

**SYLLABUS**  
*For*  
**Choice Based Credit System**  
**(CBCS)**  
*With*  
**Outcome Based Education**  
**(OBE)**  
**Three Year B.Sc. Programme**  
**in Physics**

**PAT NA WOMEN'S COLLEGE**

**Autonomous**

**PATNA UNIVERSITY**

3<sup>rd</sup> Cycle NAAC Accredited at 'A' Grade with CGPA 3.58/4

*"College with Potential for Excellence" (CPE) Status Accorded by UGC*

# **SYLLABUS**

*For*

## **Choice Based Credit System (CBCS)**

### **PHYSICS HONOURS**

**PAT NA WOMEN'S COLLEGE**

**Autonomous**

**PATNA UNIVERSITY**

3<sup>rd</sup> Cycle NAAC Accredited at 'A' Grade with CGPA 3.58/4

*"College with Potential for Excellence" (CPE) Status Accorded by UGC*

## VISION

---

Rooted in the life, vision, and teachings of Jesus Christ and inspired by Mother Veronica, the foundress of the Apostolic Carmel, Patna Women's College strives to become a centre of academic excellence in higher education, social responsibility, and empowerment of women.

## MISSION STATEMENT

---

Patna Women's College, the first college for women in Bihar, is committed to the holistic development of women so as to make an effective contribution to the creation of a better society.

To this end, we strive

- To become a center of excellence in higher education for women in an atmosphere of autonomy.
- To excel in teaching-learning, research, and consultancy.
- To provide education that promotes capacity building and holistic development of a person.
- To offer subjects for competency building and motivate/animate a workforce imbued with human values.
- To promote patriotism, communal harmony and cultural integration to maintain a free and peaceful atmosphere on the campus.
- To train the students in creative arts, social service, critical thinking, and leadership in order to make an effective contribution to the creation of a new and value-based society.
- To create women leaders and to make them agents of social change.
- To develop skill oriented and value-based courses, for the all-round development of individuals.
- To promote academic exchange and academia-industry interface.
- To form young women who are 'always wise' and who will dare to 'go ahead and conquer knowledge' through, competence, commitment, delicate conscience, and compassion.

Ashwini  
16-8-21

16/08/21  
2

16/09/21

16/08/21

Anurita  
16/08/21  
16/8/21

16-8-21

## PROGRAM OUTCOMES (PO)

Upon completion of the programme, the students will attain the ability to:

**PO1:** Demonstrate, solve and an understanding of major concepts in all disciplines of Physics.

**PO2:** Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Physics experiments.

**PO3:** Create an awareness of impact of Physics on the society and develop scientific temperament beyond the scientific community.

**PO4:** Inculcate the scientific temperament in the students of different disciplines.

**PO5:** Research fields of Physics and pursue higher education.

## PROGRAM SPECIFIC OUTCOMES (PSO)

Upon completion of the programme, the students will attain the ability to:

**PSO1:** Acquire fundamental knowledge in physics, including the major premises

of classical mechanics, quantum mechanics, electromagnetic theory, electronics, optics, special theory of relativity and modern physics.

**PSO2:** Develop a written and oral communication skill in communicating physics-related topics.

**PSO3:** Design and conduct an experiment (or series of experiments)

demonstrating their understanding of the scientific method and processes. Not only that they are expected to have an understanding of the analytical methods required to interpret and analyze results and draw conclusions as supported by their data.

**PSO4:** Learn the applications of numerical techniques for modelling physical systems for which analytical methods are inappropriate or of limited utility.

**PSO5:** Develop an understanding of the impact of physics and science on society.

**PSO6:** Apply conceptual understanding of the physics to general real-world

situations. Also, discover of physics concepts in other disciplines such as mathematics, computer science, engineering, and chemistry.

Adina  
16-8-21

16/8/21

16/8/21

16/8/21

16/8/21

16/8/21

16/8/21

# SUMMARY OF SYLLABUS

## B.Sc. (Honours) Physics

**Note: 1 credit = 15 hours**

1. Theory paper: 6 credits each (5 Theory and 1 Tutorial).
2. Tutorial group of each theory paper should have a group size of 8 students.
3. Practical paper: 6 credits each (4 Theory and 2 Practical).
4. Practical paper will not have tutorials.

### **Core Courses (6 credits each)**

**Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

#### **Semester I**

CC101: Mathematical Physics I

CC102: Mechanics

#### **Semester II**

CC203: Electricity and Magnetism

CC204: Waves and Optics

#### **Semester III**

CC305: Mathematical Physics-II

CC306: Thermal Physics

CC307: Digital system and Application

#### **Semester IV**

CC408: Analog system and Applications

CC409: Mathematical Physics III

CC410: Modern Physics

#### **Semester V**

CC511: Quantum Mechanics

CC512: Electromagnetic Theory

#### **Semester VI**

CC613: Solid State Physics

CC614: Statistical Mechanics

Adm.  
16-8-21

16/8/21

All  
16/8/21

16/8/21

16/8/21

16/8/21

### Skill Enhancement Course (SEC)(2Credits)

**Skill Enhancement Courses (SEC):** These courses may be chosen from a pool of courses designed to provide **value-based and/or skill-based knowledge**.

#### **Semester III**

SEC301: Inter Religious Studies (Value based)

#### **Semester IV**

SEC402: Physics Workshop or Electrical Circuit Network (Skill based)

### Discipline Specific Elective (DSE) (6 credits each)

**Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

#### **Semester V**

DSE501: Classical Dynamics

DSE502: Nanomaterial and Application

#### **Semester VI**

DSE603: Nuclear and Particle Physics

DSE604: Project/Dissertation/Internship

**Institute should evolve a system/policy about ECA / General Interest / Hobby / Sports / NCC / NSS / related courses on its own.**

**\*wherever there is practical there will be no tutorial and vice -versa.**

*Adha*  
16-8-21

*[Signature]*  
16/8/21

*[Signature]*  
16/8/21  
5  
*[Signature]*  
16/8/21

*[Signature]*  
16/08/2021  
*[Signature]*  
16/8/21

*[Signature]*  
16/08/21  
SPD  
*[Signature]*  
16/8/21

## Generic Elective Papers (GE) (6 credits each)

**Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/ subject and vice versa and such electives may also be referred to as Generic Elective.

### **Semester I**

GE101: Mechanics

### **Semester II**

GE202: Electricity and Magnetism

### **Semester III**

GE303: Thermal Physics and Electronics

### **Semester IV**

GE404: Modern physics

Abhi.  
16/8/21

Raj  
16/8/21

QOO  
16/8/21  
6

Suph  
16/8/21

Rs  
16/8/21  
Dint  
16/8/21

Amika  
16/8/21  
SR

W  
Ranani  
16/8/21



## PHYSICS (Hons.) CBCS Syllabus

Sem.	Core Course (14) <u>6 Credits each</u> (90 Lectures)	Ability Enhancement Compulsory Course AECC (2) <u>2 Credits each</u>	Skill Enhancement Course SEC (2) <u>2 Credits each</u>	Discipline Specific Elective DSE (4) <u>6 Credits each</u>	Generic Elective GE (4) <u>6 Credits each</u>
I	CC101 Mathematical Physics I	English/ MIL Communication/ Environmental Science			GE 1 Mechanics
	CC102 Mechanics				
II	CC203 Electricity and Magnetism	English/ MIL Communication/ Environmental Science			GE 2 Electricity and Magnetism
	CC204 Waves and Optics				
III	CC305 Mathematical Physics-II		SEC 1 Inter-Religious Studies (Value based)		GE 3 Thermal Physics and Electronics
	CC306 Thermal Physics				
	CC307 Digital system and Application				
IV	CC408 Analog System and Applications		SEC 2 Physics Workshop OR Electrical Circuit Network (Skill based)		GE 4 Modern Physics
	CC409 Mathematical Physics III				
	CC410 Modern Physics				
V	CC511 Quantum Mechanics			DSE 1 Classical Dynamics DSE 2 Nanomaterial and Application	
	C512 Electromagnetic Theory				
VI	CC613 Solid State Physics			DSE 3 Nuclear and Particle Physics DSE 4 Project/Disserta tion/ Internship	
	CC614 Statistical Mechanics				

*Adhva*  
16-8-21

*Ram*  
16/8/21

*16/8/21*

7

*16/8/21*

*16/8/21*  
*16/8/21*

*Amite*  
*16/8/21*  
*16/8/21*



## Course Structure for B.Sc. Physics (Hons.)

<u>Semester –I</u>	<u>Semester -II</u>
Phy. Core Course101: Mathematical Physics I	Phy. Core Course 203: Electricity and Magnetism
Phy. Core Course 102: Mechanics (Practical)	Phy. Core Course 204: Waves and Optics (Practical)
Ability Enhancement Compulsory Course (AECC) –I	Ability Enhancement Compulsory Course (AECC)-II
Generic Elective (GE) –I: Mechanics	Generic Elective (GE) – II: Electricity and Magnetism
<u>Semester –III</u>	<u>Semester -IV</u>
Phy. Core Course305: Mathematical Physics-II	Phy. Core Course 408: Analog System and Applications
Phy. Core Course 306: Thermal Physics	Phy. Core Course 409: Mathematical Physics III
Phy. Core Course 307: Digital system and Application	Phy. Core Course 410: Modern Physics
Skill Enhancement Course (SEC) -I	Skill Enhancement Course (SEC) –II
Generic Elective (GE) –III: Thermal Physics and Electronics	Generic Elective (GE) – IV: Modern Physics
<u>Semester –V</u>	<u>Semester -VI</u>
Phy. Core Course 511: Quantum Mechanics	Phy. Core Course 613: Solid State Physics
Phy. Core Course 512: Electromagnetic Theory	Phy. Core Course 614: Statistical Mechanics
Discipline Specific Elective (DSE) 501: Classical Dynamics	Discipline Specific Elective (DSE) 603: Nuclear and Particle Physics
Discipline Specific Elective (DSE) 502: Nanomaterial and Application	Discipline Specific Elective (DSE) 604: Project/Dissertation/Internship

