-section, Breit-Wigner dispersion formula for s-wave neutron, Bohr's hypothesis of compound nucleus, Direct reactions, Introduction to Optical model, Introduction to complex potential.
4. **Interaction of Ionizing Radiation with Matter:** Passage of charged particles through matter, Multiple scattering, Ionization, Excitation, Collision stopping power and radioactive stopping power, Passage of electromagnetic radiations through matter, Bremsstrahlung,

Photonuclear interactions, pair production and annihilation.

5. **Particles-I:** Particle classification, The standard model of particle physics, Fundamental interactions, Symmetries and conservation laws: Parity operation, Charge conjugation, Isospin symmetry, Baryon, and lepton number conservations, Strangeness and hypercharge; Production and decay of pions, muons, hyperons; Resonance particles, Leptons: Lepton multiplets, Neutrinos, Quarks, Color charge; Hadrons: Flavour independence and charge multiplets, quark model spectroscopy, Charged and neutral currents, Symmetries of the weak interactions, Particles with mass-chirality, The Higgs boson, Grand unification.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course, students will be able to

CLO-1: Describe the ground and excited state properties of the two nucleon system. They will also learn how the interaction potential depends on the spin motion of nucleons.

CLO-2: Learn about the various types of nuclear model and to calculate the spin and magnetic moment of nuclei by using the nuclear shell model.

CLO-3: Obtain theoretically the nuclear cross section using the Breit-Wigner formula. To know about the various nuclear reaction mechanisms.

CLO-4: Learn how the charged and uncharged particles interact and pass through matters and the associated terminology will also be introduced in this course.

CLO-5: Explain the basic concept of standard model and know the various conservation laws related to particle physics. To know about the color charge, quark models spectroscopy, and the symmetries of weak interaction.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	2	1	3	-	-	-	-	-	-	-
CLO-2	1	2	3	-	-	-	-	-	-	-
CLO-3	2	-	3	1	-	-	-	-	-	-
CLO-4	3	1	-	1	-	2	-	-	-	-
CLO-5	3	1	-	2	-	-	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Mid-Term
CLO-2	Lecturing and Discussion	Mid- Term and Summative Exam

CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Discussion and student activities	Assignment and Summative Exam
CLO-5	Lecturing and Student Activities	Quiz and Presentation

Course Title: Digital Electronics

Course Code: 0533-413 [PHY-413]Credit Hour: 03

(a) Rationale/Course Summary

This course will introduce students to the basic characteristics of the binary number system, the operational principle of various digital systems, circuits and its application. It helps to convert a number from one to the other number systems. Moreover, the course provides necessary logics and formulas to reduce complex expression to its simplest form.

(b) Course content

1. **Numbers:** Binary numbers, Decimal numbers, Octal numbers, Hexadecimal numbers, Number base conversion, Binary addition.
2. **Binary Codes:** Binary codes, Weighted codes: Stragit binary code, The 8421 code, The 2421 code, The 5211 code, Non weight codes: Excess-3 code, The Gray code, Code conversion, Alphanumeric codes, The ASCII code, The parity bit, The Hamming code, Error detection and correction.
3. **Boolean Algebra and Logic Gates:** Laws and theorems of Boolean algebra, Boolean functions, Simplification of Boolean functions, De Morgan's theorems, Digital Logic Gates: AND gate, OR Gate, NOT gate, NOR gate, XOR and XNOR gates, The universal building block, Logic family, TTL circuits.
4. **Simplifying Logic Circuits:** Minterm and maxterm, SOP and POS circuits, Algebraic simplification, Map method: Truth table to Karnaugh maps, Redundant groups overlapping, Don't care conditions, Tabulation method: Determination and selection of Prime- Implicants.
5. **Arithmetic Circuits:** Complements: The r's and (r-1)'s complements, Subtraction with r's and (r-1)'s complements, Adders: Half-adder and full-adder, Binary parallel adder, Decimal adder, BCD adder, Subtractors: Half-subtractor and full subtractor, Binary multiplier.
6. **Flip-Flops, SR Latches:** Transistor latch, NAND and NOR latch, Clock signal, Clocked SR flip-flop, D-type flip-flop: Unclocked and clocked D flip-flop, JK flip-flop: Edge- triggered JK flip-flop, JK master-slave flip-flop, Multivibrators.
7. **Counters and Registers:** Ripple counter, Design of synchronous counter, Parallel counter, Combination counter, BCD shift registers, Decoders: BCD- to decimal decoder, Demultiplexers, Encoders, Multiplexers.
8. **D/A and A/D Conversion:** Variable-resistor network, Binary laddr, D/A converter, D/A accuracy and resolution, A/D converter, A/D accuracy and resolution, Advanced A/D techniques.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Able to remember and understand the number system and Boolean algebra and basic properties of Boolean algebra to simplify simple Boolean functions.

