Shri Guru Ram Rai University

(Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & Recognized by UGC u/s2(f) of UGC Act 1956)

Patel Nagar, Dehradun -248001, Uttarakhand .

Minutes of Meeting

Board of Studies(Third) in Physics

Shri Guru Ram Rai University
DEHRADUN-208001 INDIA
3rd Meeting of the Board of Studies (BoS)

School of Basic & Applied Sciences
Department of Physics

To be held on 26th June 2021 at 10 AM in the SBAS Campus, Patelnagar, SGRR University, Dehradun.

Agenda

Item No.	Item	Annexure No.
3.1	To confirm the minutes of the 2nd Meeting of the BOS held on 15th May 2020.	3.1
3.2	To report the actions taken on the decisions taken in the 2nd Meeting of the Board of Studies held on 15th May 2020.	3.2
3.3	To deliberate on the Pre-PhD physics course programme in the department of physics as a new course to be included. The syllabus for the following course to be put up for discussions: i. Pre-Ph.D. course programme in Physics as per UGC Regulations 2016	3.3.1
3.4	To review and revise the following: i. Distribution of Courses for all semesters in the revised and new degree Courses (UG/PG and Pre-Ph.D.) for the Academic Session 2021-22. ii. Inclusion of Course Outcomes (COs), Program learning outcomes (POs)/ course objectives etc. in the revised PG course programmes. iii. Inclusion of Course Outcomes (COs), Program learning outcomes (POs)/ course objectives etc. in the revised UG course programmes. iv. Addition, deletion or modification in syllabi if required.	3.4.1-3.4.5
3.5	To review and revise the following (if any): i. Allotment and description of credits to different courses in the proposed degree Course Programmes for all semesters. ii. Allotment of course codes. iii. Medium of instruction, question paper pattern, medium of Examination, duration of Examination, allotment of marks in Internal and External Exams. iv. Evaluation pattern and distribution of marks	
3.6	Any other item with the permission of the Chair	

(Dr. Kumud Saklani)

CHAIRPERSON BoS

MINUTES OF MEETING

THIRD BOARD OF STUDIES MEETING IN PHYSICS

A meeting of all the members of Third Board of Studies in Physics, SBAS was held on 26th June 2021 from 10 a.m. onwards. The following members were present:

1. Prof. (Dr.) Kumud Saklani, Dean, School of Basic & Applied Sciences, SGRRU, Dehradun. (Convener)
2. Dr. O. P. Kulshreshtra, Former Principal and Head, Department of physics, DBS (PG) collage, Dehradun (External Expert).
3. Dr. Arun Kumar, Professor & Dean Research, School of Basic & Applied Sciences, SGRRU, Dehradun. (Member)
4. Dr. Pankaj Chamoli, Associate Professor & Head, Department of Physics, School of Basic & Applied Sciences, SGRRU, Dehradun. (Member)
5. Dr. Parul Goel, Professor, School of CA&IT, SGRRU, Dehradun. (Nominated Member)

PROCEEDINGS AND RESOLUTIONS:

Item No. 3.1 & 3.2: Confirmation of Minutes and action taken of Second BOS Physics.
The members of the BOS discussed the agenda item wise and resolutions were made accordingly.

Item No. 3.3 Introduction of New Degree Courses in Physics at School of Basic & Applied Sciences, Shri Guru Ram Rai University. It is proposed to introduce the following courses:
3.3.1 Pre-Ph.D. in Physics as per Regulation 2016 (UGC)
Resolutions: All the members of BOS proposed to introduce the courses mentioned above.

Item No. 3.4. To review and revise the followings

Resolutions: As follows
Item No. 3.4.1 Distribution of Courses for all semesters in the proposed degree Courses (PG and PhD) for the Academic Session 2021-22.
Resolutions:
The distribution of courses for all semesters in the proposed degree Course programmes (PG and PhD) was discussed in detail with the honourable members.

Item No. 3.4.2 Inclusion of Programme Educational objectives (PEOs), Program learning outcomes (POs)/ course objectives etc. in the revised PG course programmes.

Resolutions: The inclusion of Programme Educational objectives (PEOs), Program learning outcomes (POs)/ course objectives etc. in the revised PG course programmes were discussed in detail with the honourable members.

Item No. 3.4.3 Inclusion of Programme Educational objectives (PEOs), Program learning outcomes (POs)/ course objectives etc. in the revised UG course programmes.

