



# DHRUBA CHAND HALDER COLLEGE

(FORMERLY DAKSHIN BARASAT COLLEGE)

ESTD. - 1965

**A NAAC Accredited Degree College Affiliated to University of Calcutta**

P.O. - Dakshin Barasat ● Dist. - South 24 Parganas ● West Bengal ● Pin - 743372

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Ref. No. ....

Date .....20

## Dept. of Physics, Dhruba Chand Halder College

### Programme Outcome Overview

**UG Physics Honours Course (PHSA) Model Reference: University of Calcutta, Syllabus for Physics (Honours) under CBCS (Notification No. CSR/47/19) in effect from 2019-20**

Students of B.Sc. Physics Honours Course have to take 14 (fourteen) Core Courses (CC) from Physics and these Core Courses are distributed over all the six semesters. Two subjects other than physics are to be chosen as Generic Elective (GE). The modules of the GE courses are confined to the first four semesters. Skill Enhancement Course, SEC must be opted in 3rd, 4th Semester only. SEC A is meant for 3rd Semesters and SEC B is meant for 4th Semesters. Student should take two Discipline specific elective courses, DSEs in each 5th and 6th semester. These two courses are termed as DSE-A and DSE-B. In 5th semester the courses are DSE A1 and DSE B1. Similarly, DSE A2 and DSE B2 are the subjects for 6th Semester.

Semester	Core Courses			SEC	DSE A	DSE B
<b>Semester 1</b>	<b>CC-1</b> Mathematical Methods I	<b>CC-2</b> Mechanics				
<b>Semester 2</b>	<b>CC-3</b> Electricity & Magnetism	<b>CC-4</b> Waves & Optics				
<b>Semester 3</b>	<b>CC-5</b> Mathematical Methods II	<b>CC-6</b> Thermal Physics	<b>CC-7</b> Modern Physics	<b>SEC A-1</b> Scientific Writing Or <b>SEC A-2</b> Renewable Energy		
<b>Semester 4</b>	<b>CC-8</b> Mathematical Methods III	<b>CC-9</b> Analog Electronics	<b>CC-10</b> Quantum Mechanics	<b>SEC B-1</b> Arduino Or <b>SEC B-2</b> Electrical Circuits Network Skill		
<b>Semester 5</b>	<b>CC-11</b> Electromagnetic Theory	<b>CC-12</b> Statistical Physics			<b>DSE A1</b> Advanced Mathematical Methods Or Laser & fiber optics	<b>DSE B1</b> Astronomy & Astrophysics Or Nuclear Physics
<b>Semester 6</b>	<b>CC-13</b> Digital Electronics	<b>CC-14</b> Solid State Physics			<b>DSE A2</b> Nanomaterials Or Advanced Classical Dynamics	<b>DSE B2</b> Communication Electronics Or Advanced Statistical Mechanics

*The Course distribution of Honours Course*

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### **Programme Learning Outcomes in B.Sc (Honours) Physics**

The student graduating with the B.Sc (Honours) Physics should be able to

- Acquire a fundamental understanding of the academic field of Physics, its different learning areas and applications in basic Physics like Astrophysics, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, with related disciplinary areas.
- Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.
- Formulate mathematical model, use simulation and computation and recognize the role of approximation and mathematical approaches to describe the physical world.
- Plan and execute Physics-related experiments or investigations, analyze and interpret data/informations collected using appropriate methods.
- Pursue future career opportunities in multi-disciplinary fields.

### **Semester wise objectives and course outcomes are discussed below:**

#### **Semester-I: Mathematical Physics I (CC1) & Mechanics (CC2)**

**Paper: PHS-A-CC-1-1-TH: Mathematical Physics I (Theory):** This course provides the knowledge about solving ordinary and partial differential equations, vector algebra and vector calculus, curvilinear coordinate systems and matrix. These fundamental areas are necessary to pursue various topics of physics and enhance problem solving capacity.

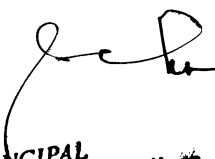
**Paper: PHS-A-CC-1-1-P: Mathematical Physics - I (Practical):** Students will learn basic python programming and plotting in gnuplot.