CLO-2: Analyze and apply the different logic gets event simplifying the different time

CLO-3: Describe the tabulation and Karnaugh map methods and apply those for simplifying combinational circuits.

CLO-4: Define Integrated circuits, Logic families and identify the basic sequential logic components: SR Latch, different Flip-Flops and their usage and able to analyze sequential logic circuits.

CLO-5: Define and explain the various types of counters, registers and advanced D/A and A/D conversion.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	2	-	1	1	-	-	-	-	-	-
CLO-2	-	2	-	3	1	-	3	-	-	-
CLO-3	-	-	1	-	3	-	2	-	-	-
CLO-4	-	-	-	-	3	1	2	-	-	-
CLO-5	-	-	1	-	-	2	3	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Summative Exam
CLO-2	Discussion and Student Activities	Mid-Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Presentation and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Plasma Physics

Course Code: 0533-414[PHY-414] **Credit Hour: 03**

(a) Rationale/Course Summary

Plasma is one of the four fundamental states of matter. Plasma Physics is the study of charged particles and fluids interacting with self-consistence electric and magnetic fields. It is a basic research discipline that has many different areas of application space and astrophysics, controlled fusion, accelerate physics and beam storage.

(b) Course content

1. **Introduction:** Definition of plasma, Plasma as a fourth state of matter, Saha equation of ionization, Occurrence of plasmas, Plasmas in the early universe, Plasmas in nature, Plasmas in laboratory, Applications of plasma physics: Gaseous electronics, controlled thermonuclear fusion, Space physics, Modern astrophysics, MHD energy conversion and ion propulsion, Solid state plasmas, Gas lasers.
2. **Fundamental Concepts of Plasma Physics:** Concept of temperature, Debye shielding, Quasi neutrality, Collective behavior, Plasma frequency, Criteria for a plasma, Different methods of plasma production, Low pressure cold cathode discharge, Thermionic-arc discharge, Plasma guns, Solar plasma, Laser-produced plasma, Plasma probes for measurement of plasma properties.
3. **Single Particle Motions:** Introduction, Motion of charged particles in homogeneous electric and magnetic fields, Motion of charged particles in non-uniform E and B fields, Motion of charged particles in time varying E(t) and B(t) fields, Plasma properties from the orbit theory.
4. **Application of Single Particle Motions:** Adiabatic invariants, The first adiabatic invariant (u), The second adiabatic invariant (J), The third adiabatic invariant, Plasma confinement by magnetic mirror field, Plasma confinement by a magnetic field.
5. **Plasmas as Fluids:** Introduction, Maxwell's equations in a plasma medium, Classical treatment of magnetic material, Classical treatment of dielectrics, Dielectric constant of a plasma, Fluid equation of motion, Convective derivative, Stress tensor, Collisions, Equation of Continuity, Equation of state.
6. **Fluid Equations and Their Applications:** A complete set of fluid equations, Fluid drifts perpendicular to B, Fluid drifts parallel to B, Plasma approximation, Plasma oscillations by fluid equations, Calculations of dielectric tensor components by fluid equations with and without magnetic fields.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Gather sound knowledge of phenomena regarding plasmas, nature of plasma and applications of plasma physics in modern technology.

CLO-2: Explain single motion in homogeneous electric and magnetic field and describe its applications.

CLO-3: Solve problems related to the fluid equation for various plasma phenomena.

CLO-4: Achieve the capacity to solve qualitative and quantitative problems in scientific and engineering contexts, using appropriate mathematical and computing techniques as necessary.

CLO-5: Enrich critical thinking through the ability to find and analysis information and judge its reliability and significance.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	1	-	-	-	-	-	-	-	-
CLO-2	-	2	1	3	-	-	-	-	-	-
CLO-3	-	-	1	3	2	-	-	-	-	-
CLO-4	-	1	-	3	2	2	-	-	-	-
CLO-5	-	-	2	-	1	3	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment and Quiz
CLO-2	Discussion and Student Activities	Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam

Course Title: Physics Practical

Course Code: 0533-415 [PHY-415] **Credit Hour: 03**

(a) Rationale/Course Summary

The rationale of this course is to introduce students to the basic principles of digital electronics and nuclear physics in practical. In this course, students will learn how to operate an operational amplifier, Geiger Mueller counter, acoustic transducers, work with 741 linear IC, TTL logic gates, voltage amplifier, high pass-active filter and recognize JEFET and SCR characteristics.