*Adina*  
16-8-21

*Raj*  
16/8/21

*16/8/21*  
*16/8/21*

*16/8/21*  
*16/8/21*

*Amrita*  
16/08/21  
*16/8/21*

## Details of Credits for Courses under B.A., B.Sc., B.Com.Honours

### PHYSICS

Semester	Course	Theory	Practical	Tutorial	Total Credits
<b><u>I. Core Course (14 Papers) – 06 credits each</u></b>					
I	101. Mathematical Physics I	5	-	1	6
	102. Mechanics (Practical)	4	2	-	6
II	203. Electricity and Magnetism	5	-	1	6
	204. Waves and Optics (Practical)	4	2	-	6
III	305. Mathematical Physics-II	5	-	1	6
	306. Thermal Physics	5	-	1	6
	307. Digital system and Application (Practical)	4	2	-	6
IV	408. Analog System and Applications	4	2	-	6
	409. Mathematical Physics III (Practical)	5	-	1	6
	410. Modern Physics	4	2	-	6
V	511. Quantum Mechanics	5	-	1	6
	512. Electromagnetic Theory (Practical)	4	2	-	6
VI	613. Solid State Physics (Practical)	4	2	-	6
	614. Statistical Mechanics	5	-	1	6
<b><u>II. Elective Course – 06 credits each</u></b>					
<b><u>A. 1. Discipline Specific Elective- DSE (4 papers)</u></b>					
V	1. Classical Dynamics	5	-	1	6
	2. Nanomaterial and Application	5	-	1	6
VI	3. Nuclear and Particle Physics	5	-	1	6
	4. Project/Dissertation	-	-	-	6
<b><u>B. 1. Generic Elective / Interdisciplinary (4 papers)</u></b>					
I	1. Mechanics (Practical)	4	2	-	6
II	2. Electricity and Magnetism	5	-	1	6
III	3. Thermal Physics (Practical)	4	2	-	6
IV	4. Modern physics	5	-	1	6
<b><u>III. Ability Enhancement Courses – 02 credits each</u></b>					
<b><u>1. Ability Enhancement Compulsory (AECC)</u></b>					
I	English / Hindi Communication	2	-	-	2
II	Environmental Science	2	-	-	2
<b><u>II. Skill Enhancement Course (SEC)</u></b>					
III	1. Inter Religious Studies	2	-	-	2
IV	2. Physics Workshop OR Electrical Circuit Network (Skill based)	-	2	-	2
<b>TOTAL</b>					<b>140</b>

*Adhva*  
16-8-21

*[Signature]*  
16/8/21

*[Signature]*  
16/8/21

*[Signature]*  
16/8/21

*[Signature]*  
16/8/21

*[Signature]*  
16/8/21

## Physics (Honours) Details of CBCS Syllabus

### Core Courses (6 credits each)

#### SEMESTER-I:Core Course

**Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

#### **PHYCC101: Mathematical Physics I**

**After completion of the course, the students will be able to:**

**CO1:** A study of mathematical techniques used in Physical problems.

**CO2:** The tutorials involve the applications of Gauss's divergence theorem, Green's theorem, Stokes theorem and Dirac Delta function.

**CO3:** The knowledge of different coordinate systems, depending on the symmetry of the system.

**CO4:** Develop the concept of divergence, gradient, curl; their physical significance; Dirac delta function and its applications.

<b>PHY CC101: Mathematical Physics (Theory: 5 credits + Tutorial: 1credit)</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
<b>1</b>	<b>Calculus:</b> Differentiation. Approximation, Taylor and Binomial series (statements only). First Order Differential Equations and Integrating Factor. Exact and Inexact differential equation and their solution. Second Order Differential equations: Homogeneous Equations with constant coefficients. Uniqueness theorem for initial value problem.	18
<b>2</b>	<b>Vector Calculus:</b> Recapitulation of vectors. Scalar and Vector fields, Vector differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field and their physical interpretation Line, surface and volume integrals. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proof).	37

Aditya  
16-8-21

Ravi  
16/8/21

Alka  
16/8/21

Sapna  
16/8/21

16/08/2021  
Pratik  
16/8/21

Anurita  
16/08/21

Ramini  
16-8-21

NR  
Sd

3	<b>Orthogonal Curvilinear Coordinates:</b> Orthogonal Curvilinear Coordinates. Basis vectors and Scale factors, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.	15
4	<b>Dirac Delta function:</b> Definition of Dirac delta function and simple examples, Properties of Dirac Delta function	05
	Tutorial	15
	<b>TOTAL</b>	90

### Reading List :

1. Arfken, G. B., Weber, H. J. , Harris F. E. (2013). *Mathematical Methods for Physicists*, 7th Edition, Elsevier.
2. Coddington E.A. (2009). *An introduction to ordinary differential equations*, PHI learning.
3. George F. Simmons. (2007). *Differential Equations*, McGraw Hill.
4. Zill D. G. and Wright W. S. (2012). *Advanced Engineering Mathematics*, 5 Ed., Jones and Bartlett Learning.
5. Goswami. *Mathematical Physics*, 1<sup>st</sup> edition, Cengage Learning.
6. Pal S. and Bhunia S.C. (2015). *Engineering Mathematics*, Oxford University Press.
7. Kreyszig Erwin (2008). *Advanced Engineering Mathematics*, Wiley India.

Adina-  
16-8-21

16/8/21

16/8/21

16/8/21

16/08/2021

Amile-  
16/08/21

16-8-21



## SEMESTER-I :Core Course

### **PHYCC102: Mechanics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the terminologies and basic concepts used in Mechanics.

**CO2:** Differentiate between the inertial and non-inertial frames and their respective equations of motion.

**CO3:** Analyse the Centre of mass and Laboratory frames of references and their use in explaining elastic and inelastic collisions.

**CO4:** Understand the Planetary motions and motions of satellites using the principles of gravitation and Kepler's laws. Getting an idea of postulates of special theory of relativity and their implications.

<b>PHY CC102: Mechanics (Practical)</b> <b>(Theory :4 credits + Practical: 2 credits)</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
1	<b>Fundamentals of Dynamics:</b> Reference frames. Inertial frames, Review of Newton's Laws of Motion. Centre of Mass. Principle of conservation of momentum.	8
2	<b>Collisions:</b> Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. Elasticity: Review of relation between Elastic constants. Twisting torque on a Cylinder or Wire (only qualitative discussion).	10
3	<b>(a) Central force Motion:</b> Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. Kepler's Laws. <b>(b) Non-Inertial Systems:</b> Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications.	22
4	<b>Special Theory of Relativity:</b> Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Lorentz contraction. Time dilation. Relativistic	20

*Adina*  
16-8-21

*[Signature]*  
16/8/21

*[Signature]*  
16/8/21

*[Signature]*  
16/8/21

*Anurag*  
16/8/21

*Ramini*  
16/8/21

	addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence.	
	<b>Practical:</b> <b>At least 05 experiments from the following</b> 1. To study the random error in observations, 2. To determine the height of a building using a Sextant, 3. Measurement of length (or diameter) using vernier caliper, 4. Measurement of length (or diameter) using screw gauge, 5. To determine the Moment of Inertia of a Flywheel, 6. To determine the Modulus of Rigidity of a Wire by dynamical method, 7. To determine the Young's Modulus by flexure of beam, 8. To determine the Modulus of Rigidity of a Wire by Barton's apparatus, 9. To determine the elastic Constants of a wire by Searle's method, 10. To determine the value of g using Bar Pendulum, 11. To determine the value of g using Kater's Pendulum.	30
	<b>TOTAL</b>	90

#### Reading List :

1. Kleppner D., Kolenkow R. J. (1973). *An introduction to mechanics*, McGraw-Hill.
2. Kittel C., Knight W., et.al. (2007). *Mechanics*, Berkeley Physics, vol.1, Tata McGraw-Hill.
3. Resnick, Halliday and Walker (2008). *Physics*, Wiley, 8/e.
4. Fowles G. R. and Cassiday G.L. (2005). *Cengage Learning*.
5. Feynman R. P., Leighton R. B., Sands M. (2008). *Feynman Lectures*, Vol.I, Pearson Education.
6. Mathur D. S. (2000). *Mechanics*, S. Chand and Company Limited.
7. Sears F. W, Zemansky M. W., Young H.D. (1986). *University Physics*. 13/e, Addison Wesley.
8. Jewett J. W., Serway R. A. (2010). *Physics for scientists and Engineers with Modern Phys.*, Cengage Learning.
9. Spiegel M.R. (2006). *Theoretical Mechanics*, Tata McGraw Hill.
10. Flint B.L. and Worsnop H.T. (1971). *Advanced Practical Physics for students*, Asia Publishing House.
11. Nelson Michael and Ogborn Jon M. (1985). *Advanced level Physics Practicals*, 4th Edition, Heinemann Educational Publishers.
12. Panigrahi S. & Mallick B. (2015). *Engineering Practical Physics*, Cengage Learning India Pvt. Ltd.
13. Squires G.L. (2015). *Practical Physics*. 4th Edition, Cambridge University Press.
14. Prakash I. & Ramakrishna (2011). *A Text Book of Practical Physics*, 11th Edn, Kitab Mahal.

Adhva  
16-8-21

16/8/21

16/8/21  
16/8/21

16/8/21  
16/8/21

Annile  
16/08/21  
R. S. 16/8/21



## SEMESTER-II:Core Course

### **PHYCC203: Electricity and Magnetism**

**After completion of the course, the students will be able to:**

**CO1:** Enhance the knowledge of electricity and its relation with magnetic effects.

**CO2:** Explore important connections between theory, experiment and applications of current. Transformer and its applications in real world.

**CO3:** Understand Gauss's law in Electrostatics, its applications; Laplace' and Poisson's equations; origin of magnetic field, study of magnetic properties in materials and their implications.

**CO4:** Analyse the concept of mutual inductance and Faraday's law of electromagnetic induction, acquire knowledge in the content areas of A.C. circuit focusing on the concepts that are commonly use in this area.

**CO5:** Understand the relation between R, L and C components and learn to use complex methods for calculating current and voltage.

<b>PHYCC203: ELECTRICITY AND MAGNETISM</b> <b>(Theory :5 credits + Tutorial: 1 credit )</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
1	<b>(a) Electric Field and Electric Potential:</b> Electric field: Electric field lines. Electric flux. Gauss' Law with applications. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Conductors in an electrostatic Field. Capacitance of a system of charged conductors. <b>(b) Dielectric Properties of Matter:</b> Electric Field in matter. Polarization, Polarizability and susceptibility of dielectrics, Displacement vector D. Relations between E, P and D.	20
2	<b>(a) Magnetic Field:</b> Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications. <b>(b) Magnetic Properties of Matter:</b> Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. B-H curve and hysteresis. Ferromagnetism	27

*Abhishek*  
16-8-21

*Abhishek*  
16/8/21

*Abhishek*  
16/8/21  
*Abhishek*  
16/8/21

*Abhishek*  
16/8/21  
*Abhishek*  
16/8/21  
*Abhishek*  
16/8/21



## SEMESTER-II:Core Course

### **PHYCC204: Waves and Optics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the wave concept of light and its interpretations.

