SCHEME OF EXAMINATION

AND

COURSE OF STUDY

Syllabus for
Four Year Undergraduate Programme (FYUGP)
B.Sc. Hons/B.Sc. Hons with Research
in
PHYSICS
2024-2025

Department of Physics
Gurukula Kangri (Deemed to be University)
Haridwar-249 404 (Uttarakhand)

Head
Department of Physics
Gurukula Kangri (Deemed to be University)

Gurukula Kangri (Deemed to be University), Haridwar

Four Year Undergraduate Programme B.Sc. Hons/ B.Sc. Hons with Research in Physics

Program Structure (w.e.f. 2024-2025)

Year	Semester	Course	Title of the Course	L	T	P	Total Credits
Year 01	1st Sem.	**BPH24 - MJ101**	Mechanics and Properties of Matter	3	-	-	3
		BPH24 - MJ151	Lab Course –I (Mechanics and Properties of Matter)	-	-	1	1
		M- 1	Vocational -1 **(as part of the minor)***	-	-	-	4
		BPH24 – MD101	Evolution of Science (for disciplines other than Physics)	3	-	-	3
		AEC - 1	English	-	-	-	4
		VAC - 1	Digital and Technological Solutions	-	-	-	2
		VAC - 2	Professional Ethics and Gender Studies	-	-	-	2
		BPH24 - SE101/ BPH24 - SE102	Electrical circuits and Network Skills / Maintenance and Repairing of Electrical Appliances	1	-	-	1
		BPH24 - SE151/ BPH24 - SE152	Lab Course – Electrical circuits and Network Skills / Lab Course – Maintenance and Repairing of ElectricalAppliances	-	-	2	2
			Total of Semester 1	-		-	**22**
	2nd Sem.	**BPH24 – MJ201**	Electricity and Magnetism	3	-	-	3
		BPH24 – MJ251	Lab Course -II (Electricity and Magnetism)	-	-	1	1
		M- 2	Vocational -2 **(as part of the minor)**				4
		BPH24 – MD102	Materials Today (for disciplines other than Physics)	3	-	-	3
		AEC - 2	MIL (Hindi/Sanskrit)				4
		VAC - 3	Understanding India				2
		VAC - 4	Environmental Science				2
		BPH24 – SE201/ BPH24 – SE202	Basic Instrumentation Skills/ Computational Physics Skills	1	-	-	3
		BPH24 – SE251/ BPH24 – SE252	Lab Course – Basic Instrumentation Skills / Lab Course – Computational Physics Skills	-	-	2	
			Total of Semester 2				**22**
	Grand Total (Semester 1 and 2)						**44**

Students on exit shall be awarded Undergraduate Certificate (in Physics) after securing the requisite 44 credits in Sem 1 and 2 provided they secure 4 credits in work based vocational courses (as part of the minor) offered during summer term or internship/ apprenticeship in addition to 6 credits from skill based courses earned during 1st and 2nd Semester

Note: Minimum one course of 2 credits per year or 6 credits (for 3 years UG) / 8 credits for 4 year UG Programme shall be opted by a student through SWAYAM platform.

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DEPARTMENT OF PHYSICS
Gurukula Kangri (Deemed to be University), Haridwar

B.Sc. Hons/ B.Sc. Hons with Research in Physics
(w.e.f. 2024-2025)

Graduate Attributes

Graduates in Physics are expected to possess a range of attributes that will enable them to succeed in their chosen careers. The NEP 2020 recognizes the importance of these attributes and aims to equip students with the necessary knowledge and skills to excel in their chosen careers. Some of such attributes connected to FYUGP are:

1. Disciplinary knowledge and skills: Graduates in Physics should possess a strong foundation in the concepts and principles of Physics, as well as the ability to apply this knowledge to solve complex problems.
2. Skilled communication: Physics graduates should be able to effectively communicate their ideas and findings through oral, written, and visual means to a diverse audience, including scientists, policymakers, and the general public.
3. Critical thinking and problem-solving capacity: Physics graduates should be able to analyze and evaluate information, identify and define problems, develop and implement solutions, and make evidence-based decisions.
4. Sense of inquiry: Physics graduates should have a curiosity-driven and self-directed approach to learning, as well as the ability to ask insightful questions and explore new areas of knowledge.
5. Team player/worker: Physics graduates should be able to collaborate effectively with others, including peers, colleagues, and interdisciplinary teams, to achieve common goals.
6. Project management skills: Physics graduates should have the ability to plan, organize, and

   manage projects, including research projects, from conception to completion.
7. Digital and ICT efficiency: Physics graduates should be proficient in the use of digital tools and information and communication technologies (ICT), including programming languages, simulation software, and data analysis tools.
8. Ethical awareness/reasoning: Physics graduates should have a strong ethical awareness and the ability to apply ethical reasoning in decision-making, including consideration of social, cultural, and environmental impacts.
9. National and international perspective: Physics graduates should be aware of the global and national issues related to science and technology, as well as their roles and responsibilities as global citizens.
10. Computational and problem-solving skills: Physics graduates should have strong computational skills and the ability to use computational tools and techniques for problem- solving and data analysis.

