LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (LOCF) FOR IN B.SC. (HONOURS) PHYSICS PROGRAMME

1. Introduction

Physics is an experimental as well as a theoretical science that studies systematically the laws of nature operating at length scales from the sub-atomic domains to the entire universe. The scope of Physics as a subject is very broad. The core areas of study within the disciplinary/subject area of the B.Sc. (Hons.) Physics programme are: Classical and Quantum Mechanics, Electricity and Magnetism, Thermal and Statistical Physics, Wave theory and Optics, Physics of the Materials, Digital Electronics, and specialized methods of Mathematical Physics and their applications in different branches of the subject. Along with the theoretical course work students also learn physics laboratory methods for different branches of physics, specialized measurement techniques, analysis of observational data, including error estimation, and scientific report writing. The latest addition to Physics pedagogy incorporated in the framework is computational physics, which involves adaptation of Physics problems for algorithmic solutions, and modelling and simulation of physical phenomenon. The elective modules of the framework offer students choice to gain knowledge and expertise in more specialized domains of Physics like Nuclear and Particle physics, Nanophysics, Astronomy and Astrophysics, etc. and interdisciplinary subject areas like Biophysics, Geophysics, Environmental Physics, Medical Physics, etc.

The physics-based knowledge and skills learnt by students also equip them to be successful in careers other than research and teaching in Physics.

2. Aim of bachelor's degree programme in B.Sc. (Hons.) Physics

The aims of LOCF based UG educational program in Physics are as follows:

- To create the facilities and learning environment in educational institutions to consolidate the knowledge acquired at +2 level, motivate students to develop a deep interest in Physics, and to gain a broad and balanced knowledge and understanding of physical concepts, principles and theories of Physics.

- To provide opportunities to students to learn, design and perform experiments in lab, 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, and computational problems and modelling.

- To develop the ability in students to apply the knowledge and skills they have acquired to get to the solutions of specific theoretical and applied problems in Physics.

- To prepare students for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas, as Physics is among the most important branches of science necessary for interdisciplinary and multidisciplinary research.

- To prepare students for developing new industrial technologies and theoretical tools for applications in diverse branches of the economic life of the country, as Physics is one of the branches of science which contribute directly to technological development; and it has the most advanced theoretical structure to make quantitative assessments and predictions, and in light of all of the above to provide students with the knowledge and skill base that would enable them to undertake further studies in Physics and related areas, or in

interdisciplinary/multidisciplinary areas, or join and be successful in diverse professional streams including entrepreneurship.

3. Expected Learning Outcomes of bachelor's degree programme in B.Sc.(Hons.) Physics

Some of the characteristic attributes of a graduate in Physics are

- **Disciplinary knowledge**
  - Comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in core areas of Physics - like Classical and Quantum mechanics, Thermodynamics and Statistical mechanics, Electricity, Magnetism and Electromagnetic theory, Wave Theory, Optics, Solid State Physics, and Analogue and Digital electronics; and in the chosen disciplinary elective sub-fields of the subject like Nuclear and Particle Physics, Analytical dynamics, Astronomy and Astrophysics, Advanced Mathematical Physics, Nanophysics and interdisciplinary subfields like Biophysics, Geophysics, Atmospheric Physics, Medical Physics, Embedded Systems, etc.
  - Ability to use physics laboratory methods and modern instrumentation for designing and implementing new experiments in physics, interdisciplinary/ multidisciplinary research areas and industrial research.

- **Critical thinking:** Ability to distinguish between relevant and irrelevant facts and information, discriminate between objective and biased information, apply logic to arrive at definitive conclusions, find out if conclusions are based upon sufficient evidence, derive correct quantitative results, make rational evaluations, and arrive at qualitative judgments according to established rules.

- **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.

- **Digitally Efficient*:*** Capable of using computers for computational and simulation studies in Physics. Proficiency in appropriate software for numerical and statistical analysis of data, accessing and using modern e-library search tools, ability to locate, retrieve, and evaluate Physics information from renowned physics archives, proficiency in accessing observational and experimental data made available by renowned research labs for further analysis.

- **Ethical awareness/analytical reasoning*:*** 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, including from other personnel in the field of their work. They should be willing to contribute to the free development of knowledge in all forms. Further, unethical behavior such as fabrication, falsification or misrepresentation of data, or committing plagiarism, or not adhering to intellectual property rights should be avoided.