**Paper: PHS-A-CC-1-2-TH: Mechanics (Theory):** In this course students will understand fundamentals of Dynamics, work & energy, central force motion and the Concept of Fundamentals of Dynamics, Rotational dynamics and fluid motion.

**Paper: PHS-A-CC-1-2-P: Mechanics (Practical):** Understanding mechanics through practical experiments Moment of Inertia of a metallic cylinder / rectangular bar, Moment of Inertia of a Flywheel, value of g using Bar Pendulum etc.

#### **Semester-II: Electricity and Magnetism (CC1) & Wave and optics (CC2)**

**Paper: PHS-A-CC-2-3-TH: Electricity and Magnetism (Theory):** The students will learn fundamental properties of charged particles and electric fields in this course. This course will also give students an understanding of the phenomena of electricity, magnetism, electromagnetic induction and electrical circuits which are extremely essential for higher studies in physics and also important for various engineering applications. This course builds the basis for studying more advanced topics in electromagnetic theory

  
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**Paper: PHS-A-CC-2-3-P: Electricity and Magnetism (Practical):** In this laboratory course the students experience to nurture different types of electrical circuits and learn to determine the value of unknown low resistance using potentiometer and Carrey-Foster Bridge, study the characteristics curve of LCR circuit, RC-circuit as high/low pass filter, mutual inductance between two coils etc.

**Paper: PHS-A-CC-2-4-TH: Wave and optics (Theory):** The students will gain knowledge of harmonic oscillator, Superposition of Harmonic Oscillations, wave motion, wave nature of light, interference and diffraction phenomena of light.

**Paper: PHS-A-CC-2-4-P: Wave and optics (Practical):** The students will be familiar with spectrometer, a very important optical instrument and some other optical instruments like Fresnel's biprism and Newton's ring experiment. They will learn how to level a spectrometer and how to take readings from it. They will also be familiar with various light sources used in physics laboratory. They will be able to determine some well-known physical quantities like refractive index etc. by performing laboratory work.

**Semester-III: Mathematical Physics II (CC5), Thermal Physics (CC6) & Modern Physics (CC7), any one from Scientific Writing (SEC A1) and Renewable Energy (SEC A2)**

**Paper: PHS-A-CC-3-5-TH: Mathematical Physics II (Theory):** Students will gain essential concept of Fourier series, Fourier transform, Frobenius Method, probability, partial differential equation etc. All these topics are very important for studying theoretical aspects of various branches of physics.

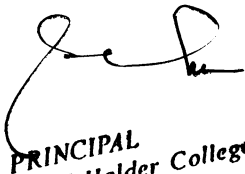
**Paper: PHS-A-CC-3-5-P: Mathematical Physics II (Practical):** Students will learn advanced computational techniques using python numpy, scipy and matplotlib python packages. This course will immensely benefit the students for higher studies and research career in Physics.

**Paper: PHS-A-CC-3-6-TH: Thermal Physics (Theory):** Students will learn the principle of operation of engines and refrigerators in this course. The students learn the basic distribution laws which are obeyed by the molecules in the Thermal Physics part and the application to explain the basic laws of ideal gas. The limitation to explain different observed phenomena with ideal gas prescription leads the study of real gas and also conduction of heat in this course. This part covers other very important aspects related to academic importance and also to industrial applications.

**Paper: PHS-A-CC-3-6-P: Thermal Physics (Practical):** The thermal physics laboratory course gives a hands-on experience on measurement of thermal conductivity of bad conductors (Lee-Charlton method), thermal expansion coefficient, temperature coefficients of resistance (Carrey-Foster bridge), boiling point of liquid using platinum resistance thermometer and calibration of thermocouple. This will also help to enrich their experimental skills learned so far.

**Paper: PHS-A-CC-3-7-TH: Modern Physics (Theory):** This course is an introductory level course on quantum mechanics. The course will begin with the basic principles of quantum mechanics and its conceptual formalism. Several applications of quantum mechanics will be discussed to train students to apply these ideas to model systems. They will also learn the nuclear structure, radioactivity, fundamental principle of Laser and its applications in this course. This course is extremely important from the conceptual point of view required in the advanced learning in the next semester.