Resolutions: The inclusion of Programme Educational objectives (PEOs), Program learning outcomes (POs)/ course objectives etc. in the revised UG course programmes were discussed in detail with the honourable members.

Item No. 3.4.4 Addition, deletion or modification in syllabi if required.

i. The Honourable External experts along with the members of the Board of Studies went through the syllabus of respective UG, PG and PhD courses thoroughly and resolved to pass the complete syllabi for all the semesters of all the degree programmes.

ii. After going through the syllabi, the detailed discussion took place with certain corrections and suggestions from all the members. As recommended by Honourable experts, likewise the corrections were made.

iii. Details of the suggestions by the members of BOS also included the following:

- Some suggested modification at PG level course structure were identified and Seminar (3 credit) were included instead insisted of "Laboratory Course I (MPHL303)" in 3rd semester.
- Some suggested modification in the syllabus of PG such as Mathematical Physics (MPHC 102), and were included at the M.Sc. course.
- Some suggested modification in the syllabus of B.Sc. was included at UG level course.

Item No. 3.5 To review and revise the following (if any)

Resolutions: As follows

Item No. 3.5.1 Allotment and description of credits to different courses in the proposed degree Course Programmes for all semesters.

Resolutions:

The credits for the UG, PG and PhD courses have been proposed. However, the credits would be finalized after discussion of BOS of other subjects to bring uniformity in all subjects and shall be as per SGRR University norms.

Item No. 3.5.2 Allotment of course codes.

The allotment of course codes have been proposed but would be finalized after discussion of BOS of other subjects and as per SGRR University norms.

Item No. 3.5.3 Medium of instruction, question paper pattern, medium of Examination, duration of Examination, allotment of marks in Internal and External Exams.

Resolutions:

- The members were of the view that the medium of instruction would be English for UG, PG and PhD course and as per SGRR University norms

Item No. 3.5.4 Evaluation pattern and distribution of marks

Resolutions:

All the members of BOS were of the view that the evaluation pattern and distribution of marks should be at par with other subjects and should follow SGRR University norms to bring uniformity.

The meeting ended with a vote of thanks to the chair.

26/6/2021

Prof. (Dr.) Kumud Saklani,

(Convener)

26/6/21

Dr. O. P. Kulshreshtra

(External expert)

26/6/21

Dr. Arun Kumar

(Member)

26/6/21

Dr. Parul Goel

(Nominated Member)

26/6/24

Dr. Pankaj Chamoli

(Member)

MINUTES OF MEETING

THIRD BOARD OF STUDIES MEETING IN PHYSICS

Attendance Sheet

A meeting of all the members of Third Board of Studies in Physics, SBAS was held on 26th June 2021 from 10 a.m. onwards. The following members were present:

S.No	Name	Signature
01	Prof. (Dr.) Kumud Saklani, Dean, School of Basic & Applied Sciences, SGRRU, Dehradun.	26/06/2021
02	Dr. O. P. Kulshreshtra, Former Principal and Head, Department of physics, DBS (PG) collage, Dehradun	
03	Dr. Arun Kumar, Professor & Dean Research, School of Basic & Applied Sciences, SGRRU, Dehradun	26/06/2021
04	Dr. Pankaj Chamoli, Associate Professor & Head, Department of Physics, School of Basic & Applied Sciences, SGRRU, Dehradun	26/06/21
05	Dr. ~~Pankaj Chamoli, Associate Professor & Head,~~ Department of Physics, ~~School of Basic & Applied~~ Sciences, SGRRU, Dehradun	
06	Dr. Parul Goel, Professor, School of CA&IT, SGRRU, Dehradun	26/6/21

SHRI GURU RAM RAI UNIVERSITY

Patel Nagar, Dehradun-248001, Uttarakhand, India

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SYLLABUS FOR

Bachelor of Science (B.Sc.)-Physics

School of Basic & Applied Sciences

(W.E.F 2021-2022)

Bachelor of Science (B.Sc.)-Physics

OUTCOME BASED EDUCATION

Programme outcome (POs)

PO 1	Bachelor of Science offers theoretical as well as practical knowledge about different subject areas.
PO2	Graduates will develop scientific temperament to solve scientific problems in emerging areas of science at National and International level.
PO3	Graduates will acquire coherent understanding of the academic field to pursue multi and interdisciplinary science careers in future.
PO4	Graduate will have clarity of thought and expression. Qualities like logical thinking and decision making will be enhanced
PO5	Graduates plan and execute experiments or investigations, analyze and interpret data information collected using appropriate methods
PO6	Graduates will be able to compete in various national and international competitive examinations.
PO7	Graduates will understand the principles of basic and applied sciences and apply them logically in environmental and socio-technological context with a systematic approach towards sustainable development.
PO8	Graduates will have critical thinking, follow innovations and developments in Science and technology
PO9	Graduates will acquire effective communication skills
PO10	Graduates will understand ethical principles and responsibilities for effective citizenship.
PO11	Graduates will develop new and enhancing conversational skills that lead to not only to good communication but also to the excellent drafting abilities linked with technical reports and presentations.
PO12	Graduates will competent enough for doing jobs in Govt. and private sectors of academia, research and industry.