(b) Course content

List of Experiment

1. To study the random nature of radioactive decay and show that the 68.3% of the measurements would fall within the limits bounded by $\pm \sigma$ from the mean value of the measurements.
2. To study the JEFET characteristics.
3. To determine the speed of sound with the help of acoustic transducers.

4.To study the SCR Characteristics.

5.To study the effect of temperature on the reverse saturation current of a given p-n junction and hence find the intrinsic forbidden energy gap of the semiconductor specimen.

6.To design, construct and analyze inverting and non-inverting high gain operational Amplifier using 741 Linear IC and hence.

a) Measure the input resistance of the inverting voltage amplifier

b) Measure the output resistance of the non-inverting voltage amplifier.

7.To construct and test a high-pass active filter using 741 linear integrated circuit and observe the following

a) Determine where the high response rolls off.

b) Plot a response curve showing frequency vs. voltage gain.

8.To construct and test of a low pass active filter using 741 linear integrated circuit and observe the following-

(a) Determine where the low response rolls off

(b) Plot a response curve showing frequency vs voltage gain and also the calculation of cut-off frequency.

9.To demonstrate the operation and characteristics of a TTL logic gate and to show how it can be used to perform different logic functions.

NB: Course teacher/s may include/exclude experiments depending on the availability of experimental facilities.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course, students will be able to

CLO-1: Design and construct any digital logic circuit and verify it using truth tables.

CLO-2: Determine the speed of sound with the help of acoustic transducers.

CLO-3: Design, construct and analyze input and output resistance of inverting and non-inverting operational amplifier by using 741 linear IC.

CLO-4: Construct and observe characteristics of high pass active filter using 741 linear IC.

CLO-5: Demonstrate the operation and characteristics of TTL logic gate.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	2	-	3	-	2	-	-	-
CLO-2	1	-	3	1	-	-	2	-	-	-
CLO-3	-	1	2	3	-	-	2	-	-	-
CLO-4	1	1	1	1	-	2	3	-	-	-

CLO-5	**1**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**-**

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Discussion and Student Activities	Mid Term and Summative Exam
CLO-2	Discussion and Student Activities	Mid Term and Summative Exam
CLO-3	Lecturing, Discussion and Student Activities	Mid Term and Summative Exam
CLO-4	Lecturing, Discussion and Student Activities	Mid Term and Summative Exam
CLO-5	Lecturing, Discussion and Student Activities	Mid Term and Summative Exam

Course Title: Solid State Physics-II

Course Code: 0533-421 [PHY-421] **Credit Hour: 03**

(a) Rationale/Course Summary

An advanced level course designed for further enrichment of the theoretical concepts that students already have from their earlier course/courses of solid state physics/materials sciences. Theories included here have direct implications in explaining the very fundamental concepts like band gap, effective mass of an electron, idea of hole, conductor, semiconductor, insulator, superconductor, excitons, magnon, and many more. All of these ideas, and the knowledge behind are already adopted in practical applications. This course, therefore, offers an opportunity to transform the theoretical knowledge in to real-life applications by allowing exploring new materials with new properties.

(b) Course content

1. **Band Theory of Solids:** Formation of energy bands in solids, Electron in a periodic potential: Bloch function, Kronig–Penny model, Effective mass, Properties of free electrons in a Brillouin zone, Concept of hole, Distinction of metals, Insulators and semiconductors, Band structure calculation and application in simple cubic (sc), body centered cubic (bcc) and face centered cubic (fcc) lattice.
2. **Band Theory of Insulators and Semiconductors:** A simplified model of an insulator and intrinsic semiconductors, Improved model of an insulator and intrinsic semiconductors, Models for an impurity semiconductor, Hall effect in semiconductors with a single type of charge carrier.
3. **Magnetism:** Origin of magnetism, Langevin's diamagnetism and paramagnetism, Q theory of paramagnetism, Ferromagnetism, Weiss theory of ferromagnetism, Nature and Origin of weiss molecular field, Concept of Domains and hysteresis, Anti ferromagnetism, Ferrimagnetism, Heisenberg model, Spin waves, Magnon.
4. **Superconductivity:** Basic properties of superconductors, Meissner effect, Type–I and Type-II superconductors, Thermodynamics of superconductivity, London equation, BCS theory, Tunneling and Josephson effect, High-T_C superconductors.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Explain- how discrete energy levels of an atom split into energy bands in solids, electrons movement in a crystalline solid/ in a periodic potential, why some materials behave as conductors, and others are either semiconductors or insulators, why magnetic fluxes are expelled by a superconductor, and many other fundamental concepts.