**Paper: PHS-A-CC-3-7-P: Modern Physics (Practical):** The students will learn to determine value of Planck's constant, study of photoelectric effect, verification of Stefan's law of radiation, determination of  $e/m$  of electron and behaviour of tunnel diode.

  
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**Students have to choose one SEC course from SEC-A1 and SEC-A2.**

**Paper: PHS-A SEC-A1-TH: Scientific Writing (Theory):** This course is a project type technical skill enhancement course. The students will learn how to prepare a scientific article containing figures, tables and mathematical equations in a presentable form through open-source scientific writing software LaTeX.

**Paper: PHS-A SEC-A1-TH: Scientific Writing (Practical):** In this course the students write laboratory notebooks using Latex. This course will hugely benefit the students for writing research papers and projects.

**Semester-IV: Mathematical Physics III (CC8), Analog Electronics (CC9) & Quantum Mechanics(CC10), any one from Arduino (SEC B1) and Electrical Circuits & Network Skill (SEC B2).**

**Paper: PHS-A-CC-4-8-TH: Mathematical Physics III (Theory):** The students will learn the mathematical tools required for study of some advanced topics of theoretical physics. The students will also be acquainted with the revolutionary concept of special theory of relativity which is extremely essential for understanding the physical world beyond Newtonian mechanics.

**Paper: PHS-A-CC-4-8-P: Mathematical Physics III (Practical):** Students will learn advanced computational programming on solving ordinary differential equation, partial differential equation fourier series etc. using python. This course will immensely benefit the students for higher studies and research career in Physics.

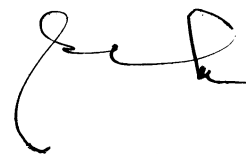
**Paper: PHS-A-CC-4-9-TH: Analog Systems and Applications (Theory):** This course forms the basis of electronics which is undoubtedly at the heart of most of the technological advances of the present era. They will gain knowledge in analysing Circuits by using network theorems, understand working and applications of semiconductor devices.

**Paper: PHS-A-CC-4-9-P: Analog Systems and Applications (Practical):** This laboratory course will provide the student with adequate exposure to some essential laboratory equipments like CRO, function generator, regulated power supply etc. The students will design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator. The students will acquire basic skill required for research in experimental Physics.

**Paper: PHS-A-CC-4-10-TH: Quantum Mechanics (Theory):** This is an advanced one which deals with bound states and discretization of energy and momentum, Hydrogen atom problem and fine structures, perturbative correction in electromagnetic field, L-S & J-J coupling. This course is essential for progress to higher studies and research career in theoretical physics.

**Paper: PHS-A-CC-3-7-P: Modern Physics (Practical):** This course is based on advanced python programming which helps a student to visualize the probability distribution and wave function of a given bound state, time evolution of wave packet.

**Students have to choose one SEC course from SEC-B1 and SEC-B2.**



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**Paper: PHS-A SEC-B1-TH: Arduino (Theory):** This course is a technical skill enhancement course. The students will learn about microprocessors and hardware software interfacing techniques through open source software package Arduino IDE.

**Paper: PHS-A SEC-B1-TH: Arduino (Practical):** The students will be able to demonstrate real life applications using Arduino IDE and Arduino UNO Board. This course will help the students to gain hands on training on software-hardware interfacing techniques. The students will get better opportunity in job market after completion of this course.

**Semester-V: Electromagnetic Theory (CC11), Statistical Physics (CC12), any one from Advanced Mathematical Methods or Laser and Fiber optics (DSE A1), any one from Astronomy and Astrophysics or Nuclear and Particle Physics (DSE B1).**

**Paper: PHS-A-CC-5-11-TH: Electromagnetic Theory (Theory):** The students will go through the important set of relations of Electrostatics, Magnetostatics, Electro-magnetic Induction, taught in earlier Semesters find application in this topic. The electromagnetic wave is generated naturally from the Maxwell's relations and the students will get the explanation of polarization and related optical and other aspects from this theory.

**Paper: PHS-A-CC-5-11-P: Electromagnetic Theory (Practical):** Different theoretical predictions of electromagnetic waves find verification through the experiments referred in this course.