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Programme Learning Outcomes

The NEP 2020 has placed significant emphasis on outcome-based education, which highlights the importance of specific learning outcomes for each course. For the FYUGP in Physics, NEP 2020 has set forth a set of programme learning outcomes, which include:

Knowledge and Comprehension: Students will be able to demonstrate a thorough understanding of fundamental principles and concepts of physics, including classical mechanics, electromagnetism, thermodynamics, quantum mechanics, and statistical mechanics.

Analytical and Problem-Solving Abilities: Students will have the ability to apply their knowledge of physics to analyze and resolve problems in various settings, using appropriate mathematical tools, experimental methods, and computational techniques.

Research and Inquiry Skills: Students will possess the ability to participate in research and inquiry- based activities, such as creating and executing experiments, collecting and evaluating data, and communicating their findings in a clear and effective manner.

Communication and Presentation Skills: Students will be able to express their ideas and discoveries effectively through both written and oral presentations, utilizing suitable scientific language and tools.

Ethics and Values: Students will possess knowledge of the ethical and social implications of their work and demonstrate a dedication to the ethical and responsible conduct of research and practice.

Interdisciplinary and Multidisciplinary Learning: Students will be capable of combining their understanding and skills with other disciplines and participating in multidisciplinary research and innovation.

These programme learning outcomes have been formulated to ensure that students acquire a strong basis in physics while also developing a range of transferable skills and abilities that will equip them for a diverse range of professions and further studies. By implementing an outcome-based approach and emphasizing learner-centric pedagogies, students will be able to meet these objectives and satisfy the ever-changing job market's demands.
The NEP 2020 emphasizes the importance of outcome-based education, which focuses on specific learning outcomes for each course. The NEP 2020 also provides multiple exit options for students after completion of different durations of study. The program learning outcomes for each exit option are as follows:

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Certificate (after completing 1 year of study):

1. Demonstrate a basic understanding of fundamental concepts and principles related to the chosen field of study.
2. Develop a basic set of skills and competencies related to the chosen field of study.
3. Demonstrate an ability to apply the basic knowledge and skills acquired to real-world problems.

Diploma (after completing 2 years of study):

1. Demonstrate a deeper understanding of the fundamental concepts and principles related to the chosen field of study.
2. Develop a more advanced set of skills and competencies related to the chosen field of study.
3. Demonstrate an ability to apply the advanced knowledge and skills acquired to real-world problems.

Bachelor's Degree (after completing a 3-year programme):

1. Demonstrate a comprehensive understanding of the fundamental concepts and principles related to the chosen field of study.
2. Develop a wide range of skills and competencies related to the chosen field of study.
3. Demonstrate an ability to apply the knowledge and skills acquired to real-world problems in a creative and innovative manner.
4. Demonstrate an ability to engage in independent research and inquiry-based activities.
5. Develop effective communication and presentation skills.
6. Demonstrate an awareness of the ethical and social implications of their work and a commitment to ethical and responsible conduct.

4-Year Multidisciplinary Bachelor's Degree (the preferred option):

1. All the learning outcomes mentioned for the Bachelor's Degree (after completing a 3-year programme).
2. Develop a multidisciplinary perspective and an ability to integrate knowledge and skills from multiple disciplines.
3. Demonstrate an ability to engage in multidisciplinary research and innovation.
4. Develop leadership and teamwork skills.
5. Demonstrate an ability to adapt to the ever-changing demands of the job market and the society.

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I Year	BPH24-MJ101	Semester-I
Core	MECHANICS & PROPERTIES OF MATTER	

PO-1 : To understand the basic laws and explore the fundamental concepts of physics along with their significance to the various physical phenomena.

PO-2 : To carry out experiments to understand the laws and concepts of physics as well as to apply the theories learnt and the skills acquired to solve real time problems.

PO-3 : To acquire a wide range of problem solving skills, both analytical and technical and to apply them.

PO-4 : To enhance the student's academic abilities, personal qualities and transferable skills this will give them an opportunity to develop as responsible citizens.

PO-5 : To produce graduates who excel in the competencies and values required for leadership to serve a rapidly evolving global community.

PO-6 : Providing a hands-on learning experience such as in measuring the basic concepts in properties of matter, heat, optics, electricity and electronics

COURSE ARTICULATION MATRIX

MAPING OF COURSE OUTCOMES (COS) WITH PROGRAMME OUTCOMS (POS)

COS		POS					
		1	2	3	4	5	6
CO-1	Understand the Frames of Reference, Dynamics of a System of Particles	X					X
CO-2	Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.	X					
CO-3	Explain the conservation of energy, momentum, angular momentum and apply them to basic problems.		X	X			
CO-4	Apply Kepler's law to describe the motion of planets and satellite in circular orbit	X			X		
CO-5	Describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting in a merry-go-round experiences an outward pull.		X				X
CO-6	Describe special relativistic effects and their effects on the mass and energy of a moving object.		X				
CO-7	In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, Vernier calipers, Travelling microscope) student shall embark on verifying various principles learnt in theory.		X	X			X

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I Year		BPH24-MJ101		Semester-I	
Core		MECHANICS & PROPERTIES OF MATTER			
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
45	**2 Hrs**	**40**	**60**	**100**	**03**