**CO2:** Comprehend the interference effects and diffraction effects due to different light sources; theory and working of interferometers.

**CO3:** Develop a practical aptitude of optics experiments demonstrating different phenomena.

**CO4:** Analyse the study of wave motion and explore the physical behaviour in different problems.

<b>PHYCC204 : Waves and Optics(Practical)</b> <b>(Theory :4 credits + Practical: 2 credits )</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
<b>1</b>	<b>Wave Motion:</b> Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Phase and Group Velocities. Changes with respect to Position and Time.	5
<b>2</b>	<b>Interference:</b> Young's double slit experiment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.	15
<b>3</b>	<b>Interferometer:</b> Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.	15
<b>4</b>	(a) <b>Fraunhofer diffraction:</b> Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Diffraction grating. Resolving power of grating. (b) <b>Fresnel Diffraction:</b> Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate.	25

Adina  
16-8-21

16/8/21

16/8/21

16/8/2021  
16/8/21

Amrita  
16/08/21  
16/8/21

16-8-21  
Std Mr

	<b>Practical:</b> <b>At least 05 experiments from the following</b>  1. To verify the law of length and law of tension in sonometer, 2. To investigate the motion of coupled oscillators, 3. To study Lissajous Figures, 4. Familiarization with: Schuster's focusing; determination of angle of prism, 5. To determine refractive index of the Material of a prism using sodium source, 6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source, 7. To determine the wavelength of sodium source, 8. To determine wavelength of sodium light using Fresnel Biprism, 9. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film, 10. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating, 11. To determine dispersive power and resolving power of a plane diffraction grating.	30
	<b>TOTAL</b>	90

#### Reading List :

1. Crawford Francis (2007). *Waves: Berkeley Physics Course*, vol. 3, Tata McGraw-Hill.
2. Jenkins F.A. and White H.E. (1981). *Fundamentals of Optics*, McGraw-Hill.
3. Born Max and Wolf Emil (1999). *Principles of Optics*, 7th Edn., Pergamon Press.
4. Ghatak Ajoy (2008) *Optics*, Tata McGraw Hill.
5. Pain H.J. (2013). *The Physics of Vibrations and Waves*, John Wiley and Sons.
6. Bajaj N.K. (1998). *The Physics of Waves and Oscillations*, Tata McGraw Hill.
7. Kumar A., Gulati H.R. and Khanna D.R. (2011). *Fundamental of Optics*, R. Chand.
8. Flint B.L. and Worsnop H.T. (1971). *Advanced Practical Physics for students*, Asia Publishing House.
9. Prakash I. & Ramakrishna (2011). *A Text Book of Practical Physics*, 11th Ed., Kitab Mahal.
10. Nelson Michael and Ogborn Jon M. (1985). *Advanced level Physics Practicals* 4th Edition, Heinemann Educational Publishers.
11. Khandelwal D.P. (1985). *A Laboratory Manual of Physics for undergraduate classes*, Vani Pub.

*Adina*  
16-8-21

*Agar*  
16/8/21

*Amrita*  
16/08/21  
*Aspl*  
16/8/21

*As*  
16/08/2021  
*Pr*  
16/8/21  
*ASummi*  
16-8-21



### SEMESTER –III: Core course

#### **PHYCC305: Mathematical Physics – II**

**After completion of the course, the students will be able to:**

- CO1:** Explore a mathematical basis underlying the physical problems, study and practice the numerical problems involving different method of problem solving.
- CO2:** Understand Periodic functions and their analyses using Fourier's theorem.
- CO3:** Apply Methods of problem solving in Partial differential equations and study of special functions and integrals.
- CO4:** Analyse and demonstrate the different errors in experiments and their propagation.

<b>PHY CC305: Mathematical Physics – II (Theory: 5 credits +Tutorial: 1 credit)</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of Hours</b>
<b>1</b>	<b>Fourier Series:</b> Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Fourier series for even and odd functions. Expansion of periodic functions in a series of sine and cosine functions.	20
<b>2</b>	<b>Special Functions:</b> Singular Points of Second Order Linear Differential Equations. Legendre and Bessel Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality.	20
<b>3</b>	<b>(a) Special Integrals:</b> Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. <b>(b) Theory of Errors:</b> Systematic and Random errors, Propagation of Errors.	20
<b>4</b>	<b>Partial Differential Equations:</b> Solutions to partial differential equations using separation of variables: Laplace's equation in Rectangular and Spherical Polar coordinates. Laplace equation in Cylindrical coordinates.	15
	<b>Tutorial</b>	15
	<b>TOTAL</b>	90

Adhwa  
16-8-21

16/8/21

16/8/21  
18

16/8/2021  
16/8/21

Anurag  
16/8/21  
16/8/21  
16-8-21

16/8/21

### Reading List:

1. Weber, Arfken (2005). *Mathematical Methods for Physicists*, Harris, Elsevier.
2. Spiegel M.R. (2004). *Fourier Analysis*, Tata McGraw-Hill.
3. Lea, Susan M. (2004). *Mathematics for Physicists*, Thomson Brooks/Cole.
4. Simmons George F. (2006). *Differential Equations*, Tata McGraw-Hill.
5. Pal S. and Bhunia S.C. (2015). *Engineering Mathematics*, Oxford University Press.
6. McQuarrie D.A. (2003). *Mathematical methods for Scientists & Engineers*, Viva Books.
7. H. K. Das and Rama Verma, *Advanced Mathematical Physics*, S. Chand Publications.

Abhinav  
16-8-21

16/8/21

19  
16/8/21

16/8/21

Anurag  
16/08/21

16/8/21

16-8-21



### SEMESTER –III: Core course

#### **PHYCC306:Thermal Physics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the Laws of thermodynamics, which form the basis of Thermal Physics.

**CO2:** Analyse the study of Carnot's cycle and Carnot's theorem.

**CO3:** Comprehend the Concept of entropy and its effect in systems and study the van der Waals equation of state

**CO4:** Understand the Maxwell's equations using the concept of thermodynamic potentials.

<b>PHY CC306 : Thermal Physics</b> <b>(Theory : 5 credits + Tutorial : 1 credit)</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
<b>1</b>	<b>(a) Zeroth and First Law of Thermodynamics:</b> Zeroth Law of Thermodynamics & Concept of Temperature, First Law of Thermodynamics and its differential form, Internal Energy, Applications of First Law: General Relation between $C_P$ and $C_V$ , Work Done during Isothermal and Adiabatic Processes. <b>(b) Second Law of Thermodynamics :</b> Reversible and Irreversible process with examples. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics : Kelvin – Planck and Clausius Statements and their Equivalence. Carnot's Theorem.	<b>20</b>
<b>2</b>	<b>Entropy:</b> Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas, Entropy Changes in Reversible and Irreversible processes, Temperature–Entropy diagrams for Carnot's Cycle, Third Law of Thermodynamics, Unattainability of Absolute Zero.	<b>20</b>

Ashu  
16-8-21

16/8/21

20 16/8/21

16/8/2021

16/8/21

Anurag  
16/8/21

16/8/21

Ashu  
16-8-21  
SPD

3	<b>Thermodynamic Potentials and Maxwell's Relations:</b> Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions and Applications. Clausius – Clapeyron Equation. Maxwell Relations: Derivation and applications.	17
4	<b>Kinetic Theory of Gases:</b> Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification, Mean free Path, Van der Waal's Equation of State for Real Gases.	18
	<b>Tutorial</b>	15
	<b>TOTAL</b>	90

### Reading List :

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

Adves  
16-8-21

16/8/21

16/8/21

16/8/2021

16/8/22

16/8/21

16/08/21

16-8-21

16/8/21

### SEMESTER –III: Core course

#### **PHYCC307: Digital system and Application**

**After completion of the course, the students will be able to:**

- CO1:** Understand number systems, Boolean algebra and the difference between analog and digital electronics.
- CO2:** Have an understanding of arithmetic circuits' realization and their truth tables.
- CO3:** Explore the different network theorems and their applications to circuits.
- CO4:** Understand the different types of modulation and basics of communication theory.

<b>PHY CC307: Digital System and Application (Practical)</b> <b>(Theory: 4 credits + Practical:2 credit)</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
<b>1</b>	<b>Digital Circuits:</b> Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion., Octal and Hexadecimal numbers and their conversion to Decimal, BCD. Addition and Subtraction using 1's and 2's complement method. Logic gates AND, OR and NOT Gates. NAND and NOR Gates as Universal Gates.	20
<b>2</b>	<b>(a) Boolean algebra:</b> De Morgan's Theorems, Boolean Laws. Simplification of Logic Circuit using Boolean Algebra, Conversion of a truth table into logic circuit by Sum of Products, Karnaugh Map. <b>(b) Arithmetic Circuits:</b> Half and Full Adders. Half and Full Subtractor.	20
<b>3</b>	<b>Sequential Circuits:</b> SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.	10

4	<b>Integrated Circuits:</b> Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital ICs.	10
	<b>Practical :</b> <b>At least 05 experiments from the following:</b>  <b>Thermal Physics:</b> 1. To determine Mechanical Equivalent of Heat, J, by Joule's Calorimeter method. 2. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT), 3. To study the variation of Thermo-Emf of a Thermocouple. 4. To calculate the latent heat of ice.  <b>Digital Electronics:</b> 5. Obtain the truth table of two input Logic gates in a positive logic system. 6. Obtain the truth table of three input Logic gates using positive logic system. 7. To design and study the truth table of a RS Flip-Flop. 8. Verification of Maximum Power Transfer theorem.	30
	<b>TOTAL</b>	90

#### Reading List:

1. Malvino A.P., Leach D.P. and Saha (2011). *Digital Principles and Applications*, 7th Ed., Tata McGraw
2. KumarAnand (2009). *Fundamentals of Digital Circuits*, 2nd Edn, PHI Learning Pvt. Ltd.
3. Venugopal (2011). *Digital Circuits and systems*, Tata McGraw Hill.
4. KharateG.K. (2010). *Digital Electronics*, Oxford University Press
5. Vingron Shimon P. (2012). *Logic circuit design*, Springer.
6. Ghoshal Subrata(2012). *Digital Electronics*, Cengage Learning.
7. Mandal S.K.(2010). *Digital Electronics*, 1st edition, McGraw Hill
8. Flint B.L. and Worsnop H.T. (1971). *Advanced Practical Physics for students*, Asia Publishing House.
9. Prakash I. & Ramakrishna (2011). *A Text Book of Practical Physics*, 11th Ed., KitabMahal.
10. Nelson Michael and Ogborn Jon M. (1985). *Advanced level Physics Practicals* 4th Edition, Heinemann Educational Publishers.
11. Khandelwal D.P. (1985). *A Laboratory Manual of Physics for undergraduate classes*, Vani Pub.