**Paper: PHS-A-CC-5-12-TH: Statistical Physics (Theory):** Students will have achieved the ability to find the connection between statistics and thermodynamics, differentiate between different ensemble theories used to explain the behavior of the systems, differentiate between classical statistics and quantum statistics, explain the statistical behavior of ideal Bose and Fermi systems.

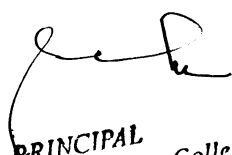
**Paper: PHS-A-CC-5-12-P: Statistical Physics (Practical):** The students will use Python programming to study aspects of statistics like Random numbers and Time scale, application of Random numbers including Monte Carlo integration. The approach is extended also to the study of different distributions in statistical mechanics.

**Paper: PHS-A-DSE-A1(b)-TH: Laser and Fiber Optics (Theory + tutorial):** The students will learn this topic which finds many applications in different spheres starting from industry to medical fields. The study of many well-known devices for the generation of LASER and their controlling tools are covered. The topic of Fiber Optics is now a well-known terminology in the world of Internet and other connections and Telecommunication.

**Paper: PHS-A-DSE-B1(a)-TH: Astronomy and Astrophysics (Theory + tutorial):** The objective of Astronomy course is to make the students familiar with astronomical tools, stars and stellar system, galaxies and the Universe and short introduction to cosmology.

**Semester-VI: Digital Electronics (CC13), Solid State Physics(CC14), any one from Nanomaterials or Advanced Classical Dynamics (DSE A2), any one from Communication Electronics or Advanced Statistical Mechanics (DSE B2).**

**Paper: PHS-A-CC-6-13-TH: Digital Systems and Applications (Theory):** This topic plans to make the students acquainted with the digital world. Starting from the introductory ideas of ICs, fundamental

  
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Gates and different number systems, the topic in steps is extended to implementation of different logic circuits. The students will be familiar with the basics of hardware; learn Counters, Registers, Flip-Flops, Data Processing Circuits and Computer Organization.

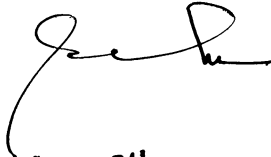
**Paper: PHS-A-CC-6-13-P: Digital Systems and Applications (Practical):** Digital electronics laboratory enables a student to design and fabricate various logic gates, flip flops, shift registers, multiplexers etc.

**Paper: PHS-A-CC-6-14-TH: Solid State Physics (Theory):** This course includes the understanding of the organizational, mechanical, magnetic and electrical properties of the materials as well as the forces that bind the units into the solid state. Students will also learn the various properties of superconductors. This course is essential for progress to higher studies and research career in condensed matter physics.

**Paper: PHS-A-CC-6-14-P: Solid State Physics (Practical):** Solid state laboratory gives the students a hands-on experience on to study and measure dielectric and magnetic properties of matter, e.g., dielectric constants, magnetic susceptibility, Hall voltage, hysteresis etc. This will improve the corresponding theoretical concepts of the course.

**Paper: PHS-A-DSE-A2(a)-TH: Nano Materials and Applications (Theory + tutorial):** This course will offer the entry into the Nano World. The basic physics of nano particles and their synthesis following different methodology will be taught. The important characteristic features like optical properties, electron transport phenomena in nanostructures will be studied.

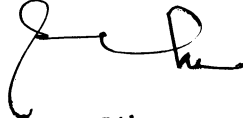
**Paper: PHS-A-DSE-B2(a)-TH: Communication Electronics (Theory + tutorial):** The objective of this course is to give the students an overview on analog modulation, pulse modulation, communication through satellite and mobile telephony system.