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

TABLE 1
DISTRIBUTION OF CREDITS

Semester	**Core Courses (C) (6 Credits each)**	**Generic Electives (GE) (6 Credits each) To be selected from other disciplines**	**Skill Enhancement Courses (SEC) (4 Credits each)**	**Discipline Specific Elective (DSE) (6 Credits each)**	**Ability Enhancement Compulsory Courses (AECC) (4 Credits each)**	**Total Credits**
	84 Credits	24 Credits	08 Credits	24 Credits	08 Credits	148 Credits
Semester-I	CC-1 CC-2	GE-1			AECC-1	22 Credits
Semester-II	CC-3 CC-4	GE-2			AECC-2	22 Credits
Semester-III	CC-5 CC-6 CC-7	GE-3	SEC-1			28 Credits
Semester-IV	CC-8 CC-9 CC-10	GE-4	SEC-2			28 Credits
Semester-V	CC-11 CC-12			DSE-1 DSE-2		24 Credits
Semester-VI	CC-13 CC-14			DSE-3 DSE-4		24 Credits

Department of Applied Physics, Gautam Buddha University
Course Structure of B.Sc. (Honours) Physics(Session 2019-20)

Semester	S.No.	Course Code	Course Name	Nature	L	T	P	Credits	Total Credits per Semester
First	1	PH111	Mechanics	C	4	0	0	4	22
	2	PH113	Mechanics Lab	C	0	0	4	2	
	3	PH115	Mathematical Physics-I	C	4	0	0	4	
	4	PH117	Mathematical Physics-I Lab	C	0	0	4	2	
	5	ES101	Environmental Studies	AECC	4	0	0	4	
	6	GE-1	Generic Elective/Interdisciplinary	GE	4/5	0/1	2/0	6	
			Total Contact Hours (Max.): 28						
Second	1	PH112	Electricity and Magnetism	C	4	0	0	4	22
	2	PH114	Electricity and Magnetism Lab	C	0	0	4	2	
	3	PH116	Waves and Optics	C	4	0	0	4	
	4	PH118	Waves and Optics Lab	C	0	0	4	2	
	5	EN105	Communicative English	AECC	4	0	0	4	
	6	GE-2	Generic Elective/Interdisciplinary	GE	4/5	0/1	2/0	6	
			Total Contact Hours (Max.): 28						
Third	1	PH211	Mathematical Physics-II	C	4	0	0	4	28
	2	PH213	Mathematical Physics-II Lab	C	0	0	4	2	
	3	PH215	Thermal Physics	C	4	0	0	4	
	4	PH217	Thermal Physics Lab	C	0	0	4	2	
	5	PH219	Digital Systems and Applications	C	4	0	0	4	
	6	PH221	Digital Systems and Applications Lab	C	0	0	4	2	
	7	SEC-1	Skill Based Course	SEC	4	0	0	4	
	8	GE-3	Generic Elective/Interdisciplinary	GE	4/5	0/1	2/0	6	
			Total Contact Hours (Max.): 36						
Fourth	1	PH212	Mathematical Physics-III	C	4	0	0	4	28
	2	PH214	Mathematical Physics-III Lab	C	0	0	4	2	
	3	PH216	Elements of Modern Physics	C	4	0	0	4	
	4	PH218	Elements of Modern Physics Lab	C	0	0	4	2	
	5	PH220	Analog Systems and Applications	C	4	0	0	4	
	6	PH222	Analog Systems and Applications Lab	C	0	0	4	2	
	7	SEC-2	Skill Based Course	SEC	4	0	0	4	
	8	GE-4	Generic Elective/Interdisciplinary	GE	4/5	0/1	2/0	6	
			Total Contact Hours (Max.): 36						
Fifth	1	PH311	Quantum Mechanics and Applications	C	4	0	0	4	24
	2	PH313	Quantum Mechanics Lab	C	0	0	4	2	
	3	PH315	Solid State Physics	C	4	0	0	4	
	4	PH317	Solid State Physics Lab	C	0	0	4	2	
	5	DSE-1	Discipline Specific Elective-1	DSE	4/5	0/1	2/0	6	
	6	DSE-2	Discipline Specific Elective-2	DSE	4/5	0/1	2/0	6	
			Total Contact Hours (Max.): 32						
Sixth	1	PH312	Electromagnetic Theory	C	4	0	0	4	24
	2	PH314	Electromagnetic Theory Lab	C	0	0	4	2	
	3	PH316	Statistical Mechanics	C	4	0	0	4	
	4	PH318	Statistical Mechanics Lab	C	0	0	4	2	
	5	DSE-3	Discipline Specific Elective-3	DSE	4/5	0/1	2/0	6	
	6	DSE-4	Discipline Specific Elective-4	DSE	4/5	0/1	2/0	6	
			Total Contact Hours (Max.): 32						
								Total Credits	**148**