Adna.  
16/8/21

16/8/21

16/08/2021  
16/8/21

Anurita  
16/08/21  
16/8/21  
Sed W/

## SEMESTER – IV : Core Course

### **PHY CC408: Analog system and Applications**

**After completion of the course, the students will be able to:**

**CO1:** Develop an insight into concepts of Analog electronics.

**CO2:** Set up circuits and analyse their working and study the semiconductor devices which are of great significance.

**CO3:** Analyse the Knowledge of Transistor, biasing and applications, amplifiers and their uses.

**CO4:** Understand the detailed study of feedback circuits and their applications and know the theory and practical usage of oscillator.

<b>PHYCC408 : Analog Systems and applications</b> <b>(Theory : 5 credits + Tutorial : 1 credit )</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
<b>1</b>	<b>(a) Practical Network theorems:</b> Ideal Constant-voltage and Constant-current Sources, Network Theorems: Thevenin theorem, Norton theorem, Maximum Power Transfer theorem <b>(b) Semiconductor Diodes:</b> P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility. Barrier Formation in PN Junction Diode. Current Flow Mechanism in Forward and Reverse Biased Diode. <b>(c) Two-terminal Devices and their Applications:</b> Rectifier Diode: Half-wave Rectifiers. Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, Zener Diode and Voltage Regulation.	20
<b>2</b>	<b>Bipolar Junction transistors:</b> n-p-n and p-n-p Transistors. I-V characteristics of CB, CC and CE Configurations. Active, Cutoff and Saturation Regions. Current gains $\alpha$ and $\beta$ . Relations between $\alpha$ and $\beta$ . Load Line analysis of Transistors. DC Load line and Q -point.	10

*Adnan*  
16-8-21

*Sohail Sid*  
16/08/2021

*Pratik*  
16/8/21

*Anurag*  
16/08/2021

*R. Samir*  
16/8/21



3	<b>(a) Amplifiers:</b> Transistor Biasing and Stabilization Circuits. h-parameters, CE Amplifier, Power Amplifier. <b>(b) Feedback in Amplifiers:</b> Positive and Negative Feedback, Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. <b>(c) Modulation:</b> Amplitude modulation, Analysis of amplitude modulator.	35
4	<b>(a) Sinusoidal Oscillators:</b> Barkhausen's Criterion for self-sustained oscillations. determination of Frequency in Hartley & Colpitts oscillators. <b>(b) Field Effect Transistors:</b> JFET, MOSFET (Introduction), Study of Working Principle of FET.	10
	<b>Tutorial</b>	15
	<b>TOTAL</b>	90

#### Reading List :

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

Adva  
16-8-21

16/8/21

25  
16/8/21

16/08/2021  
16/9/21

SPD 16/8/21

Amrita  
16/08/21  
R. Suman  
16/8/21



## SEMESTER – IV : CoreCourse

### **PHYCC409: Mathematical Physics III**

**After completion of the course, the students will be able to:**

**CO1:** Develop an understanding of mathematical tools for problem solving

**CO2:** Analyse the study of complex analyses and functions of complex

variables **CO3:** Understand the study of analytical functions and calculation of residue.

**CO4:** Comprehend the theory and solve numerical problems involving Fourier and Laplace transforms.

<b>PHYCC409 : Mathematical Physics-III</b> <b>(Theory: 4 credits + Practical: 2 credits)</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
<b>1</b>	<b>Complex Analysis:</b> Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Analytic functions and examples.	10
<b>2</b>	<b>Integration of Complex Functions:</b> Singular functions: poles and branch points, Cauchy's Inequality, Cauchy's Integral formula, Residues and Residue Theorem, Applications in solving definite integrals.	15
<b>3</b>	<b>Fourier Transforms:</b> Fourier Integral theorem, Fourier transform of derivatives, Properties of Fourier transforms.	15
<b>4</b>	<b>Laplace Transforms:</b> Laplace Transform (LT) of Elementary functions. Properties of LTs. LTs of 1st and 2nd order Derivatives and Integrals of Functions.	20
	<b>Practical :</b> <b>At least 05 experiments from the following:</b> 1. Plot the V-I Characteristics of p-n junction diode (Ge and Si), 2. Draw the characteristics of Zener diode,	30

*Adarsh*  
16-8-21

*kg*  
16/8/21

*Qee*  
16/8/21

*16/08/2021*

*S. Ph*  
16/8/21

*P. Rat*  
16/8/21

*Anvika*  
16/08/21

*Adarsh*  
16-8-21

3. Plot the input and output characteristic of npn transistor in CB configuration,	
4. Plot the input and output characteristic of npn transistor in CE configuration,	
5. Plot the input and output characteristic of npn transistor in CC configuration,	
6. Plot the V-I characteristics of phototransistor,	
7. Study of characteristics of a Hartley oscillator,	
8. To study the characteristics of FET.	
<b>TOTAL</b>	<b>90</b>

### Reading List :

1. Riley K.F., Hobson M.P. and Bence S.J. (2006). *Mathematical Methods for Physics and Engineers*, 3<sup>rd</sup>ed., Cambridge University Press.
2. Dennery P. and Krzywicki A. (1967). *Mathematics for Physicists*, Dover Publications.
3. Fokas A.S. & Ablowitz M.J. (2011). *Complex Variables*, 8<sup>th</sup>Ed., Cambridge Univ. Press
4. Kapoor A.K. (2014). *Complex Variables*, Cambridge Univ. Press.
5. Brown J.W. & Churchill R.V. (2003). *Complex Variables and Applications*, 7<sup>th</sup>Ed., Tata McGraw-Hill.
6. Flint B.L. and Worsnop H.T. (1971). *Advanced Practical Physics for students*, Asia Publishing House.
7. Prakash I. & Ramakrishna (2011). *A Text Book of Practical Physics*, 11th Ed., KitabMahal.
8. Nelson Michael and Ogborn Jon M. (1985). *Advanced level Physics Practicals*, 4th Edition, Heinemann Educational Publishers.
9. Panigrahi S. & Mallick B. (2015). *Engineering Practical Physics*, Cengage Learning India Pvt. Ltd.
10. Squires G.L. (2015). *Practical Physics*, 4th Edition, Cambridge University Press.

*Phan*  
16-8-21

*kyu*  
16/8/21

*Q*  
16/8/21

*16/08/2021*  
*16/8/21*

*Anu*  
16/08/21

*16-8-21*

## SEMESTER – IV : Core Course

### **PHYCC410: Modern Physics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the fundamentals of early quantum theory.

**CO2:** Analysis the study of nucleus and its properties.

**CO3:** Develop the knowledge of laws of Radioactivity and its numerical implications.

**CO4:** Understand the theory behind laser and learn about the different types of Lasers.

<b>PHYCC410: Modern Physics</b> <b>(Theory: 5 credits + Tutorial: 1 credits)</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
<b>1</b>	Planck's Quantum, Blackbody radiation, Photoelectric effect, Compton's scattering, De-Broglie's wavelength, Davisson-Germer experiment, Wave description of particles by wave packets. Heisenberg Uncertainty principle.	20
<b>2</b>	(a) <b>Many electron atoms</b> : Bohr's Atomic model, Bohr's Sommerfeld atomic model, Fine structure of hydrogen lines, Total Angular Momentum, Vector Atom Model, Quantum numbers associated with the atom, Spin Quantization, Spin-orbit coupling in atoms-L-S and J-J couplings. (b) <b>Particle Accelerators</b> : Cyclotron. Detection of Nuclear Radiation: GM counter. Measurement of Charge and the ratio (e/m).	20
<b>3</b>	(a) Size and structure of atomic nucleus, Nature of Nuclear force, NZ curve, Binding energy Stability of the nucleus; Radioactivity, Mean life and half-life; Alpha decay; Beta decay Gamma ray emission. (b) <b>Molecular Physics</b> : Pure rotational and vibrational-rotational spectra of diatomic molecules, Origin of X-ray spectra, introduction of NMR and ESR spectroscopy. (b) <b>Fission and fusion</b> : Mass deficit and generation of energy; Fission-nature of fragments and emission of neutrons. Nuclear Reactor, Fusion and thermonuclear reactions (brief qualitative discussions).	20

*Ashra*  
16-8-21

*Solanki*  
16/08/2021

*Pank*  
11/8/21

*Annika*  
16/08/2021

*Ramani*  
16/8/21  
WV

4	<b>Lasers:</b> Spontaneous and Stimulated emissions. Metastable states. Einstein's A & B coefficients, Optical Pumping and Population Inversion, Ruby Laser, He-Ne Laser.	15
	Tutorial	15
	<b>TOTAL</b>	90

#### Reading List:

1. Beiser Arthur (2002). *Concepts of Modern Physics*, McGraw-Hill.
2. Meyer Rich, Kennard, Coop, (2002). *Introduction to Modern Physics*, Tata McGraw Hill
3. Griffith David J. (2005). *Introduction to Quantum Mechanics*, Pearson Education.
4. Jewett and Serway (2010). *Physics for scientists and Engineers with Modern Physics*, Cengage Learning.
5. Kaur G. and Pickrell G.R. (2014). *Modern Physics*, McGraw Hill
6. Gautreau R. and Savin W. *Theory and Problems of Modern Physics, Schaum's outline*, 2<sup>nd</sup> Edn, Tata McGraw-Hill Publishing Co. Ltd.
7. Wichman E.H. (1971). *Quantum Physics, Berkeley Physics*, Vol. 4, Tata McGraw-Hill Co.
8. Moore T.A. (2003), *Six Ideas that Shaped Physics: Particle Behave like Waves*, McGraw Hill.