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<b>Programme Outcomes Nos</b>	<b>Programme Outcomes (PO)</b>
<b>PO 1</b>	<b>To provide a comprehensive understanding of fundamental physical laws and principles.</b>
<b>PO 2</b>	<b>Ability to analyze and solve physics problems using mathematical methods and critical thinking.</b>
<b>PO 3</b>	<b>To motivate the students for higher education and to take research as a career as well as prepare them for successful career in industry.</b>
<b>PO 4</b>	<b>To develop laboratory skills, including the ability to design and conduct experiments, analyze data, and interpret results.</b>
<b>PO 5</b>	<b>To develop computational insight in solving different analytical problems of Physics.</b>
<b>PO 6</b>	<b>To improve communication skills, including the ability to present and interpret scientific results, both orally and in writing.</b>
<b>PO 7</b>	<b>To improve understanding of the interdisciplinary nature of science and the relationship between physics and other fields.</b>
<b>PO 8</b>	<b>To develop the ability to engage in independent and life-long learning in the current context of technological change.</b>
<b>PO 9</b>	<b>To develop individual and team work by functioning effectively as an individual or as a member in a group in laboratory classes.</b>

<b>Programme Specific Outcomes Nos</b>	<b>Programme Specific Outcomes (PSO)</b>
<b>PSO 1</b>	<b>Apply knowledge in emerging and varied areas of Physics for higher studies, research and industries related to software and hardware applications</b>
<b>PSO 2</b>	<b>Develop leadership and managerial skills and understanding the need for lifelong learning to be a competent professional</b>
<b>PSO 3</b>	<b>To equip with front level communication technologies (ICT) for innovating ideas and solutions to existing/novel challenges</b>
<b>PSO 4</b>	<b>To be acquainted with good laboratory practices and safety measures</b>

  
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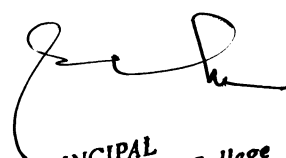
**Mapping of PO & PSO for Physics Hons Syllabus of University of Calcutta**

Programme Specific Outcomes (PSO) Nos	Programme Outcomes (PO)								
	1	2	3	4	5	6	7	8	9
PSO 1	✓	✓	✓	✓	✓	✓		✓	
PSO 2	✓		✓	✓		✓	✓	✓	✓
PSO 3	✓				✓				✓
PSO 4				✓	✓	✓			✓

**Programme Outcome mapping for Semester wise Course outcome in Physics Honours under University of Calcutta**

COURSE	COURSE DETAIL	PROGRAMME OUTCOME (PO)								
		1	2	3	4	5	6	7	8	9
SEMESTER-I	PHS-A-CC-1-1-TH, Mathematical Physics – I(Theory)	✓	✓	✓		✓				
	PHS-A-CC-1-1-P, Mathematical Physics - I (Practical)		✓	✓	✓	✓	✓			✓
	PHS-A-CC-1-2-TH: Mechanics (Theory)	✓	✓	✓					✓	
	PHS-A-CC-1-2-P: Mechanics (Practical)	✓		✓	✓		✓	✓		✓

COURSE	COURSE DETAIL	PROGRAMME OUTCOME (PO)								
		1	2	3	4	5	6	7	8	9
SEMESTER-II	PHS-A-CC-2-3-TH, Electricity and Magnetism (Theory)	✓	✓	✓				✓		
	PHS-A-CC-2-3-P, Electricity and Magnetism (Practical)	✓		✓	✓		✓			✓
	PHS-A-CC-2-4-TH Waves and Optics (Theory)	✓	✓	✓				✓		
	PHS-A-CC-2-4-P Waves and Optics (Practical)	✓		✓	✓		✓			✓

  
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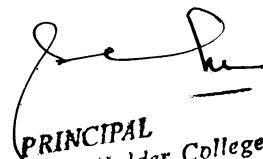
*Programme outcome overview, UG Physics Honours course*

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COURSE	COURSE DETAIL	PROGRAMME OUTCOME (PO)								
		1	2	3	4	5	6	7	8	9
<b>SEMESTER-III</b>	PHS-A-CC-3-5-TH, Mathematical Physics - II (Theory)	✓	✓	✓		✓				
	PHS-A-CC-3-5-P, Mathematical Physics - II (Practical)		✓	✓	✓	✓	✓			✓
	PHS-A-CC-3-6-TH, Thermal Physics (Theory)	✓	✓	✓			✓	✓		
	PHS-A-CC-3-6-P, Thermal Physics (Practical)	✓		✓	✓					✓
	PHS-A-CC-3-7-TH: Modern Physics (Theory)	✓	✓	✓				✓	✓	
	PHS-A-CC-3-7-P: Modern Physics (Practical)	✓		✓	✓		✓			✓
	PHS-A SEC-A1-TH: Scientific Writing (Theory + project)			✓	✓		✓	✓		