Program Specific Outcome (PSOs)

On Successful completion of the B.Sc. Program, students will able to:

PSO 1	To develop practical, analytical and mathematical skills in physics
PSO2	To demonstrate knowledge of various fields such as electricity, properties of matter, optics, electronics, modern physics, and to analyse complex physical phenomena.
PSO3	To learn Physics laboratory skills and analyse the measurements to draw valid conclusions.
PSO4	To develop academic and scientific abilities, personal qualities and transferable skills in students to make them responsible citizen.

Eligibility for admission:

Any candidate who has passed the Plus Two of the Higher Secondary Board of Examinations in any state recognized as equivalent to the Plus Two of the Higher Secondary Board in PCM with not less than 45% marks in aggregate is eligible for admission, However, SC/ST, OBC and other eligible communities shall be given relaxation as per University rules.

Duration of the Programme: 3 years

STUDY & EVALUATION SCHEME: Choice Based Credit System (CBCS)

Bachelor of Science (B.Sc.)-Physics

First Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BPHC101	Mechanics	4	0	0	4	30	70	100
2	Ability Enhancement Compulsory course	AECC 101/ 102/ 103	Environmental Science/ English/MIL communication	4	0	0	4	30	70	100
Practical										
1	Core	BPHL101	Lab. Course based on BPHC101	0	0	4	2	30	70	100
			Total	8	0	4	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

Second Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BPHC201	Electricity and Magnetism	4	0	0	4	30	70	100
2	Ability Enhancement Compulsory course	AECC 201/ 202/ 203	Environmental Science/ English/MIL communication	4	0	0	4	30	70	100
Practical										
1	Core	BPHL201	Lab. Course based on BPHC201	0	0	4	2	30	70	100
			Total	8	0	4	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

Third Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BPHC301	Thermal Physics and	4	0	0	4	30	70	100

			Statistical Mechanics							
2	Skill Enhancement Course	BPHS302	Computational Physics	4	0	0	4	30	70	100
Practical										
1	Core	BPHL301	Lab. Course based on BPHC301	0	0	4	2	30	70	100
			Total	8	0	4	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

Fourth Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	BPHC401	Waves and Optics	4	0	0	4	30	70	100
2	Skill Enhancement Course	BPHS402	Radiation Safety	4	0	0	4	30	70	100
Practical										
1	Core	BPHL401	Lab. Course based on BPHC401	0	0	4	2	30	70	100
			Total	8	0	4	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

Fifth Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Elective	BPHD501/ BPHD502 (Anyone to be opted by students)	Elements of Modern Physics / Mathematical Physics	4	0	0	4	30	70	100
2	Skill Enhancement Course	BPHS503	Electronics –I (Network Theorems, Solid state Devices,	4	0	0	4	30	70	100

			Rectifiers and Filters)							
Practical										
1	Elective	BPHL501/ BPHL502	Lab. Course based on BPHD501/ Lab. Course based on BPHD502	0	0	4	2	30	70	100
			Total	8	0	4	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

Sixth Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Elective	BPHD601/ BPHD602 (Anyone to be opted by students)	Solid State Physics/ Quantum Mechanics	4	0	0	4	30	70	100
2	Skill Enhancement Course	BPHS503	Electronics-II (Amplifiers and oscillators)	4	0	0	4	30	70	100
Practical										
1	Elective	BPHL601/ BPHL602	Lab. Course based on BPHD601/ Lab. Course based on BPHD602	0	0	4	2	30	70	100
			Total	8	0	4	10	90	210	300

L – Lecture, T – Tutorial, P – Practical, C – Credit

Total Credits (Summary)

1. Core Courses (Th. + Pr.) - 6 X 4 = 24 X 3 (Three Subjects in B.Sc.) =72
2. Discipline Specific Elective (Th. + Pr.) – 6 X 2 = 12 X 3 (Three Subjects in B.Sc.) =36
3. Ability Enhancement Compulsory Courses – 4 X 2 = 8 (Common in all the three subjects) =8
4. Skill Enhancement Courses – 4 X 4 = 16 (One course each from 03 Subjects + One course from any of the 03 subjects) = 16

Total = 72+36+8+16 = 132 Credits to be earned in B.Sc.