Amite  
16/8/21

Amite  
16/8/21

Amite  
16/8/21

29

Amite  
16/8/21

Amite  
16/8/21

Amite  
16/8/21

Amite  
16/8/21

Amite  
16/8/21



## SEMESTER-V : Core Course

### **PHYCC511: Quantum Mechanics**

**After completion of the course, the students will be able to:**

- CO1:** Learn the mathematical tools needed to solve quantum mechanical problems which include complex functions and Hilbert spaces, and the theory of operator algebra.
- CO2:** Apply solutions of ordinary and partial differential equations that arise in quantum mechanics.
- CO3:** Develop problem solving methods that will include mathematical as well as numerical computations and solutions.
- CO4:** Build connections between mathematical development and conceptual understanding.

<b>PHY CC511: Quantum Mechanics (Theory: 5 credits + Tutorial: 1credit)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
<b>1</b>	<b>(a) Time dependent Schrodinger equation:</b> Wave function of a free particle, Time dependent Schrodinger equation; Properties of Wave Function. Interpretation of Wave Function, Normalization, Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. <b>(b) Time independent Schrodinger equation:</b> Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states.	30
<b>2</b>	<b>General discussion of bound states in an arbitrary potential-</b> Particle in a box, potential step; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions, ground state, zero point energy & uncertainty principle. Particle in a Potential barrier, Infinite potential well.	20

Adhva  
16/8/21

16/8/21

30

16/8/21

16/8/2021

Amrute  
16/08/21

16/8/21

3	<b>Quantum theory of hydrogen-like atoms:</b> time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; Angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method Orbital angular momentum quantum numbers l and m; s, p, d, shells.	15
4	<b>Atoms in Electric and Magnetic Fields</b> Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Stern-Gerlach Experiment. Normal and Anomalous Zeeman Effect: Electron Magnetic Moment and Magnetic Energy. Gyroscopic Ratio & Bohr-Magneton.	10
	Tutorial	15
	<b>TOTAL</b>	90

#### Reading list:

1. Mathews P.M. and Venkatesan K. (2010). *A Text book of Quantum Mechanics*, 2<sup>nd</sup> Ed, McGraw Hill.
2. Eisberg Robert and Resnick Robert (2002). *Quantum Mechanics*, 2<sup>nd</sup> Ed, Wiley.
3. Schiff Leonard I. (2010). *Quantum Mechanics*, 3<sup>rd</sup> Edn. Tata McGraw Hill.
4. Miller D.A.B. (2008). *Quantum Mechanics for Scientists & Engineers*, Cambridge University Press.
5. Merzbacher Eugen (2004). *Quantum Mechanics*, John Wiley and Sons, Inc.
6. Griffith D.J. (2005). *Introduction to Quantum Mechanics*, 2<sup>nd</sup> Ed. Pearson Education.
7. Nouredine Zettili (2016). *Quantum Mechanics, Concepts and Applications*. Wiley Publication.
8. Satya Prakash (2016). *Quantum Mechanics*. Kedar Ram Nath Publication.
9. RajKumar . *Atomic and Molecular Spectra; Laser* , Kedar Ram Nath Publication.
10. H.C.Verma (2009). *Quantum Physics*, 2<sup>nd</sup> edition, Surya Publications.
11. Ajoy Ghatak (2010), *Basic Quantum Mechanics*, Macmillan Pub.
12. Ajoy Ghatak and S. Loknathan,(2004), *Quantum Mechanics and Applications*, Macmillan Pub.
13. S.N.Biswas, (2004) ,*Quantum Mechanics*, Books and Allied Co.

*Adva*  
16-8-21

*Raj*  
16/8/21

*Q*  
16/8/21

*Re*  
16/08/2021  
*Spd*  
16/8/21

*Anurita*  
16/08/21

*P*  
16/8/21

*Rajni*  
16-8-21



## SEMESTER-V

### PHYCC512: Electromagnetic Theory

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

**CO1:** Understand the time varying electric and magnetic fields and their relations.

**CO2:** Analyse the Wave propagation in conducting and dielectric media.

**CO3:** Comprehend the concepts of electromagnetic theory and boundary conditions.

**CO4:** Employ conceptual understanding to make predictions and then approach towards the problem mathematically.

PHY CC512: Electromagnetic Theory (Theory: 4 credits + Practical: 2 credits)		
Unit	Topics to be covered	No. of hours
1	<b>Maxwell Equations:</b> Review of Maxwell's equations. Displacement Current. Boundary Conditions at Interface between Different Media. Wave Equations. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density.	14
2	<b>EM Wave Propagation in Unbounded Media:</b> Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media.	12
3	<b>EM Wave in Bounded Media:</b> Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Brewster's law. Reflection & Transmission coefficients. Total internal reflection.	15
4	(a) <b>Double Refraction</b> , theory of dispersion, optical properties of metals and dispersion in metals, scattering by free and bound charges. (b) <b>Optical Fibres:</b> Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres.	19

Adm: 16-8-21

16/8/21

32 16/8/21

16/08/2021

16/8/21

16/8/21

16/08/21

16/8/21

	<b>Practical :</b> <b>Introduction to Numerical computation software Scilab/MATLAB:</b> Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Sub-array, Special values, Displaying output data, data file, Scalar and array operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting, Branching Statements and program design, Relational and logical operators, the while loop, for loop, details of loop operations, break and continue statements, nested loops, logical arrays and vectorization. User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function	30
--	--	----

#### Reading List :

1. Griffiths D.J. (1998). *Introduction to Electrodynamics*, 3<sup>rd</sup> Ed., Benjamin Cummings.
2. Sadiku M.N.O. (2001). *Elements of Electromagnetics*, Oxford University Press.
3. Miah M.A.W., (1982). *Fundamentals of Electromagnetics*, Tata McGraw Hill.
4. Kshetrimayun R.S. (2012). *Electromagnetic field Theory*, Cengage Learning.
5. Hayt William H. (2012). *Engineering Electromagnetic*, 8<sup>th</sup> Edition, McGraw Hill.
6. Edminster J.A. (2006). *Electromagnetics*, Schaum Series, Tata McGraw Hill.
7. Guru B. and Hizioglu H. (2015). *Electromagnetic field theory fundamentals*, Cambridge University Press.
8. Riley K.F., Hobson M.P. and Bence S.J. (2006). *Mathematical Methods for Physics and Engineers*, 3<sup>rd</sup> ed., 2006, Cambridge University Press
9. Fokas A.S. & Ablowitz M.J. (2011). *Complex Variables*, 8<sup>th</sup> Ed., Cambridge Univ. Press
10. Walker D. (2015). *Computational Physics*, 1<sup>st</sup> Edn., Scientific International Pvt. Ltd.
11. Hunt B.R., Lipsman R.L., Rosenberg J.M. (2014). *A Guide to MATLAB*, 3<sup>rd</sup> Edn., Cambridge University Press
12. Pratap Rudra (2010). *Getting started with Matlab*, Oxford University Press.
13. Wouwer A.V., Saucez P., Fernández C.V. (2014). *Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications*, Springer

## SEMESTER-V

### Discipline Specific Elective (DSE) (6 credits each)

**Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

#### **PHYDSE 501: Classical Dynamics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the terminologies used in Classical Mechanics.

**CO2:** Understand the important connections between theory and experiment.

**CO3:** Connect concepts and mathematical rigor in order to enhance understanding.

**CO4:** Study of retarded potentials and concepts of Plasma physics.

<b>PHY DSE501: CLASSICAL DYNAMICS</b> <b>(Theory :5 credits + Tutorial: 1 credit )</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of Hours</b>
<b>1</b>	<b>Classical Mechanics of Point Particles:</b> Generalized coordinates and velocities, Hamilton's principle, Lagrangian and the Euler-Lagrange equations. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, Particle in a central force field, Poisson brackets, Canonical transformation.	22
<b>2</b>	<b>Relativistic Electrodynamics:</b> Electromagnetic field tensor and its transformation under Lorentz transformation: relation to known transformation properties of <b>E</b> and <b>B</b> . Electric and magnetic fields due to a uniformly moving charge. Motion of charged particles in external electric and magnetic fields.	23
<b>3</b>	<b>Electromagnetic Radiation:</b> Review of retarded potentials, Potential due to a moving charge: Lienard Wiechart potentials, Electric and Magnetic fields due to a moving charge: Power radiated.	20

*Adina*  
16-8-21

*Robert Singh*  
16/08/2021  
34

*Pune*  
16/8/21

*Anurag*  
16/08/2021

*R. Suresh*  
16/8/21  
W

4	<b>Plasma Physics:</b> Plasma: definition, characteristics, Saha's theory of thermal ionization, Debye's length, Debye's screened potential, Plasma Oscillations, Kinetic theory of Plasma, Landau's Damping.	10
	<b>Tutorial</b>	15
	<b>TOTAL</b>	90

#### Reading List :

1. Goldstein H., Poole C.P., Safko J.L. (2002). *Classical Mechanics*, 3<sup>rd</sup> Edn., Pearson Education.
2. Landau L.D. and Lifshitz E.M. (1976). *Mechanics*, Pergamon.
3. Jackson J.D. (1998). *Classical Electrodynamics*, 3<sup>rd</sup> Edn., Wiley.
4. Landau L.D., Lifshitz E.M. (2003). *The Classical Theory of Fields*, 4<sup>th</sup> Edn., Elsevier.
5. Joag P.S., Rana N.C. *Classical Mechanics*, 1<sup>st</sup> Edn., McGraw Hall.
6. Gregory Douglas R. (2015). *Classical Mechanics*, Cambridge University Press.
7. Delange O.L. and Pierrus J. (2010). *Solved Problems in classical Mechanics*, Oxford Press
8. S.N. Sen, (2013). *Plasma Physics*, 10<sup>th</sup> Edn, Pragati Prakashan