COURSE	COURSE DETAIL	PROGRAMME OUTCOME (PO)								
		1	2	3	4	5	6	7	8	9
<b>SEMESTER-IV</b>	PHS-A-CC-4-8-TH, Mathematical Physics - III (Theory)	✓	✓	✓		✓				
	PHS-A-CC-4-8-P, Mathematical Physics - III (Practical)		✓	✓	✓	✓	✓			✓
	PHS-A-CC-4-9-TH, Analog Electronics (Theory)	✓		✓	✓				✓	✓
	PHSA-CC-4-9-P, Analog Electronics (Practical)	✓		✓	✓		✓			✓
	PHS-A-CC-4-10-TH Quantum Mechanics (Theory)	✓		✓	✓			✓	✓	✓
	PHS-A-CC-4-10-P Quantum Mechanics (Practical)	✓	✓	✓	✓	✓	✓			✓
	PHS-A SEC-B1-TH: Arduino (Theory + project)						✓	✓	✓	✓

COURSE	COURSE DETAIL	PROGRAMME OUTCOME (PO)								
		1	2	3	4	5	6	7	8	9
<b>SEMESTER-V</b>	PHS-A-CC-5-11-TH, Electromagnetic theory (Theory)	✓	✓	✓				✓		
	PHS-A-CC-5-11-P, Electromagnetic theory (Practical)	✓		✓	✓		✓			✓

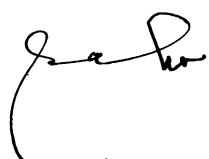
  
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*Programme outcome overview, UG Physics Honours course*

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<b>SEMESTER-V</b>	PHS-A-CC-5-12-TH, Statistical Physics (Theory)	✓	✓	✓				✓		
	PHS-A-CC-5-12-P, Statistical Physics (Practical)	✓	✓	✓	✓	✓	✓			✓
	DSE A1(b) Laser and Fiber Optics (Theory + tutorial)	✓	✓	✓			✓	✓	✓	
	DSE B1(a) Astronomy and Astrophysics (Theory + tutorial)	✓	✓	✓			✓	✓	✓	

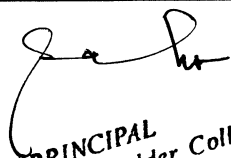
COURSE	COURSE DETAIL	PROGRAMME OUTCOME (PO)								
		1	2	3	4	5	6	7	8	9
<b>SEMESTER-VI</b>	PHS-A-CC-6-13-TH, Digital Electronics (Theory)	✓	✓	✓				✓	✓	
	PHS-A-CC-6-13-P, Digital Electronics (Practical)	✓	✓	✓	✓		✓			✓
	PHS-A-CC-6-14-TH Solid State Physics (Theory)	✓	✓	✓				✓		
	PHS-A-CC-6-14-P Solid State Physics (Practical)	✓	✓	✓	✓		✓			✓
	DSE A2(a) Nano Materials and Applications (Theory + tutorial)	✓	✓	✓			✓	✓	✓	
	DSE B2(a) Communication Electronics (Theory + tutorial)	✓	✓	✓			✓	✓	✓	

  
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**UG Physics General Course (PHSG) Model Reference: University of Calcutta, Syllabus for Physics (Honours) under CBCS (Notification No. CSR/47/19) in effect from 2019-20**

**General Course: Physics Modules distribution**

Semester	Core Course	SEC-A	SEC-B	DSE-A	DSE-B
Semester-1	CC1/GE1				
	Mechanics				
Semester-2	CC2/GE2				
	Electricity & Magnetism				
Semester-3	CC3/GE3	SEC A-1			
	Thermal Physics	Scientific Writing			
		Or			
		SEC A-2			
		Renewable Energy			
Semester-4	CC4/GE4		SEC B-1		
	Waves & Optics		Arduino		
			Or		
			SEC B-2		
			Electrical Circuit & Network Skill		
Semester-5		SEC A-1		DSE-A(1)	
		Scientific Writing		Analog Electronics	
		Or		Or	
		SEC A-2		DSE-A(2)	
		Renewable Energy		Modern Physics	
Semester-6			SEC B-1		DSE-B(1)
			Arduino		Digital Electronics
			Or		Or
			SEC B-2		DSE-B(2)
			Electrical Circuit & Network Skill		Nuclear Physics