Unit	Content	L	T	P	Hours
Unit 1:	**1.1:** Frames of Reference, Inertial Frames, Galilean Transformations, Galilean Invariance; Dynamics of a System of Particles, Centre of Mass, Principle of Conservation of Linear Momentum.	3	-	-	3
	1.2: The Work-Energy Theorem, Conservative and Non-conservative Forces, Conservation of Mechanical Energy, Work done by non-conservative forces, Force as gradient of potential energy, Energy Diagram, Stable and Unstable Equilibrium.	4	-	-	4
	1.3: Rotational Motion: Angular velocity and angular momentum. Moment of Inertia, Torque. Conservation of angular momentum. Moment of Inertia, calculation of M.I. for rod, disc, solid cylinder, spherical shell and solid sphere, M.I. of Flywheel, M.I. of an irregular body..	4	-	-	4
Unit 2:	**Gravitation:** Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Compound pendulum, Bar pendulum, Kater's pendulum, Bessel's theory of computed time.	8	-	-	8
Unit 3:	**Elasticity:** Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants-Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants-Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder-Determination of Rigidity modulus by static torsion- Torsional pendulum-Determination of Rigidity modulus - Y, η and σ by Searles method.	8	-	-	8

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Unit 4:	Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication, Rotating cylinder method, Stokes Law.	6	-	-	6
Unit 5:	Michelson-Morley Experiment and its outcome, Postulates of Special Theory of Relativity, Lorentz Transformations, Simultaneity and order of events, Lorentz contraction, Time dilation. Relativistic Transformation of Velocity, Frequency and Wave- number, Relativistic addition of Velocities, Variation of Mass with Velocity, Massless Particles, Mass-energy Equivalence.	12	-	-	12
	Total	**45**	-	-	**45**

(L= Lecture, T= Tutorial, P= Practical)

Reference Books

- University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison- Wesley
- Mechanics Berkeley Physics course,v.1:Charles Kittel, et. Al. 2007, Tata McGraw- Hill.
- Physics – Resnick, Halliday & Walker 9/e, 2010, WileyUniversity Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Suggested Reading

1 R. Resnick and D. Hilliday : Physics Vol-I
2 Berkeley Physics Course : Mechanics Vol-I
3 R.P. Feynman, R.B.Lightan and M.Sand : The Feynman Lectures in Physics
4 D.S. Mathur : Mechanics
5 D.S. Mathur : Elements of Properties of Matter
6 Murray Spiegel, Seymour Lipschutz, Dennis Spellman, "Schaum's Outline Series: Vector Analysis", McGraw Hill, 2017
7 J. C. Upadhaya: Mechanics, S. Chand

Suggested Online Link:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

This course can be opted as an elective by the students of following subjects: The course can be opted as an elective, which is open to all students.

(i) Course learning outcome:

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After going through the course, the student should be able to

- Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.
- Explain the conservation of energy, momentum, angular momentum and apply them to basic problems.
- Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.
- Apply Kepler's law to describe the motion of planets and satellite in circular orbit.
- Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.
- Describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting in a merry-go-round experiences an outward pull.
- Describe special relativistic effects and their effects on the mass and energy of a moving object.
- In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, vernier callipers, Travelling microscope) student shall embark on verifying various principles learnt in theory. Measuring 'g' using BarPendulum, Kater pendulum and measuring elastic constants of materials, viscous properties of liquids etc.

(ii) Broad contents of the course

- Laws of Motion
- Momentum and Energy
- Rotational Motion
- Gravitation
- Oscillations
- Elasticity
- Special Theory of Relativity

(iii) Skills to be learned

- Learn and to understand linear and rotational motion.
- Learn basics of Newtonian gravitation theory and central force problem.
- Learn basic ideas about mechanical oscillators.
- Learn elasticity and elastic constants of material and perform experiments to study them.
- Acquire basic knowledge of special theory of relativity.

I Year	BPH24-MJ151				Semester-I
Core	LAB COURSE-I: MECHANICS & PROPERTIES OF MATTER				
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
30	**2 Hrs**	**20**	**30**	**50**	**01**

LIST OF EXPERIMENTS

1. Measurements of length (or diameter) using vernier caliperse, screw gauge and travelling microscope.
2. To determine the Height of a Building/Object by Sextant.
3. To determine moment of inertia of an irregular body by inertia table
4. To determine the Moment of Inertia of a Flywheel.
5. To determine 'Y' by bending beam
6. To determine 'η' by torsional pendulum
7. To determine 'η' by statical method
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
10. To determine the Elastic Constants of a Wire by Searle's method.
11. To determine g by Bar Pendulum.
12. To determine g by Kater's Pendulum.
13. To determine g and velocity for a freely falling body using Digital Timing Technique.
14. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.
15. To determine the Coefficient of Viscosity of water by Poiseuille's method.

NOTE:

1. *In practical examination the student shall be required to perform **ONE** experiment.*
2. *A teacher shall be assigned 20 students for daily practical work in laboratory.*
3. *No batch for practical class shall consist of more than 20 students.*
4. *The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.*
5. *Addition/deletion in the above list of* **some experiments of similar nature** *may be made in accordance with the facilities available with the approval of H.O.D.*

Reference Books

- Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

Suggested Readings:

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962.
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015.
3. Indu Prakash: Practical Physics
4. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014.