Examination Scheme:

Components	Ist internal	IInd Internal	External (ESE)
Weightage (%)	15	15	70

Bachelor of Science (B.Sc.)-Physics

Course code	**: BPHC101**				
Course Name	**: Mechanics**				
Semester /Year	**: I / I**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about the Vectors, Coordinate system and Newton's Law of Motion and acquire basic knowledge and understanding of special theory of relativity.

Course Contents

Unit 1 Vectors and Differential Equations: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.1storder homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.

[No. of Hours: 10]

Unit 2 Laws of Motion and Rotational Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Angular velocity and angular momentum. Torque. Conservation of angular momentum.

[No. of Hours: 10]

Unit 3 Gravitation and Special Theory of Relativity: 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 orbit and applications, Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS: Constancy of speed of light. Postulates of Special, Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities. **[No. of Hours: 10]**

Unit 4 Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaeger's method. 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. **[No. of Hours: 15]**

Unit 5 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 and moment of inertia - q, η by Searle's method. **[No. of Hours: 15]**

Text Books:

TB1. Integrated Mechanics, J.P. Agarwal, Pragati Publication
TB2. Mechanics Berkeley Physics course, v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.

Reference Books:

RB1. University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison- Wesley
RB2. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
RB3. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Course outcomes (COs):

CO1	Visualise vector calculus and describe laws of motion, rotational motion, gravitation, special theory of relativity, fluids and elasticity.
CO2	Develop a basic understanding of scalar and vector products conservation laws, motions of rockets, special theory of relativity, surface tension viscosity, elastic constants.
CO3	Explain length contraction, time dilation, GPS, stoke's law Poiseuille's formula, Hooke's law and apply these in various problems
CO4	Classify and differentiate elastic constant, angular velocity and linear velocity, frame of reference
CO5	Evaluate the modulus of rigidity by torsional pendulum, work done in stretching and twisting the wire
CO6	Solve the problems of vectors and differential equation Poisson's ratio, viscosity, surface tension.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	1	2	2	2	2	2	3	2	2	2	2	3	2	1	2	2
CO3	2	3	2	3	2	2	2	2	3	2	3	2	2	2	2	2
CO4	1	1	2	2	2	1	2	1	2	3	2	3	2	1	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	2	2	2	2	1	1	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHL101**			
Course Name	**: Lab. Course based on BPHC101**			
Semester /Year	**: I / I**			
L	**T**	**P**	**C**	
0	**0**	**4**	**2**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to teach the students moment of inertia, Young's modulus, elastics constants and pendulums characteristics by having the students perform hands on experiments supervised by a specialized instructor.

Course Contents **Total hours: 60**

1. Measurements of length (or diameter) using Vernier calliper, screw gauge and travelling microscope.
2. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To determine g and velocity for a freely falling body using digital timing technique.
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g

Text Books:

TB1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia.
TB2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

Reference Books:

RB1. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11thEdition, 2011, Kitab Mahal, New Delhi.
RB2. Practical Physics, Gupta Kumar, Pragati Publication

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Learn and gain knowledge about viscosity, moment of inertia, elastic constants ,motion of spring, acceleration due to gravity.
CO2	Understand about measurement tools, Bar Pendulum, kater's pendulum, flywheel, Maxwell needle, inertia table, barton's apparatus
CO3	Apply the principle of viscosity, gravity, elasticity on instruments
CO4	Analyse the motion of spring, pendulums, inertia table and then calculate the value of spring constant, elastic constants and acceleration due to gravity.
CO5	Evaluate the value of elastic constants, coefficient of viscosity, acceleration due to gravity, diameter, radius, and length of various bodies
CO6	Formulate the results of elastic constants, acceleration due to gravity, diameter and length of various bodies

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2	1	1	2	2	2	2	2	1	1	1	1	1
CO2	2	2	3	2	2	2	3	2	2	1	2	2	2	2	2	1
CO3	2	3	2	3	2	2	2	2	3	2	3	2	2	2	2	2
CO4	3	2	3	2	2	1	2	1	2	1	1	2	1	3	2	1
CO5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1
CO6	2	1	2	2	1	1	2	1	1	2	2	2	2	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHC201**				
Course Name	**: Electricity and Magnetism**				
Semester /Year	**: II / I**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about the basic concepts of electricity, magnetism and their application. This course will help in understanding Maxwell's equation, Poynting vector and concept of vector analysis.