  
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The student graduating with the B.Sc (General) Physics should develop a fundamental understanding on various branches of physics, demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling physics-related problems, plan and execute Physics-related experiments or investigations, analyse and interpret data/information collected using appropriate methods.

**Semester wise objectives and course outcomes are discussed below:**

**Semester-I: Mechanics (CC1 / GE1)**

**Paper: PHS-G-CC-1-1-TH: Mechanics (Theory):** In this course students will understand fundamentals of Dynamics, work & energy, central force motion and the Concept of Fundamentals of Dynamics, Rotational dynamics and fluid motion.

**Paper: PHS-G-CC-1-1-P: Mechanics (Practical):** Understanding mechanics through practical experiments Moment of Inertia of a metallic cylinder / rectangular bar, Moment of Inertia of a Flywheel, value of g using Bar Pendulum etc.

**Semester-II: Electricity and Magnetism (CC2 / GE2)**

**Paper: PHS-G-CC-2-2-TH: Electricity and Magnetism (Theory):** The students will learn fundamental properties of charged particles and electric fields in this course. This course will also give students an understanding of the phenomena of electricity, magnetism, electromagnetic induction and electrical circuits.

**Paper: PHS-G-CC-2-2-P: Electricity and Magnetism (Practical):** The students experience to nurture different types of electrical circuits and learn to determine the value of unknown low resistance using potentiometer and Carrey-Foster Bridge etc.

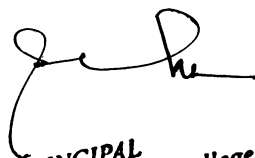
**Semester-III: Thermal Physics and Statistical Mechanics (CC3 / GE3), any one from Scientific Writing (SEC A1) and Renewable Energy and energy harvesting (SEC A2)**

**Paper: PHS-G-CC-3-3-TH: Thermal Physics and Statistical Mechanics (Theory):** The students will learn fundamental laws of thermodynamics and their applications in various systems. They will have achieved ability to solve problems related to thermodynamics, heat transfer and thermodynamic processes and also learn the relationship between thermodynamics and statistical mechanics.

**Paper: PHS-G-CC-3-3-P: Thermal Physics and Statistical Mechanics (Practical):** This course gives a hands-on experience on measurement of thermal conductivity of bad conductors (Lee-Charlton method), thermal expansion coefficient, temperature coefficients of resistance (Carry-Foster bridge) etc. This will also help to enrich their experimental skills learned so far.

**Paper: PHS-G SEC-A-TH: Scientific Writing (Theory):** This course is a project type technical skill enhancement course. The students will learn how to prepare a scientific article containing figures, tables and mathematical equations in a presentable form through open-source scientific writing software LaTeX.

**Paper: PHS-G SEC-A-PR: Scientific Writing (Practical):** In this course the students write laboratory notebooks using Latex. This course will hugely benefit the students for writing scientific papers.

  
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**Semester-IV: Wave and optics (CC3 / GE3), any one from Arduino (SEC B1) and Electrical Circuits and Network skills (SEC B2)**

**Paper: PHS-G-CC-4-4-TH: Wave and optics (Theory):** The students will gain knowledge of harmonic oscillator, Superposition of Harmonic Oscillations, wave motion, wave nature of light, interference and diffraction phenomena of light.

**Paper: PHS-G-CC-4-4-P: Wave and optics (Practical):** The students will be familiar with spectrometer, a very important optical instrument and some other optical instruments like polarimeter and Newton's ring experiment. They will be able to determine some well-known physical quantities like refractive index etc. by performing laboratory work.