Suggestive Digital Platforms / Web Links:

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74

Digital Platforms /Web Links of other virtual labs may be suggested

Head

I Year	BPH24-MJ201	Semester-II
Core	ELECTRICITY AND MAGNETISM	

PROGRAMME OUTCOMES (POS)

PO-1 : To understand the basic laws and explore the fundamental concepts of physics along with their significance to the various physical phenomena.

PO-2 : To carry out experiments to understand the laws and concepts of physics as well as to apply the theories learnt and the skills acquired to solve real time problems.

PO-3 : To acquire a wide range of problem solving skills, both analytical and technical and to apply them.

PO-4 : To enhance the student's academic abilities, personal qualities and transferable skills this will give them an opportunity to develop as responsible citizens.

PO-5 : To produce graduates who excel in the competencies and values required for leadership to serve a rapidly evolving global community.

PO-6 : Providing a hands-on learning experience such as in measuring the basic concepts in properties of matter, heat, optics, electricity and electronics

COURSE ARTICULATION MATRIX
MAPING OF COURSE OUTCOMES (COS) WITH PROGRAMME OUTCOMS (POS)

Course Outcomes (Cos)		POS					
		1	2	3	4	5	6
CO-1:	Demonstrate Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.	X					
CO-2:	Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.		X				
CO-3:	Apply Gauss's law of electrostatics to solve a variety of problems.	X					
CO-4:	Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential.	X		X			
CO-5:	Demonstrate a working understanding of capacitors.				X		
CO-6:	Describe the magnetic field produced by magnetic dipoles and electric currents.	X					
CO-7:	Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.		X				
CO-8:	Describe how magnetism is produced and list examples where its effects are observed.					X	
CO-9:	Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.	X					
CO-10:	Apply various network theorems such as Superposition Theorem, Thevenin Theorem, Norton Theorem, Reciprocity Theorem, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.			X			
CO-11:	In the laboratory course the student will get an opportunity to verify all the above mentioned theorems elaborated above, using simple electric circuits.				X		

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course.

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I Year	BPH24-MJ201				Semester-II
	ELECTRICITY AND MAGNETISM				
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
45	**2 Hrs**	**40**	**60**	**100**	**03**

Unit	Content	L	T	P	Hours
Unit 1:	**Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.	12	-	-	12
Unit 2:	**Current Electricity:** Electric current and current density, Kirchhoff's laws and their application to Kelvin's and Mance's method. Kelvin double bridge, Callender and Griffith bridge.	6	-	-	6
Unit 3:	**Magnetism:** Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.	7	-	-	7
Unit 4:	**Magnetic properties of materials:** Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials. Hysteresis cycle, Ballistic method for drawing B-H curve (Anchor ring method).	8	-	-	8
Unit 5:	**Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. Search coil method of measuring strong magnetic field, Rayleigh method to determine the self inductance. Charging & discharging of a condenser throgh a resistance, Growth & decay of currents. **Alternating Currents:** Analysis of a.c. circuits and their phase diagrams, Series and parallel resonant a.c. circuits, Q-factor, Power in a.c. circuit, Transformer.	12	-	-	12
	Total	**30**	-	-	**45**

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Reference Books

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..
- Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

Suggested Reading

1. Edward M. Purcell : Electricity and Magnetism
2. J.H. Fewkes & J.Yarwood : Electricity & Magnetism, Vol. I
3. D C Tayal : Electricity and Magnetism
4. Ronald Lane Reese : University Physics
5. D.J.Griffiths : Introduction to Electrodynamics, 3rd Edn.
6. B.L.Flint & H.T.Worsnop : Advanced Practical Physics for Students
7. M. Nelson and J. M. Ogborn : Advanced level Physics Practicals, 4th Ed
8. I.Prakash & Ramakrishna : A Text Book of Practical Physics, 11th Ed
9. S.Panigrahi & B.Mallick : Engineering Practical Physics

Suggested Online Link:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

(i) Course learning outcome:

After going through the course, the student should be able to

- Demonstrate Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
- Apply Gauss's law of electrostatics to solve a variety of problems.
- Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential.
- Demonstrate a working understanding of capacitors.
- Describe the magnetic field produced by magnetic dipoles and electric currents.
- Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
- Describe how magnetism is produced and list examples where its effects are observed.
- Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.
- Apply various network theorems such as Superposition Theorem, Thevenin Theorem, Norton Theorem, Reciprocity Theorem, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.
- In the laboratory course the student will get an opportunity to verify all the above mentioned theorems elaborated above, using simple electric circuits.

(ii) Broad contents of the course:

- Electrostatistics
- Magnetism
- Electromagnetic Induction

(iii) Skills to be learned

- This course will help in understanding basic concepts of electricity and magnetism and their applications.
- Basic course in electrostatics will equips the student with required prerequisites to understand electrodynamics phenomena.