C: Core Course, **AECC:** Ability Enhancement Compulsory course, **GE:** Generic Elective, **SEC:** Skill Enhancement Course, **DSE:** Discipline Specific Elective

General Elective from other departments (Four papers of any one discipline) – GE-1 to GE-4

1. **Mathematics**: Lecture (5) + Tut (1) / Lecture (4) + Lab (2)
2. **Chemistry**: Lecture (4) + Lab (2)
3. **Economics**: Lecture (5) + Tut (1)
4. **Computer Science**: Lecture (4) + Lab (2)
5. **Electronics**: Lecture (4) + Lab (2)

OR any other discipline of importance.

Skill Enhancement Courses (02 papers) (Credit: 04 each) - SEC-1, SEC-2

Semester III			Semester IV		
1.	**PH223**	Computational Physics	**1.**	**PH224**	Applied Optics
2.	**PH225**	Electrical circuits and Network	**2.**	**PH226**	Renewable Energy and Energy Harvesting
3.	**PH227**	Basic Instrumentation	**3.**	**PH228**	Radiation Safety

Discipline Specific Elective Papers (04 Papers, 06 Credits each): DSE-1, DSE-2, DSE-3, DSE-4

Semester V	**DSE-1**	**1.**	**PH319** **PH321**	Experimental Techniques (4) Experimental Techniques Lab (2)
		2.	**PH323** **PH325**	Physics of Devices and Communication (4) Physics of Devices and Communication Lab (2)
		3.	**PH 327**	Classical Dynamics: Lecture (5) + Tutorials (1)
	DSE-2	**1.**	**PH 329** **PH 331**	Nano Materials and Applications (4) Nano Materials and Applications Lab (2)
		2.	**PH 333**	Astronomy and Astrophysics (5) + Tutorials (1)
		3.	**PH 335** **PH 337**	Atmospheric Physics (4) Atmospheric Physics Lab (2)
Semester VI	**DSE-3**	**1.**	**PH 320** **PH 322**	Applied Dynamics (4) Applied Dynamics Lab (2)
		2.	**PH 324** **PH 326**	Communication System (4) Communication System Lab (2)
	DSE-4	**1.**	**PH 328**	Nuclear and Particle Physics: Lectures (5) + Tutorials (1)
		2.	**PH330** **PH332**	Digital Signal Processing (4) Digital Signal Processing Lab (4)
			PH334	Dissertation

- Department may increase number of courses in the above-mentioned list.
- In the VIth Semester the students will be offered either Dissertation (12 Credits) or two courses DSE-3 and DSE-4 (6 credits each).

Generic Elective Papers (GE) (Minor-Physics) (any four) for other Departments / Disciplines: (Credit: 06 each)

Semester I

1. **PH119** Mechanics (4) + **PH113** Mechanics Lab (2)
2. **PH121** Mathematical Physics (4) + **PH117** Mathematical Physics Lab (2)

Semester II

1. **PH120** Electricity and Magnetism (4) + **PH114** Electricity and Magnetism Lab (2)
2. **PH122** Waves and Optics (4) + **PH118** Waves and Optics Lab (2)

Semester III

1. **PH229** Thermal Physics and Statistical Mechanics (4) + **PH217** Thermal Physics Lab (4)
2. **PH231** Elements of Modern Physics (4) + **PH218** Elements of Modern Physics Lab (2)

Semester IV

1. **PH230** Nuclear and Particle Physics (5) + Tutorial (1)
2. **PH232** Digital, Analog Circuits and Instrumentation (4)
   + **PH234** Digital, Analog Circuits and Instrumentation Lab (2)