**Paper: Paper: PHS-G SEC-B-TH: Arduino (Theory):** This course is a technical skill enhancement course. The students will learn about microprocessors and hardware software interfacing techniques through open-source software package Arduino IDE.

**Paper: Paper: PHS-G SEC-B-PR: Arduino (Practical):** The students will be able to demonstrate real life applications using Arduino IDE and Arduino UNO Board. This course will help the students to gain hands on training on software-hardware interfacing techniques. The students will get better opportunity in job market after completion of this course.

**Semester-V: Any one from Analog Electronics (DSE A1(1)) and Modern Physics (DSE A1(2))**

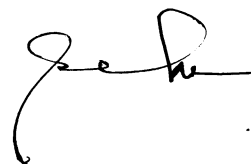
**Paper: PHS-G-DSE-A-TH: Analog Electronics (Theory):** This course forms the basis of electronics which is undoubtedly at the heart of most of the technological advances of the present era. They will gain knowledge in analysing Circuits by using network theorems, understand working and applications of semiconductor devices.

**Paper: PHS-G-DSE-A-P: Analog Electronics (Practical):** This laboratory course will provide the student with adequate exposure to some essential laboratory equipment like CRO, function generator, regulated power supply etc. The students will design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator. The students will acquire basic skill required for research in experimental Physics.

**Semester-V: Any one from Analog Electronics (DSE A1(1)) and Modern Physics (DSE A1(2))**

**Paper: PHS-G-DSE-B-TH: Digital Electronics (Theory):** This topic plans to make the students acquainted with the digital world. Starting from the introductory ideas of ICs, fundamental Gates and different number systems, the topic in steps is extended to implementation of different logic circuits. The students will be familiar with the basics of hardware; learn Counters, Registers, Flip-Flops etc.

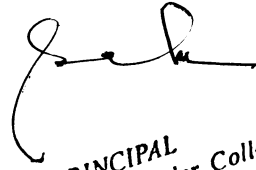
**Paper: PHS-G-DSE-B-P: Digital Electronics (Practical):** Digital electronics laboratory enables a student to design and fabricate various logic gates, flip flops, shift registers, multiplexers etc.



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**Programme Outcome mapping for Semester wise Course outcome in Physics General under University of Calcutta**

COURSE	COURSE DETAIL	PROGRAMME OUTCOME (PO)								
		1	2	3	4	5	6	7	8	9
SEM-I	Paper: PHS-G-CC-1-1-TH: Mechanics (Theory)	✓	✓	✓					✓	
	Paper: PHS-G-CC-1-1-P: Mechanics (Practical)	✓		✓	✓		✓	✓		✓
SEM-II	Paper: PHS-G-CC-2-2-TH: Electricity and Magnetism (Theory)	✓	✓	✓				✓		
	Paper: PHS-G-CC-2-2-P: Electricity and Magnetism (Practical)	✓		✓	✓		✓			✓
SEM-III	Paper: PHS-G-CC-3-3-TH: Thermal Physics and Statistical Mechanics (Theory)	✓	✓	✓				✓		
	Paper: PHS-G-CC-3-3-P: Thermal Physics and Statistical Mechanics (Practical)	✓		✓	✓		✓			✓
	Paper: PHS-G SEC-A-TH: Scientific Writing (Theory + Project)	✓	✓		✓	✓	✓			
SEM-IV	Paper: PHS-G-CC-4-4-TH: Wave and optics (Theory)	✓	✓	✓				✓		
	Paper: PHS-G-CC-4-4-P: Wave and optics (Practical)	✓		✓	✓		✓			✓
	Paper: Paper: PHS-G SEC-B-TH: Arduino (Theory + Project)						✓	✓	✓	✓
SEM-V	Paper: PHS-G-DSE-A-TH: Analog Electronics (Theory)	✓		✓	✓				✓	✓
	Paper: PHS-G-DSE-A-P: Analog Electronics (Practical)	✓		✓	✓		✓			✓
SEM-VI	Paper: PHS-G-DSE-B-TH: Digital Electronics (Theory)	✓	✓	✓				✓	✓	
	Paper: PHS-G-DSE-B-P: Digital Electronics (Practical)	✓	✓	✓	✓		✓			✓

  
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