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I Year	BPH24-MJ251				Semester-II
	LAB COURSE-II : ELECTRICITY & MAGNETISM				
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
30	**2 Hrs**	**20**	**30**	**50**	**01**

LIST OF EXPERIMENTS

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measurement of charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine a high resistance by Leakage Method
   (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
   (v) To study C_1/C_2 by ballistic galvanometer
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid.
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor.
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorem.
10. To verify the Superposition, and Maximum Power Transfer Theorem.
11. To study variation of magnetic field along the axis of a circular coil.
12. To compare two resistances (R_1/R_2) by potentiometer.
13. Calibration of ammeter by potentiometer.
14. Calibration of voltmeter by potentiometer.
15. To determine resistance of galvanometer by Kelvin's method.
16. To determine internal resistance of a cell by Mance's method.
17. To determine internal resistance of a cell by potentiometer.
18. Conversion of galvanometer into ammeter of a given range.
19. Conversion of galvanometer into voltmeter of a given range.
20. To determine the resistance per unit length of a C.F. bridge wire and to prepare one ohm coil to determine the specific resistance of a given wire

NOTE:

1. *In practical examination the student shall be required to perform **ONE** experiments.*
2. *A teacher shall be assigned 20 students for daily practical work in laboratory.*
3. *No batch for practical class shall consist of more than 20 students.*
4. *The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.*
5. *Addition/deletion in the above list of* **some experiments of similar nature** *may be made in accordance with the facilities available with the approval of H.O.D.*

Reference Books

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
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- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

Head

I Year	BPH24-MD101				Semester-I
Multidisciplinary	EVOLUTION OF SCIENCE				Generic Elective
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
45	2 Hrs	40	60	100	03

Course objectives:

1. To provide students with an understanding of the historical development of scientific knowledge, including key figures and their contributions.
2. To examine the interdisciplinary nature of science and its impact on various fields and industries.
3. To explore the ethical and social implications of scientific advancements, and to promote critical thinking about their consequences.
4. To foster an appreciation for the scientific method and the role of experimentation and observation in advancing scientific knowledge.

Overall, the course aims to provide students with a comprehensive understanding of the evolution of science, its impact on society, and the role that science will play in shaping the future.

Unit	Content	L	T	P	Hours
Unit 1:	Concept of Vedas: Introduction and facts of Vedic Science, Rigveda: Concept and its education, Knowledge of ancient Indian culture. Yajurveda: Its concept and method of living Dharma, Arth, Kaam and Moksha. Samaveda: the rituals of healing Gyan yoga, Bhakti yoga and Karma yoga AtharvaVeda: Knowledge storehouse of atharvāṇas, The Procedures for everyday life. Indian Culture Vs Western culture Moral judgment and moral action Approaches of moral development: Social theory approach and cognitive development approach	13	0	0	13
Unit 2:	Invention of wheel and beginning of science, Science for progress.Science in ancient world Medieval science,Renaissance and industrial revolution: Rise of western science Contributions of Aristotle, Galileo Galilei, Robert Hooke, Darwin, Kepler etc. Contributions of Sir Isaac Newton: Laws of motion, Universal law of Gravitation.	12	0	0	12
Unit 3:	Nineteenth century and beginning of modern science: Developments of electricity and magnetism, Maxwell's contributions, Contributions of Thomas A. Addison.	10	0	0	10
Unit 4:	Einstein and Special Theory of Relativity: The paradigm shift. Quantum Theory, Quantum generation, The Second creation: development of concept of field quantisation, ups and downs. Nuclear era: space science and technology. Electronic age and birth of computers.Laser and optical evolution.Contemporary science and India's contribution.	10	0	0	10
	Total	45	-	-	**45**

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Learning outcomes: At the completion of this course, a student will be able to

1. At the completion of course the students shall have basic knowledge of vedic science and its value of understanding difficult and important issues of human life with cool mind.
2. Students shall be able to solve out different life hacks and problems with chants and scholarly works in this area of great significance.
3. The students shall have capacity of communication with others on human values and shall be able to make presentations before the wider audience to put their views forward.
4. The students having studied vedic science can seek jobs in the vedic study centres, math, academia, international organizations, foreign universities, and institutions and can carry out practice of international institutional and vedic science matters.
5. Attain a comprehensive comprehension of the development of science from antiquity to the present era.
6. Comprehend the noteworthy scientific breakthroughs, inventions, and contributions that have paved the way for modern science.
7. Assess the influence of science on human civilization and how scientific progress has positively impacted societal progress.
8. Cultivate a critical mindset to evaluate the significance of scientific contributions and their effect on society.
9. Develop an admiration for the interdisciplinary character of science and its interconnection with other academic disciplines.

Suggested Readings:

1.RIGVEDA: The Oldest Divine Book (Hardcover, Ed. by F. Max Muller, Translated by R.T.H. Griffith)
2.The Rig Veda by Anonymous Translated by Ralph T H Griffith, Digireads.com
3.Yajurveda (Hardcover, Hindi, RUPESH THAKUR)
4.Samaveda Samhita
5. Sanatan Sanskriti Shree Vedas by Satyaveer Shastri (All four Vedas in Hindi)
6. Bhatiya Dhaval, Vedic Mathematics Made Easy, Jaico Publishing House
7. Unicorn Books 2015 or Later Edition The Scientific Revolution by Steven Shapin.
8. A history of physics in its elementary branches, including the evolution of physical laboratories by F. Cajori.
9. A brief history of Physics by P. F. Kisak.