CLO-2: Various equations, models, and theories, and their significance in explaining different types of materials, namely- intrinsic semiconductors, insulators, para-/diamagnetic materials, and superconductors, etc.

CLO-3: The transformation of the theoretical knowledge in to real life applications.

CLO-4: Realize application prospects of crystals in general, magnetic materials, and superconductors as well as expansion of applications horizon by controlling the property of solids through introducing defects, color centres, and traps, etc.

CLO-5: Analyze numerically different mathematical problems, and other critical aspects discussed in different chapters in order to enhance the critical thinking.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	2	1	-	-	-	1	-	-
CLO-2	3	-	2	2	1	-	-	-	-	-
CLO-3	1	-	1	-	2	-	2	-	-	-
CLO-4	-	2	-	2	-	2	2	-	-	-
CLO-5	-	-	1	3	3	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Interactive Discussion	Mid-Sem and Summative Exam
CLO-2	Lecturing and Student Activities	Mid-Sem and Summative Exam
CLO-3	Interactive Discussion	Quiz/Assignment
CLO-4	Lecturing and Student Activities	Mid-Sem and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Reactor Physics

Course Code: 0533-422 [PHY-422] **Credit: 03**

(a) Rationale/Course Summary

The rationale of this course is to introduce students to the elementary concepts of reactor Physics. This course includes the process of nuclear fission in reactor core, diffusion and moderation of energetic neutrons in nuclear reactor, concept of chain reaction and four factor formula. In addition, concepts of various types of power, research, and breeder reactors as well as the concepts of fuel cycle, isotope separation and radioactive waste management are also discussed in this course.

(b) Course content

1. **Nuclear Reactions by Neutrons:** Interaction of neutrons with matter, Neutron cross section and its determination, Energy dependence of neutron cross-section, Nuclear fission and cross-section.
2. **Diffusion and Moderation of Neutrons:** Fick's law, steady-state diffusion equation and diffusion length, Solution of diffusion equation, Thermal neutron diffusion, Fast neutron diffusion and Fermi age equation; Energy distribution and cross section of thermal neutrons, Slowing down of reactor neutrons, Transport mean free path and scattering cross-section, Average logarithmic energy decrement, Slowing-down power and moderating ratio, Critical equation and reaction buckling.
3. **Nuclear Chain Reaction:** Neutron cycle and multiplication factor, The four factor formula, Neutron leakage and critical size, Calculation of K for homogeneous reactors, Calculation of K for heterogeneous reactors.
4. **Design of Nuclear Reactor:** Non-nuclear components of nuclear reactors, Components of nuclear reactors, Classification of reactors, Power reactors- PWR, BWR, VVER, Research reactors-swimming pool type, TRIGA, Breeder reactors- LMFBR, Heterogeneous reactors,. Basic components of nuclear power plants, Difference between nuclear reactor and atomic bomb.
5. **Reactor Fuels:** The fuel cycle, Production of nuclear reactor fuels, Separation of uranium isotopes, Re-processing of irradiated fuel, Radioactive waste disposal.
6. **Heat Removal:** Thermal problems in reactor design, Design of cooling system, Heat sources in reactor systems, Reactor coolants.
7. **Control of Nuclear Reactors:** Reactor kinematics, General features of reactor control, Design of control system and reactor operation, Effect of temperature on reactivity, Fission product poisoning, Burnable poisons.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course, students will be able to

CLO-1: The interaction of neutrons through matter and nuclear fission cross section.

CLO-2: Describe the steady-state diffusion equation and solve various types of diffusion equations. The process of slowing down of neutrons and associated parameters will also be able to learn.

CLO-3: Describe the neutron cycle and multiplication factor. Various nuclear and non-nuclear components of nuclear reactor can be learnt. Classification of reactors on the basis of several parameters can be studied.