Abhishek  
16-8-21

16/8/21  
35

16/08/2021  
Anurag  
16/08/21  
16/01/2021  
16-8-21  
SPD



## SEMESTER-V: Discipline Specific Elective (DSE) II

### **PHY DSE502: Nanomaterials and Application**

**After completion of the course, the students will be able to:**

**CO1:** Acquire knowledge in the content areas of nanotechnology.

**CO2:** Learn different methods to synthesize Nanomaterials.

**CO3:** The applications of nanotechnology in day-to-day life and its importance.

**CO4:** Understand the introduction to the field of Biophysics.

**CO5:** Comprehend the study of heat transfer in biomaterials.

<b>PHY DSE502: Nanomaterials and Application (Theory: 5 credits + Tutorial: 1 credit )</b>		
<b>Unit</b>	<b>Current Topics</b>	<b>No. of hours</b>
<b>1</b>	<b>Nanoscale Systems:</b> Length scales in physics, Nanostructures: (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement.	12
<b>2</b>	<b>(a) Synthesis of Nanostructure Materials:</b> Top down and Bottom up approach. Ball milling. Gas phase condensation. Vacuum deposition. Sol-Gel. Electro deposition. Hydrothermal synthesis. Preparation through colloidal methods. <b>(b) Characterization:</b> X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy.	10
<b>3</b>	<b>(i) "Building Blocks &amp; Structure of Living State:</b> Atoms and ions, molecules essential for life, what is life. <b>Living state interactions:</b> Forces and molecular bonds" to be introduced <b>(ii) "Heat Transfer in biomaterials:</b> Heat Transfer Mechanism, The Heat Equation, Joule heating of tissue, Living State Thermodynamics: Thermodynamics equilibrium, first law of thermodynamics and conservation of energy, Entropy and second law of thermodynamics. Protein folding and unfolding" to be introduced.	23

*Adna*  
16-8-21

*Sohit Singh*  
16/08/2021

*Prat*  
16/8/21

*Ramuni*  
16-8-21  
*W*



4	<b>APPLICATIONS:</b> Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Nanomaterial Devices: optical switching and optical data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).	18
	Tutorial	15
	<b>TOTAL</b>	90

#### Reading List :

1. Poole C.P., Owens Jr. Frank J. *Introduction to Nanotechnology*, Wiley India Pvt.Ltd.
2. Kulkarni S.K., *Nanotechnology: Principles & Practices*, Capital Publishing Company
3. Chattopadhyay K.K. and Banerjee A. N. *Introduction to Nanoscience and Technology*, PHI Learning Private Limited
4. Mitin V.V., Kochelap V.A. and Strosio M.A. (2011). *Introduction to Nanoelectronics*, Cambridge University Press
5. Booker Richard, Boysen Earl, *Nanotechnology*, John Wiley and Sons.

Adina  
16-8-21

16/8/21 37

16/8/21

16/8/21

16-8-21

## SEMESTER VI: Core Course

### **PHYCC613: Solid State Physics**

**After completion of the course, the students will be able to:**

**CO1:** Understand crystal structures of different solids.

**CO2:** Calculate band gap and analyse the characteristics of solid.

**CO3:** Differentiation between Ferro-, Ferri-, Antiferro-, Dia-, Para-magnetic materials based on their crystal structures.

**CO4:** Analyse the study of Bloch's theorem and K. P. Model.

<b>PHY CC613: Solid State Physics ( Theory: 4 credits + Practical:2 credits )</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
<b>1</b>	<b>Crystal Structure:</b> Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Wigner- Seitz cell. Miller Indices. Reciprocal Lattice. Bravais lattices in 2 and 3 dimensions. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law.	12
<b>2</b>	<b>Elementary Lattice Dynamics:</b> Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical branch, Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids, $T^3$ law.	12
<b>3</b>	<b>Free electron theory of metal:</b> Drude's model, Sommerfeld's theory of free electron gas, Fermi energy, Density of states. Heat capacity of electron gas, Electrical conductivity, Thermal conductivity, Wiedemann-Franz relation, Boltzmann transport equation, Sommerfeld theory of electrical conductivity.	20
<b>4</b>	<b>(a)Elementary band theory:</b> Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. <b>(b)Superconductivity:</b> Meissner effect. Type I and type II Superconductors, . Idea of BCS theory (No derivation).	16

Ashra:  
16-8-21

Bobit Singh  
16/08/2021

Pune  
16/8/21

Anurag  
16/08/2021  
Saurav  
16-8-21  
W

	<b>Practical:</b> <b>At least 05 experiments from the following:</b> 1.Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method), 2.To measure the Magnetic susceptibility of Solids, 3.To determine the Coupling Coefficient of a Piezoelectric crystal, 4.To measure the Dielectric Constant of a dielectric Materials with frequency, 5.Plot the input and output characteristic of npn transistor in CE configuration, 6.Draw the characteristics of Zener diode and its use as a voltage regulator, 7.To determine wavelength of sodium light using Newton's Rings, 8.Plot the characteristics of UJT, 9.Plot the input and output characteristic of pnp transistor in CE configuration, 10.To determine the refractive index of a dielectric using SPR technique, 11.To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis, 12.To measure the resistivity of a semiconductor (Ge) with temperature (up to 150°C) by four-probe method and to determine its band gap, 13.To determine the Hall coefficient of a semiconductor sample.	30
	<b>TOTAL</b>	90

#### Reading List :

1. Kittel Charles (2004). *Introduction to Solid State Physics*, 8<sup>th</sup> Edn., Wiley India Pvt. Ltd.
2. Srivastava J.P. (2006). *Elements of Solid State Physics*, 2<sup>nd</sup> Edn., Prentice-Hall of India.
3. Azaroff, Leonid V. (2004). *Introduction to Solids*, Tata Mc-Graw Hill.
4. Ashcroft N.W. and Mermin N.D. (1976). *Solid State Physics*, Cengage Learning.
5. Ibach H. and Luth H. (2009). *Solid-state Physics*, Springer.
6. John Rita (2014). *Solid State Physics*, McGraw Hill
7. Wahab M.A. ( 2011). *Solid State Physics*, Narosa Publications.
8. Flint B.L. and Worsnop H.T. (1971). *Advanced Practical Physics for students*, Asia Publishing House.
9. Prakash I. & Ramakrishna (2011). *A Text Book of Practical Physics*, 11th Ed., Kitab Mahal.
10. Srivastava J.P. (2006), *Elements of Solid State Physics*, 2<sup>nd</sup> Ed., Prentice-Hall of India.
11. S.O.Pillai , *Solid State Physics*, New Age International Publication.
12. R.L.Singhal (2009), *Solid State Physics*, Kedar Ram Nath Publication.

*Adhva*  
16-8-21

*Ray*  
16/8/21  
39

*B*  
16/8/2021  
16/8/2021

*Anurita*  
16/08/21  
16/8/21

*R. Sammi*  
16/8/21

*SPd*

## SEMESTER VI: Core Course

### **PHYCC614: Statistical Mechanics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the terminologies used in Statistical Mechanics.

**CO2:** Employ conceptual understanding to make predictions, and then approach towards the problem mathematically.

**CO3:** Understand the differences between Classical and Quantum Statistics.

**CO4:** Study the theory of radiation and its implications.

<b>PHY CC614: Statistical Mechanics (Theory: 5 credits + Tutorial: 1credit)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
<b>1</b>	<b>Classical Statistics:</b> Microstates and Microstate, Phase Space, Elementary Concept of Ensemble, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs paradox, Sackur - Tetrode equation, Law of Equipartition of Energy (with proof).	22
<b>2</b>	<b>Theory of Radiation:</b> Properties of Thermal Radiation. Blackbody Radiation. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Wien's Displacement law. Wien's Distribution Law. Rayleigh-Jean's Law. Planck's Quantum Postulates.	15
<b>3</b>	<b>Quantum Statistics :</b> <b>(a)Bose-Einstein Statistics:</b> B-E distribution law, Bose Einstein condensation, properties of liquid-He (qualitative description). <b>(b)Fermi-Dirac Statistics:</b> Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy.	28
<b>4</b>	<b>(a) Non equilibrium states:</b> Boltzmann transport equation, electrical conductivity and thermal conductivity, Isothermal Hall effect. <b>(b)Fluctuations:</b> Mean square deviations and Fluctuations in ensembles.	10
	<b>Tutorial</b>	15
	<b>TOTAL</b>	90

Adhva  
16-8-21

16/8/21  
40

16/8/21  
16/8/21

16/8/21  
16/8/21  
16/8/21  
16/8/21

### Reading List :

1. Pathria R.K., Heinemann Butterworth (1996). *Statistical Mechanics*, 2<sup>nd</sup> Ed., Oxford University Press.
2. Reif F. (2008). *Statistical Physics*, Berkeley Physics Course, Tata McGraw-Hill.
3. Sears Francis W. and Salinger Gerhard L. (1986). *Thermodynamics, Kinetic Theory and Statistical Thermodynamics*, Narosa.
4. Helrich Carl S. (2009). *Modern Thermodynamics with Statistical Mechanics*, Springer
5. Swendsen R.H. (2012). *An Introduction to Statistical Mechanics & Thermodynamics*, Oxford Univ. Press.
6. Gupta, Kumar And Sharma (2016). *Elements of Spectroscopy*, Pragati Edition.

Adhar  
16-8-21

Ram  
16/8/21  
41

Cell  
16/8/21

Uday  
16/9/2021

16/08/2021

Anurag  
16/08/21

Pooja  
16/08/21

Ad

Mr

Ram  
16-8-21



### SEMESTER-VI: Discipline Specific Elective (DSE) III

#### **PHYDSE603: Nuclear and Particle Physics**

**After completion of the course, the students will be able to:**

**CO1:** Develop insight into Nuclear Physics and its correlation with Particle Physics.

**CO2:** Understand the different nuclear models and understand the different fundamental forces in nature

**CO3:** Comprehend the study of the particles: quarks, baryons and leptons

**CO4:** Learn the study of radioactive decay and nuclear detections.

<b>PHY DSE603: Nuclear and Particle Physics ( Theory :5 credits + Tutorial: 1 credit )</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
<b>1</b>	<b>General Properties of Nuclei:</b> Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, magnetic moment, nuclear excited states.	10
<b>2</b>	<b>Nuclear Models:</b> Liquid drop model approach, semi empirical mass formula and significance of its various terms, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, Concept of nuclear force	20
<b>3</b>	<b>Radioactivity decay:</b> (a) Alpha decay: basics of $\alpha$ -decay processes, theory of $\alpha$ -emission (b) $\beta$ -decay. (c) Gamma decay. Soddy-Fajan's theory of Radioactive decay, Law of Radioactive Successive disintegration. <b>Detector for Nuclear Radiations:</b> Gas detectors: GM Counter. Basic principle of Scintillation Detectors.	25
<b>4</b>	<b>Particle physics:</b> Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum numbers.	20
	<b>Tutorial</b>	15
	<b>TOTAL</b>	90