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I Year	BPH24-MD201				Semester-II
Multidisciplinary	MATERIALS TODAY				Generic Elective
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
45	2 Hrs	40	60	100	03

Course objectives: This course is intended to provide an introduction to

(1) The various states of matter along with a distinction between matter and materials

(2) The development of materials over the ages

(3) The classification of materials and their properties

(4) Advanced class of materials and their applications

Unit	Content	L	T	P	Hours
Unit 1: States of Matter	Overview of the different states of matter: Solid, Liquid, Gas, Plasma	7	-	-	7
Unit II: History and Evolution of Materials	Materials: Drivers of human civilization Development of materials: Stone age, Copper age, Bronze age, Iron age Explanation with examples to mark this development	10	-	-	10
Unit III: Classification of Engineering Materials	Metals & Alloys, Non-Metals, Ceramics, Polymers, Composites etc. with xamples and applications Uses, Performance, Composition & Structure; Physical and Chemical properties; Processing & Synthesis of various classes of materials	13	-	-	13
Unit IV: Trends in Advanced Materials	Breakthroughs in Materials Development Overview of Advanced Materials: Semiconductors, Biomaterials, Smart Materials (Materials of the Future), Nano-structured Materials	15	-	-	15
	Total	**45**	**-**	**-**	**45**

Learning outcomes: This course will enable the students to

(1) Define the possible states of matter as well as to distinguish matter from material

(2) Explain the chronological development that materials have gone through for achieving their present stage

(3) Compare and classify materials and their properties

(4) Define advanced materials and their fascinating behavior

Suggested readings:

(1) Materials Science and Engineering: An introduction, William D. Callister, Jr. and David **G. Rethwisch, John Wiley & Sons, Inc.**

(2) Understanding Materials Science: History, Properties, Applications, Rolf E. Hummel, **Springer-Verlag, New York**

(3) Essentials of Materials Science and Engineering, Donald R. Askeland and Pradeep P. Fulay, Cengage learning, Canada

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Detailed Syllabus of Skill Enhancement Courses (SEC)

I Year	BPH24-SE101				Semester-I
SEC	ELECTRICAL CIRCUITS AND NETWORK SKILLS				
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
T-15	**T-1 Hr**	**20**	**30**	**50**	**1**
P-60	**P-2 Hr**	**20**	**30**	**50**	**2**

Course objectives: The aim of this course is to

1. Develop the skill of the students in domestic wiring and troubleshooting the electrical circuits specially electrical wiring and common household appliances through hands-on mode.
2. To prepare a working diagram of electrical wiring for a house/ building and install and commission electrical wiring and maintenance in domestic applications.

Unit	Content	L	T	P	Hours
	1-credit theory				
Unit 1: Basics of Electrical Circuits	Introductory concepts and basic circuit elements: Concept of Electric current and its unit, Conductors, Insulators, Resistance, potential and potential difference-units- different voltage sources (AC and DC)- Effects of current- - Ohm's law, heating effect of current, Joule's law of heating, electric power, electric energy, Analysis of DC circuits; Kirchhoff's laws: KCL, KVL, Current and voltage drop across the DC circuit elements. Series circuit, parallel circuit, combination circuit, . AC current and voltage, single-phase and three-phase alternating current sources, Transformers, transmission of AC Unit of power and energy, kWh, KVA. Different types of light sources like filament bulb, tube (fluorescent) light, CFL, LED and Neon light, Different types of switches, two way, three way, four way switches, fan regulators, dimmer, different types of domestic electrical appliances and their power.	4	-	-	4
Unit 2: Types of wiring	Various types of tools and wiring accessories, Basics of wiring: casing-capping, PVC conduit wiring, concealed wiring (PVC/MS), comparison of different wire joint (flat and straight), types of wiring systems; selection and design of wiring schemes for particular situation (domestic), selection of wire, cables, wiring accessories and use of protective devices i.e., MCB, ELCB etc.; rating and current carrying capacity of wires, cables, fuse, switches, socket, MCBs, ELCBs and other electrical accessories.	2	-	-	2

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Unit 3: Electrical Drawing and Symbols	Different types of electrical symbols used in domestic installation and power systems as per BIS code. Electrical Schematics. Power circuits and control circuits. Reading of circuit schematics. Understanding the connections of elements and identifying current flow and voltage drop. Wiring diagram of light, fan, bell and alarm circuit, staircase wiring, schematic diagram of lighting system of small room, hall and conference room, circuit breakers, inverter connections, Design and drawing of panels, distribution board using MCB, ELCB, main switches and change over switches for domestic installations, Estimation of electrical materials for domestic wiring.	6	-	-	6
Unit 4: Electrical Protection and Safety	Earthing: Concept and purpose of earthing, different types and procedure of earthing, drawing of plate and pipe earthing, test material and costing and estimating. Safety precautions: Effect of electric shock on human body, first aid for electric shock-rules and standards in house wiring, Introduction to Lightning Arresters – Types - Necessity and Advantages - Layout and Installation, Electrical Hazards and its effects - Basic safety introduction - Personal protection and PPE - Basic injury prevention - Basic first aid - Hazard identification and avoidance	3	-	-	3
	2-credits practical: BPH24-SE101 Demonstration and Laboratory				
Lab Course	1. Safety use in electricity, shock treatment methods, safety precautions. 2. To study & find the specifications of various types of wires and cables. 3. To measure the gauge of a given wire with the help of a wire gauge. 4. Prepare a chart of wattage of different electrical items/ appliances like CFL bulb, LED bulb, Tube light, Ceiling Fan, Table Fan, Gyger, Mixer-grinder, Refrigerator, Water pump, Iron, Xerox Machine, Inverter, TV, Hanging/ pendant Light, Microwave oven etc. 5. Measurements of ac voltage with multimeter. 6. To connect the wires with different electrical accessories. 8. Skinning the cable and joint practice on single and multi-strand wire.	-	-	30	60