CLO-4: Explain the nuclear fuel cycle. Know how to separate uranium isotope, re-processing of irradiated fuel, how to manage the produced radioactive waste can be studied.

CLO-5: Explain the control mechanism and system of reactor. Learn how the reactivity depends on the temperature, how the produced radioactive products poison the whole system.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	2	1	-	-	-	-	-	-
CLO-2	1	-	1	2	3	-	-	-	-	-
CLO-3	3	-	2	-	1	-	-	1	-	-
CLO-4	3	-	2	-	-	-	1	1	-	-
CLO-5	1	-	2	2	-	-	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Assignment
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing, Discussion and Student Activities	Mid-Term, Quiz, Presentation and Summative Exam
CLO-4	Student activities and Discussion	Presentation and Summative Exam
CLO-5	Lecturing and Discussion	Summative Exam

Course Title: Renewable Energy Physics

Course Code: 0533-423 [PHY-423] **Credit Hour: 03**

(a) Rationale/Course Summary

Energy is essential in human life. Now a day's human society can't survive without a continuous supply of energy. Although energy has brought about significant changes in life-

styles, its generation, processing and consumption is also a source of both localized pollution and a major contributor to global climate change. In that case, renewable energy is proving its potential as an important part of the solution. An increasing amount of energy can be produced without using fossil fuels and without emitting greenhouse gases or harmful air pollutants. In general the course will introduce students to various aspects of renewable energy technologies and its applications in our modern society.

(b) Course content

1. **Introduction:** World energy requirement, Source of energy, Solar energy, Wind energy, Geothermal, OTEC, Wave energy, Biomass, MHD, Chemical energy, Fuel cell, Nuclear fusion.
2. **Solar Energy:** Solar radiation, Solar constant, Solar geometry, Azimuth, Declination, Day length, Solar length, Solar time, Solar radiation of titled surface, Monthly average solar radiation, Measurement of solar radiation.
3. **Solar Collector**: Flat plate collectors, General description of flat plate collector, Heat transfer properties of the flat plate collector, Energy balance, Temperature distribution, Collector overall heat transfer coefficient, Collector efficiency factor, Heat removal factor and flow factor.
4. **Energy Storage:** Energy storage in solar process system, Types of energy storage, Sensible heat storage, Latent heat storage, Phase change energy storage, Thermo-chemical Storage.
5. **Photovoltaic:** Interaction of light with semiconductor, Absorption and recombination process, Photovoltaic principles, Semiconductor junction, Power output and conversion efficiency, Efficiency limiting factor.
6. **Photovoltaic System and Modules:** Basic photovoltaic system for power generation, Solar modules, Module circuit design, Application of photovoltaic system.
7. **Other Source of Non-Conventional Energy:**

   a) Wind Energy: Suitability of wind power, Factors of wind speed, Height above ground and terrain characteristics, Betz' law, Basic wind power system, Advantage and disadvantages of wind power.

   b) Biomass and Biogas: Source of biomass method of obtaining energy, Introduction to water power and tidal power.

(c) Course Learning Outcomes (CLOs)

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

CLO-1: Gather sound knowledge of present conditions of global energy system and analyze their potential (World energy requirement: Renewable and non-renewable energy sources).

CLO-2: Explain the present and future demand patterns of renewable energy sources.

CLO-3: Detailed explanation of solar energy, solar energy collecting system and different energy storage process.

CLO-4: Gather sound knowledge of photovoltaic principles, Semiconductor junction, High power output and high conversion efficiency.

CLO-5: Design and construct energy generation system for future purposes. Acquire, estimate physical data and write scientific reports.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	1	-	-	-	-	-	-	-
CLO-2	-	1	3		-	-	-	-	-	-
CLO-3	-	2	-	-	-	1	-	-	-	-
CLO-4	-	2	1	-	-	3	-	-	-	-
CLO-5	-	-	-	2	2	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Experimental Techniques in Physics

Course Code: 0533-424[PHY-424] **Credit Hour: 03**

(a) Rationale/Course Summary

This course includes a study of basic characterization techniques in Physics. Different techniques are used to characterize in physical parameters which are mentioned as follows: Optical and spectroscopy instruments for morphology analysis of sample, Electrical Measurements for resistance measurement. High and ultra-high vacuum are used to main the contamination free environment. Finally, some techniques are used for thin film technique and sample preparation.