Ashu  
16-8-21

42  
16/8/21

16/8/21  
16/8/21

16/8/21

16/8/21

16/8/21

16-8-21

**Reading List :**

1. Krane Kenneth S. (2008). *Introductory nuclear Physics*, Wiley India Pvt. Ltd.
2. Cohen Bernard L. (1998). *Concepts of nuclear physics*, Tata Mcgraw Hill
3. Dunlap R.A.. (2004). *Introduction to the physics of nuclei & particles*, Thomson Asia
4. Perkins D.H. *Introduction to High Energy Physics*, Cambridge Univ. Press
5. Griffith D. *Introduction to Elementary Particles*, John Wiley & Sons
6. Knoll G.F. (2000). *Radiation detection and measurement*, John Wiley & Sons

Adm-  
16/8/21

16/8/21  
43

16/8/21

16/8/21

Amite  
16/08/21

16/8/21

16/8/21  
SPD

16/8/21

### SEMESTER-VI: Discipline Specific Elective (DSE) IV:

#### **PHYDSE 604: Project / Dissertation /Internship**

**After completion of the course, the students will be able to:**

**CO1:** Apply experimental approach of various scientific phenomena.

**CO2:** Develop an insight into different research areas of physics and their applications.

**CO3:** Develop knowledge on Augmenting reading habit of research/review articles

**CO4:** Skilled knowledge on specific project work

PHY DSE604: Project / Dissertation/Internship ( 6 Credits)		
Unit	Topics to be covered	No. of hours
1	<b>Optional Dissertation or project work in place of one Discipline Specific Elective paper (6 credits) in 6<sup>th</sup> Semester.</b>  <b>Dissertation/Project:</b> An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.  <b>Project work/Dissertation</b> is considered as a special course involving application of knowledge involving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper	
	<b>TOTAL</b>	90

Adm-  
16-8-21

16/8/21

16/8/21

16/8/21

16/8/21

16/8/21

16/8/21

16/8/21

### Generic Elective Papers (GE) (6 credits each)

**Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

#### SEMESTER I: Generic Elective

##### **PHYGE 101: Mechanics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the terminologies and basic concepts used in Mechanics.

**CO2:** Differentiate between the inertial and non-inertial frames and their respective equations of motion.

**CO3:** Analyse the Centre of mass and Laboratory frames of reference and their use in explaining elastic and inelastic collisions.

**CO4:** Understand the Planetary motions and motions of satellites using the principles of gravitation and Kepler's laws. Get an idea of postulates of special theory of relativity and their implications.

<b>PHY GE101 : Mechanics (Practical)</b> <b>(Theory :4 credits + Practical: 2 credits )</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Fundamentals of Dynamics:</b> Reference frames. Inertial frames, Review of Newton's Laws of Motion. Principle of conservation of momentum.	8
2	<b>Collisions:</b> Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. Elasticity: Hooks law-stress strain diagram.	10
3	(a) <b>Gravitation and Central force Motion :</b> Inertial & gravitational mass. Motion of a particle under a central force field. Kepler's Laws. (b) <b>Non-Inertial Systems:</b> Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications.	22







## Semester II: Generic Elective

### **PHYGE202: Electricity and Magnetism**

**After completion of the course, the students will be able to:**

- CO1:** Enhance the knowledge of electricity and its relation with magnetic effects, have a clear understanding of Gauss's law in Electrostatics and its applications, Laplace' and Poisson's equations.
- CO2:** Understand the origin of magnetic field and study the magnetic properties of materials and their implications.
- CO3:** Analyse the concept of mutual inductance and Faraday's law of electromagnetic induction.
- CO4:** Understand the relation between R, L and C components and Transformer and its applications in real world.

<b>PHY GE 202 : ELECTRICITY AND MAGNETISM</b> <b>(Theory :5 credits + Tutorial: 1 credit )</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>(a) Electric Field and Electric Potential :</b> Electric field: Electric field lines. Gauss' Law with applications . Electrostatic Potential. Laplace's and Poisson equations. <b>(b) Dielectric Properties of Matter:</b> Electric Field in matter. Polarization, Polarizability and susceptibility of dielectrics, Displacement vector D. Relations between E, P and D.	20
2	<b>(a) Magnetic Field:</b> Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications. <b>(b) Magnetic Properties of Matter:</b> Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. B-H curve and hysteresis. Ferromagnetism	27

*Adna*  
16/8/21

*16/8/21*

47

*16/8/21*

*16/08/2021*

*16/8/21*

*16/08/21*

*16/8/21*

3	<b>Electromagnetic Induction:</b> Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Introduction to Maxwell's Equations.	8
4	<b>Electrical Circuits:</b> AC Circuits: Kirchhoff's laws for AC circuits. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width Transformer, Losses in transformer.	20
	Tutorial	15
	<b>TOTAL</b>	90

#### Reading List :

1. Mahajan S. and Choudhury (2012). *Electricity, Magnetism & Electromagnetic Theory*, Tata McGraw.
2. Purcell Edward M. (1986). *Electricity and Magnetism*, McGraw-Hill Education.
3. Griffiths D.J. (1998). *Introduction to Electrodynamics*, 3rd Edn., Benjamin Cummings.
4. Feynman R.P., Leighton R.B., Sands M. (2008). *Feynman Lectures*, Vol.2, Pearson Education.
5. Sadiku M.N.O. (2010). *Elements of Electromagnetics*, Oxford University Press.
6. Fewkes J.H. & Yarwood J. (1991). *Electricity and Magnetism*, Vol. I, Oxford Univ. Press.
7. Tewary R. K. *Electricity and Magnetism*.

Abhishek  
16-8-21

16/8/21

16/08/21

16/08/21

16/8/21

16-8-21

SPH

### Semester III: Generic Elective

#### **PHYGE303: Thermal Physics and Electronics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the Laws of thermodynamics, which form the basis of Thermal Physics.

**CO2:** Analyse the study of Carnot's cycle and Carnot's theorem and get concepts of entropy and its effect in systems.

**CO3:** Understand the Maxwell's equations using the concept of thermodynamic potentials.

**CO4:** Study the van der Waals equation of state, number systems, Boolean algebra, logic gates and their inter-conversions

<b>PHYGE 303 : Thermal Physics and Electronics(Practical)</b> <b>(Theory :4 credits + Practical: 2 credits )</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Laws of Thermodynamics :</b> Zeroth Law of Thermodynamics & Concept of Temperature, First Law of Thermodynamics, Work Done during Isothermal and Adiabatic Processes. Entropy, Second Law of Thermodynamics in terms of Entropy. Temperature-Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics (Definition)	20
2	<b>Thermodynamic Potentials:</b> Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, and Applications, Clausius Clapeyron Equation, Value of $C_p-C_v$ , Tds Equations.	14
3	<b>Kinetic Theory of Gases:</b> Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas Degrees of Freedom. Law of Equipartition of Energy Specific heats of Gases.	16
4	<b>Logic gates :</b> AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR Gates.	10

*Adina*  
16-8-21

*16/8/21*

*16/8/21*

*16/08/2021*  
*16/8/21*

*Amrita*  
16/08/21

*16/8/21*  
874

*16-8-21*





## Semester IV: Generic Elective

### **PHYGE404: Modern Physics**

**After completion of the course, the students will be able to:**

**CO1:** Understand the Fundamentals of early quantum theory.

**CO2:** Study of nucleus and its properties.

**CO3:** Understanding of laws of Radioactivity and its numerical implications

**CO4:** Understand the theory behind laser and learn about the different types of Lasers.

<b>PHY GE404: Modern Physics</b> <b>(Theory : 5 credits + Tutorial: 1 credit)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Planck's Quantum, Blackbody radiation, Photoelectric effect, Compton's scattering, De-Broglie's wavelength, Davisson-Germer experiment, Wave description of particles by wave packets. Heisenberg Uncertainty principle.	20
2	(a) <b>Nucleus and its Properties</b> : Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Binding Energy. Liquid Drop model. (b) <b>Radioactivity</b> : stability of the nucleus; Rutherford-Soddy theory of radioactive decay; Mean life and half-life; Alpha decay; Beta decay Gamma ray emission, Artificial Radioactivity.	20
3	(a) <b>Semiconductor Diodes</b> : P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. Barrier Formation in PN Junction Diode. Current Flow Mechanism in Forward and Reverse Biased Diode. Zener Diode and Voltage Regulation. (b) <b>Bipolar Junction transistors</b> : n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains $\alpha$ and $\beta$ . Relations between $\alpha$ and $\beta$ .	20
4	<b>Lasers</b> : Einstein's A & B coefficients, Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. He-Ne Laser.	15
	Tutorial	15
	<b>TOTAL</b>	90

Adhra  
16-8-21

Rohit Singh  
16/08/2021

Pankaj  
16/8/21

Anurag  
16/08/2021  
R. Samir  
16.8.21



### Reading List :

1. Beiser Arthur (2002). *Concepts of Modern Physics*, McGraw-Hill.
2. Meyer Rich, Kennard, Coop, (2002). *Introduction to Modern Physics*, Tata McGraw Hill
3. Griffith David J. (2005). *Introduction to Quantum Mechanics*, Pearson Education
4. Jewett and Serway (2010). *Physics for scientists and Engineers with Modern Physics*, Cengage Learning.
5. Kaur G. and Pickrell G.R. (2014). *Modern Physics*, McGraw Hill
6. Gautreau R. and Savin W. *Theory and Problems of Modern Physics, Schaum's outline*, 2<sup>nd</sup> Edn, Tata McGraw-Hill Publishing Co. Ltd.
7. Wichman E.H. (1971). *Quantum Physics, Berkeley Physics*, Vol. 4, Tata McGraw-Hill Co.
8. Moore T.A. (2003). *Six Ideas that Shaped Physics: Particle Behave like Waves*, McGraw Hill.

Adhvi  
16-8-21

KP  
16/8/21

QD  
16/8/21

Spl  
16/8/21

Rs  
16/08/2021

Ananta  
16/08/21

Pune  
16/8/21

ASaurin  
16.8.21

## Ability Enhancement Compulsory Courses (AECC)

“AECC” courses are the courses based upon the content that leads to Knowledge enhancement; i. English/Hindi communication, ii. Environmental Science

### Semester – I

By the end of the course, the students should be able to:

- Communicate effectively using the techniques in the area of spoken as well as written communication.
- Hone their LSRW skills within their communication.
- Design and answer job interview questions.
- Demonstrate the ability to craft professional messages that are clear yet courteous.