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	9. To make a main switch board for house wiring 10. Installation of common electrical accessories such as switch, holder, plug on board 11. Installation and wiring connection of ceiling fan, exhaust fan, geyser, and water purifier. 12. Preparation of extension board with switches, sockets and indicator. 13. Demonstrate electrical circuit diagrams related to electrical household appliances. 14. Carry out the earthing of the installed electrical circuit as per standard practice 15. Practice on different types of House Wiring installation and testing 16. House wiring circuits using fuse, switches, sockets, ceiling fan etc. in P.V.C. casing-capping. 17. Prepare one estimate of materials required for CTS wiring for small domestic installation of one room and one verandah within 25 m^2 with given light, fan & plug points.				
	Total	**15**	**-**	**30**	**75**

Learning outcomes:

After successful completion of this course students will be able to identify various electrical devices, circuits and their symbols, familiar with schematic and wiring diagrams of electrical devices, understand electrical installation plan, perform and practice any type of domestic wiring and its maintenance.

Suggested readings:

1. Elementary Electrical Engineering- M.L. Gupta (New Heights)
2. Electrical Installation and Estimating- Surjit Singh, Dhanpatrai and sons
3. A course in Electrical Installation, Estimating and costing- J B Gupta, S K Kataria and Sons
4. A textbook in Electrical Technology - B L Theraja - S Chand & Co.
5. A textbook of Electrical Technology - A K Theraja

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I Year	BPH24-SE102				Semester-I
SEC	MAINTENANCE AND REPAIRING OF ELECTRICAL APPLIANCES				
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
T-15	**T-1 Hr**	**20**	**30**	**50**	**1**
P-60	**P-2 Hr**	**20**	**30**	**50**	**2**

Course objectives:

1. Design and troubleshoot the electrical circuits, networks and appliances through hands on mode.
2. Build the basic foundation for learning electrical wiring and repairing other household equipment.

Unit	Content	L	T	P	Hours
	1-credit theory				
Unit 1: Basic Electricity Principles	Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC, Electricity. Familiarization with multimeter, voltmeter and ammeter.	2	-	-	2
Unit 2: Understandin g Electrical Circuits	Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single- phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.	2	-	-	2
Unit 3: Electrical Drawing and Symbols	Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identifying current flow and voltage drop.	2	-	-	2
Unit 4: Generators and Transformers	DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.	1	-	-	1
Unit 5: Electric Motors	Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heater and motors, speed and power of ac motor	2	-	-	2

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Unit 6: Solid State Devices	Resistors, inductors and capacitors , Diode and rectifiers, Components in series or in shunt, Response of Inductors and capacitors with AC or DC sources.	1	-	-	1
Unit 7: Electrical Protections	Relays, fuses and disconnect switches, Circuit breakers, Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)	2	-	-	2
Unit 8: Electrical Wiring	Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of the extension board.	3	-	-	3
	2-credits practical , BPH24-SE102 **(Demonstration and aboratory)**				
Lab Course	1. Identify different electrical components: Resistor, Capacitor, variable resistor, Rheostat, dc voltage sources: battery, battery eliminator, power supply. 2. Use ammeter and voltmeter in a circuit and measure current and voltage 3. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and Checking electrical continuity and fuses. 4. Connect resistances in series and parallel and measure the equivalent resistance using multimeter 5. Build a dc circuit using elements like battery, resistances and switch and measure current flow and voltage drop across the components. 6. Demonstration of dc motor and ac motor (like motor of a fan) and identify the differences between them.	-	-	60	60

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	7. Identify the electronic components like rectifying diodes, Zener diodes, transistor, carbon resistance, capacitors, and test them with multimeter. 8. Read electrical diagrams and draw an electrical diagram of room with proper symbols. 9. To study & find the specifications of various types of wires and cables. 10. Demonstrate different types of Splices (knot) and joints and practice. 11. Demonstration of different types of connectors used in electrical circuits: split bolts connector, Terminal blocks etc. 12. Identify the different types of Protection Devices: that prevents from electrical damages: Fuse, Circuit Breaker, MCB, Lighting Arrester 13. Demonstrate a distribution box with connections. 14. Preparation of extension board with switches, sockets and indicator.				
	Total	**15**	-	**60**	**75**

Learning outcomes:

1. Design and troubleshoot certain electrical circuits and domestic appliances along with the understanding of the working of those appliances.
2. Do electrical wiring and repairing. This knowledge will develop the skill of the students for various electrical repairing and servicing purposes.

Recommended readings:

- A textbook in Electrical Technology - B L Theraja - S Chand & Co.
- A textbook of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn.