(b) Course content

1. **Optical and Spectroscopy Instruments:** Phase contrast and polarizing microscope, Spectrophotometers, Optical transmittance, Reflectance and absorption coefficients.
2. **Electrical Measurements:** Potentiometer, High impedance analyzer, Oscilloscope, DC amplifier, Frequency meter and counter, Four-point probe, Hall probe.

3. **High and Ultra-high Vacuum:** Production and measurement of high and ultra-high vacuum, Rotary pump, Diffusion pump, Ion pump, Turbo pump, Pirani gauge, Penning and ionization gauges.

4. **Phase Sensitive Detection:** Lock in amplifier, SCR type temperature controller.

5. **Thin Film Technique and Sample preparation:** Production and characterization of thin film, Nucleation, Homogenous and heterogeneous nucleation, Evaporation, sputtering, CVD, MBE, MOCVD, liquid crystal, grinding, annealing, normalizing, quenched, etching, sintering, solid state reaction, Thickness measurement, Interferometric and gravimetric methods.

(c) Course Learning Outcomes (CLOs)

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

CLO-1: Gather sound knowledge of optical and spectroscopy instruments for observing the surface morphology of different samples.

CLO-2: Use different tools such as high impedance analyzer, Four-point probe, hall probe etc. and measure the electrical resistance of various samples.

CLO-3: Explain the behavior of different methods for production and measurement of high and ultra-high vacuum to use contamination free environment.

CLO-4: Describe the phase sensitive detection: Lock in amplifier, SCR type temperature controller.

CLO-5: Explain the different techniques for thin film and sample preparation and as well as sample characterizations.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	2	-	2	-	2	-	-	-	-	-
CLO-2	-		3	2	1	-	-	-	-	-
CLO-3	2	2	1	-	-	-	-	-	-	-
CLO-4	-	-	-	-	3	1	2	-	-	-
CLO-5	1	-	-	2	2	2	-	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Quiz
CLO-2	Discussion and Student Activities	Assignment and Summative Exam
CLO-3	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid-Term and Summative Exam
CLO-5	Discussion and Student Activities	Summative Exam

Course Title: Physics Practical

Course Code: 0533-425 [PHY-425] **Credit Hour: 03**

(a) Rationale/Course Summary

This course will introduce students with the advanced technology of electronics and improve their skills to design and solve different kinds of circuits in digital electronics. In this course, the students will be able to learn and work with fundamental, universal and exclusive logic gates, Flip-flop circuit and low pass active filter.

(b) Course content

List of Experiment

1. To construct OR gate using diodes and transistors and also verify its truth table.
2. To construct AND gate using diodes and transistors and also verify its truth table.
3. To construct NOT and NOR gates and also verify its truth table.
4. To construct NOT and NAND gates and also verify its truth table.
5. To study the UJT characteristics.
6. (a) To demonstrate the operation and characteristics of set –reset (latch) Flip-Flop.

   (b) To demonstrate the operation and characteristics of a D-type Flip-Flop and a storage Register.
7. To design, construct and test a low pass active filter using 747 linear integrated ckt and observe the following:

   (i) Determine in what low frequency range filtering occurs.

   (ii) Plot a graph of frequency vs voltage gain.

(c) Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO-1: Design and construct various types of logic gates by using diode, IC and transistors.

CLO-2: Constrictions of the logic circuits and verifying their logic operations using truth table.

CLO-3: Using the elementary knowledge of semiconductor devices demonstrate the output characteristics of Uni junction Transistor (UJT).

CLO-4: Validate the operation and characteristics of set-reset and D-type flip-flop and investigate their ability as a storage register.

CLO-5: Design, construct and observe characteristics of a low pass active filter using 747 linear integrated circuit and study the low frequency filtering action with the help of frequency *vs* voltage gain graph.

(d) Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10
CLO-1	3	-	2	1	-	-	2	-	-	-
CLO-2	-	1	3	1	-	2	2	-	-	-
CLO-3	2	2	-	-	-	1	2	-	-	-
CLO-4	1	-	2	-	2	2	3	-	-	-
CLO-5	1	1	1	1	2	2	3	-	-	-

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

(e) Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO-1	Lecturing and Discussion	Mid-Term and Summative Exam
CLO-2	Discussion and Student Activities	Mid- Term and Summative Exam
CLO-3	Lecturing and Discussion	Mid- Term and Summative Exam
CLO-4	Lecturing and Student Activities	Mid- Term and Summative Exam
CLO-5	Discussion and Student Activities	Mid- Term and Summative Exam