<b>ENG AEC101 : English Communication</b> <b>PWC (Theory :2 credits)</b>		
<b>Units</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<u>Communication</u> (a) Definition of Communication (b) Stages of Communication (c) Barriers of Communication (d) Verbal and Non-verbal Communication (e) Skills of Communication – Listening, Reading, Writing, Speaking	5
2	<u>Listening Skill</u> (a) Meaning and Importance of Listening (b) Principles of Good listening	5
3	<u>Writing Skills</u> (a) Notice, Agenda, Minutes of the meeting (b) Report writing, Circulars (c) Writing Resume (d) Building vocabulary	15
4	<u>Speaking Skill</u> (a) Interview (b) Meeting (c) Situational Conversation (d) Group Discussion	5
<b>TOTAL</b>		<b>30</b>

Adm.  
16-8-21

16/8/21

16/8/21

16/8/21  
16/8/21

16/8/21  
16/8/21  
16/8/21

### Reading List:

1. Scot, O.; *Contemporary Business Communication*. Biztantra, New Delhi.
2. Lesikar, R.V. & Flatley, M.E.; *Basic Business Communication Skills for Empowering the Internet Generation*, Tata McGraw Hill Publishing Company Ltd. New Delhi.
3. Ludlow, R. & Panton, F.; *The Essence of Effective Communications*, Prentice Hall Of India Pvt. Ltd., New Delhi.
4. R. C. Bhatia, *Business Communication*, Ane Books Pvt Ltd, New Delhi.

Ashu  
16-8-21

16/8/21

16/8/21

16/08/2021

16/8/21

16/08/21

16/8/21

16-8-21

**EVS AEC202: Environmental Science ( 2 Credits)****PWC**

After completion of the course, the student will

- Understand multidisciplinary nature of environmental studies.
- Understand the concept and types of natural resources and environmental pollution.
- Evaluate the anomalies created due to haphazard population growth and its impact on environment.
- Understand about the organizations, conventions and legislations working on mitigation of environmental issues.

Unit	Topics to be covered	No. of hours
1	(a) <b>Multidisciplinary Nature of Environmental Studies:</b> Definition, Scope and Importance. (b) <b>Concept of Ecosystem:</b> - Components, Elementary Idea of Major Ecosystem:	07
2	(a) <b>Natural Resources : Land, Water, Forest And Mineral Resources :</b> Introduction; Earth's Resources and Man; Renewable and Non-Renewable Resources ; Natural Resources and Associated Problems ; Non-Renewable Resources ; Renewable Resources ; Non-Renewable Energy; Renewable Energy, Conservation of Natural Resources (b) <b>Biodiversity and its conservation: Hotspots and threats to Biodiversity :</b> Biodiversity ; Definition ;Keystone Species ; Conservation of Biodiversity ; Methods For The Conservation of Wildlife ; Hot Spots ; Types of Biodiversity ; Genetic, Species and Ecosystem Diversity, Threats to Biodiversity ; Endangered And Endemic Species ; Conservation of Biodiversity: In Situ And Ex-Situ ; Wildlife Sanctuaries and National Parks of India ; The Need for An Integrated Protected Area System (IPAS) ;; Beej Bachao Andolan ; List of Biosphere Reserves in India ; Tiger Reserves in India.	10

Abhinav  
16-8-21

16/8/21

16/8/21

55

16/08/2021

16/8/2021

16/08/21

16-8-21

3	<b>Environmental Pollution:</b> <b>(a) Causes, Effects, and Control Measures ;</b> Types and sources of Pollution. <b>(i) Air Pollution ;</b> Sources of air pollution and its impact on human health. <b>(ii) Water Pollution and contamination:</b> Introduction, Types and sources; Classification of Water Pollutants. Impact on human health <b>(iii) Soil Pollution :</b> Introduction: Contaminants and Degradation; Impact on human health.  <b>(iv) Noise Pollution:</b> Effects of Noise Pollution on Physical Health; Permitted Noise Levels; Noise-Control Techniques. Impact on human health. <b>(b) Public Awareness about</b> Greenhouse Effects; Acid Rain; Effects; Ozone Layer Depletion, Ganga Action Plan (GAP); Chipko Movement; Chernobyl disaster; Bhopal Gas Tragedy. <b>(c) Environment and Human Health:</b> Outcome of Unhygienic Environmental Conditions	05
4	<b>Human Population and Environment and Important Organizations:</b> <b>(a) Population Growth, Variation Among Nations :</b> Global Population Growth ; Population Explosion – Family Welfare Program ; Urban Poverty and The Environment ; Environment and Human Health ; Environmental Health ; Examples of Linkages ; Definition of Health Impact Assessment (HIA) by WHO ; Climate and Health ; Infectious Diseases; Water borne and water related diseases, Mitigation Strategies to control adverse health impact, Role of Information Technology in Environment and Human Health. <b>(b) Important Organizations :</b> IUCN ; WWF ; BNHS ; PETA; Important Dates and Years; Some Important Environmental Conventions ; Atmospheric conventions ; Biodiversity conventions ; Land conventions ; Hazardous wastes ; Some important Acts and Notifications in India ; Environment Action Programme – India (EAP) ; Environment Protection Act ; Penalties ; Air (Prevention and Control of Pollution) Act 1981 ; Penalties ; Water (Prevention and control of Pollution) Act ; Penalties ; Wildlife Protection Act ; Penalties ; Forest Conservation Act ; Penalties ; Issues involved in enforcement of environmental legislation.	08
	<b>TOTAL</b>	<b>30</b>



### Reading List :

1. Chandna R. C., 2002: *Environmental Geography*, Kalyani Publications, Ludhiana.
2. UNEP, 2007: *Global Environment Outlook: GEO4: Environment for Development*, United Nations Environment Programme
3. Odum, E. P. et al, 2005: *Fundamentals of Ecology*, Ceneage Learning India.
4. Singh S., 1997: *Environmental Geography*, PrayagPustak Bhawan. Allahabad.
5. Baskar Sushmita and Baskar R. 2007 :*Environmental studies for Undergraduate Courses*, Unicorn Books, Bangalore.

Adhwa  
16-8-21

16/8/21

16/8/21

16/08/2021

Amrita  
16/08/21

16/8/21

16-8-21

## Skill Enhancement Course (SEC) (2 courses)

### SEMESTER III

Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

**After the completion of the course, the student will be able to:**

**CO1:** Develop Inter-religious harmony & better understanding of other religions.

**CO2:** Interpret the different religions of the world.

**CO3:** Identify the common elements that bind different religions together.

**CO4:** Acquaint with the salient features of different religions.

#### **PHILSEC301: Inter-Religious Studies (Value Based) (02credits)**

Units	Topics to be covered	No. of hours
1	Nature and Need of Inter-Religious study, Scope of Comparative Religion.	05
2	Salient Features of Hinduism, Jainism and Buddhism, Salient Features of Christianity, Islam and Sikhism.	10
3	Similarities and Differences among Religions, Conflicting Truth claims of different religions and inter-religious Harmony.	10
4	Religious Tolerance, Secularism.	05
	TOTAL	30

#### **Reading List:**

1. Chaudhary, C. Neeraj(1979)-"Hinduism",B.I.Publication,New Delhi.
2. Devraj,N.K., (1917)-"Hinduism and Christianity"Asian Publishing House.
3. Gordh, George, -"Christian Faith and its Cultural Exopcrssion", Printed in USA.
4. Hick, John, - "Philosophy of Religion", Prentice Hall of India.
5. Hopfe, M.Lewis (1983)- "Religion of the World", Macmillan Publishing Co. Inc, New York
6. Masih,Y. (1990)- "Comparitive study of Relgion",Motilal Banarasidass.
7. Sethi,S. Arijit, Pummer, Reinhard, (1979)-"Comparitive Religion", Vikas Publishing House pvt. ltd, Delhi.
8. Singh, B.N., (1994)-"Vishwa Dharma Darshan ki Samasyain", Ratna Printing Works.
9. Tiwari, Nath Kedar,(1983)-"Comparative Religion", Motilal Banarasidass.
10. Ward, CHS (1998) – 'Early Buddhism", Caxton Publication, Delhi.

Ashra  
16-8-21

16/08/2021

16/8/21

Anita  
16/08/2021  
R. Sami  
16-8-21  
W

## SEMESTER-IV

### PHYSEC 402 - Physics Workshop Skill

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

**CO1:** Solve problems and also think methodically, independently and draw a logical conclusion.

**CO2:** Use modern techniques, decent equipments and scientific softwares. Develop the following experimental tools: Numerically model simple physical systems using Euler's method, curve fitting, and error analysis.

**CO3:** Describe the methodology of science and the relationship between observation and theory & learn to minimize contributing variables and recognize the limitations of equipment.

**CO4:** Develop the proficiency in the acquisition of data using a variety of laboratory instruments and in the analysis and interpretation of such data.

PWS SEC 402 : Physics Workshop Skill (Theory : 1credits + Practical: 1 credits )		
Unit	Topics to be covered	No. of hours
1	<b>Introduction:</b> Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc.	4
2	<b>Electrical and Electronic Skill:</b> Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply.	3
3	<b>Basic Electricity Principles:</b> Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations.	5

Adh  
16-8-21

16/8/21  
16/8/21  
59

16/08/2024  
16/8/24

Amite  
16/08/21  
16/8/21  
spd

16/8/21

4	<b>Generators and Transformers:</b> DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.	3
	<b>Practical (Hands on Training)</b>	15
	<b>TOTAL</b>	30

**Reading List :**

1. Theraja B. L. *A text book in Electrical Technology*, S. Chand and Company.
2. Say M.G. *Performance and design of AC machines*, ELBS Edn.
3. John K.C. (2010). *Mechanical workshop practice*, PHI Learning Pvt. Ltd.
4. Black Bruce J. (2005). *Workshop Processes, Practices and Materials*, 3<sup>rd</sup> Edn., Editor Newnes [ISBN: 0750660732].
5. Smyth Lawrence, Hennessy Liam. *New Engineering Technology*, The Educational Company of Ireland [ISBN: 0861674480]

Adha.  
16-8-21

16/8/21

16/8/21

16/8/21

16/8/21

16/8/21

16/8/21

16/8/21