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I Year	BPH24-SE201				Semester-II
SEC	BASIC INSTRUMENTATION SKILLS				
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
T-15	**T-1 Hr**	**20**	**30**	**50**	**1**
P-60	**P-2 Hr**	**20**	**30**	**50**	**2**

Course objectives: This course aims to

1. Provide exposure to various aspects of instruments
2. Provide hands-on experience of handling instruments.
3. Teach various debugging techniques for the instruments.

Unit	Content	L	T	P	Hours
	1-credit theory				
Unit 1: Basic of Measurement	Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance	2	-	-	2
Unit 2: Electronic Voltmeter	Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. **AC millivoltmeter:** Type of AC milli voltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.	2	-	-	2
Unit 3:	Block diagram of basic CRO. Construction of CRT,	2	-	-	2
Cathode Ray Oscilloscope	Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.				

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	Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.	1	-	-	1
Unit 4: Signal Generators and Analysis Instruments	Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.	2	-	-	2
Unit 5: Impedance Bridges & Q-Meters	Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q-Meter. Digital LCR bridges.	2	-	-	2
Unit 6: Digital Instruments	Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.	2	-	-	2
Unit 7: Digital Multimeter	Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.	2	-	-	2
Lab Course	**2-credits practical: BPH24-SE201** **Demonstration and Laboratory**				
	The test of lab skills will be of the following test items: 1. Use of an oscilloscope. 2. CRO as a versatile measuring device. 3. Circuit tracing of Laboratory electronic equipment,	-	-	60	60

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	4. Use of Digital multimeter / VTVM for measuring voltages 5. Circuit tracing of Laboratory electronic equipment, 6. Winding a coil / transformer. 7. Study the layout of a receiver circuit. 8. Troubleshooting a circuit 9. Balancing of bridges **Laboratory Exercises:** 1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance. 2. To observe the limitations of a multimeter for measuring high frequency voltage and currents. 3. To measure Q of a coil and its dependence on frequency, using a Q- meter. 4. Measurement of voltage, frequency, time period and phase angle using CRO. 5. Measurement of time period, frequency, average period using universal counter/ frequency counter. 6. Measurement of rise, fall and delay times using a CRO. 7. Measurement of distortion of a RF signal generator using distortion factor meter. 8. Measurement of R, L and C using a LCR bridge / universal bridge. **Open Ended Experiments:** 1. Using a Dual Trace Oscilloscope 2. Converting the range of a given measuring instrument (voltmeter, ammeter)				
	Total	**15**	**-**	**60**	**75**

Learning outcomes: After completing this course the students will be able to:

1. Handle various measuring laboratory instruments properly
2. Assess the possible sources of error in the measurements
3. Analyze issues and debug problems in the instrument functioning

References:

- A textbook in Electrical Technology - B L Theraja - S Chand and Co.
- Performance and design of AC machines - M G Say ELBS Edn
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

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I Year	BPH24-SE202				Semester-II
SEC	COMPUTATIONAL PHYSICS SKILLS				
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
T-15	**T-1 Hr**	**20**	**30**	**50**	**1**
P-60	**P-2 Hr**	**20**	**30**	**50**	**2**

Course objectives:

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

1. Highlights the use of computational methods to solve physical problems.
2. Use of computer language as a tool in solving physics problems.

Unit	Content	L	T	P	Hours
	1-credit theory				
Unit 1: Introduction	Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.	3	-	-	3
Unit2: Scientific Programming	Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non- Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.	3	-	-	3

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Unit 3: Control Statements	Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO- CONTINUE, DO-ENDDO, DO- WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE	3	-	-	3
	Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.				
Unit 4: Scientific word processing: Introduction to LaTeX	TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. **Equation representation:** Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.	3	-	-	3
Unit 5: Visualization	Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot	3	-	-	3
Lab Course II	**2-credits practical , BPH24-SE202**				
	Programming: 1. Exercises on syntax on usage of FORTRANUsage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write source codes in FORTRAN. 2. To print out all natural even/ odd numbers between given limits. 3. To find maximum, minimum and range of a given set of numbers. 4. Calculating Euler number using exp(x) series evaluated at x=1	-	-	30	60

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	Hands on exercises: 1. To compile a frequency distribution and evaluate mean, standard deviation etc. 2. To evaluate the sum of a finite series and the area under a curve. 3. To find the product of two matrices 4. To find a set of prime numbers and Fibonacci series. 5. To write a program to open a file and generate data for plotting using Gnuplot. 6. Plotting trajectory of a projectile projected horizontally. 7. Plotting trajectory of a projectile projected making an angle with the horizontal. 8. Creating an input Gnuplot file for plotting data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file. 9. To find the roots of a quadratic equation. 10. Motion of a projectile using simulation and plot the output for visualization. 11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization. 12. Motion of a particle in a central force field and plot the output for visualization.				
	Total	**15**	-	**30**	**75**

Learning outcomes: After successful completion of this course the student will be able to

1. Work smoothly in a Linux environment.
2. Use FORTRAN programming in numerical analysis..
3. Prepare documents (including scientific documents) using LATEX.
4. Do graph plotting and analysis through programming languages like GNU plot.

References:

- Introduction to Numerical Analysis, S.S. Sastry, 5thEdn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
- LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999)
- A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
- Elementary Numerical Analysis, K.E. Atkinson, 3 rdEdn . , 2 007, Wiley India Edition.

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