Course Contents

Unit 1

Vector Analysis: Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

[No. of Hours: 12]

Unit 2

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, 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.

[No. of Hours: 22]

Unit 3

Magnetism: Magnetostatics: 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. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

[No. of Hours: 10]

Unit 4

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.

[No. of Hours: 6]

Unit 5

Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

[No. of Hours: 10]

Text Books:

TB1. Integrated Electricity and Magnetism, J.P. Agarwal, Pragati Publication.
TB2. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House

Reference Books:

RB1. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cumming

RB2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol. I, 1991, Oxford Univ. Press.

RB3. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe vector analysis, electrostatics, magnetism, electromagnetic induction, Maxwell`s equations and Electromagnetic wave propagation
CO2	Understand about Gauss's divergence theorem, Stoke's theorem, Gauss theorem and its applications, Maxwell's equation, equation of continuity, Polarisation,
CO3	Explain and distinguish between dia-, para-, and ferromagnetic material. Apply Biot-Savart's law, Ampere's circuital law in various systems
CO4	Analyse gradient, divergence and curl, electric flux, poynting vector, displacement current, Parallel plate, spherical and cylindrical condenser.
CO5	Evaluate and assess Faraday's laws of electromagnetic induction, Gauss's theorem in dielectrics
CO6	Solve the problems based on electric field, electric potential, magnetism , dielectrics and electromagnetic wave propagation.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	2	1	2	2	2	1	2	1	1	1	1	1
CO2	1	2	2	2	3	2	3	2	2	2	2	2	2	3	2	2
CO3	2	3	2	3	2	2	2	2	3	2	3	2	2	2	2	2
CO4	1	1	2	2	3	1	2	1	2	3	2	2	2	1	3	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2
CO6	2	2	2	1	2	1	2	1	1	2	2	1	3	3	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHL201**			
Course Name	**: Lab. Course based on BPHC201**			
Semester /Year	**: II / I**			
L	**T**	**P**	**C**	
0	**0**	**4**	**2**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to teach the students resistance, voltage, current, galvanometer, capacitance, various circuits and network theorems by having the students perform hands on experiments supervised by a specialized instructor.

Course Contents **Total hours: 60**

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.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study 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

Text Books:

TB1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia.
TB2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

Reference Books:

RB1. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11thEdition, 2011, Kitab Mahal, New Delhi.

RB2. Practical Physics, Gupta Kumar, Pragati Publications.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Observe multimeter measurements of resistance, voltage, and current and gain knowledge about Carey Foster's Bridge, LCR Circuit
CO2	Understand about various circuits such as LC, RC and LCR circuits, De'Sauty's bridge.
CO3	Apply Superposition, Thevenin, Norton and Maximum Power Transfer theorems in various systems.
CO4	Analyse the high resistance by Leakage Method,
CO5	Estimate the values of voltage, current, resitance by multimeter, Self Inductance of a Coil by Rayleigh's Method, Characteristics of as LC, RC and LCR circuits
CO6	Formulate the results of various network theorems, LCR circuit, Carey Foster's Bridge.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	1	2	2	2	3	2	3	2	2	2	2	3	2	3	2	3
CO3	2	3	2	3	2	2	2	2	3	3	3	2	2	2	2	2
CO4	1	1	2	2	2	1	2	1	2	3	2	3	2	1	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	2	2	2	2	1	1	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHC301**			
Course Name	**: Thermal Physics and Statistical Mechanics**			
Semester /Year	**: III / II**			
L	**T**	**P**	**C**	
4	**0**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about the laws of thermodynamics, Entropy, the thermodynamic potentials and their physical significance. To provide knowledge and understanding of Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics.

Course Contents

Unit 1

Laws of Thermodynamics: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamically Processes, Applications of First Law: General Relation between CP&CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. **[No. of Hours: 15]**

Unit 2

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations. **[No. of Hours: 10]**

Unit 3

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

[No. of Hours: 15]

Unit 4

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy,

Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. **[No. of Hours: 10]**

Unit 5

Statistical Mechanics: Maxwell-Boltzmann law - distribution of velocity – Quantum statistics - Phase space - Fermi-Dirac distribution law, Bose-Einstein distribution law and comparison of three statistics.

[No. of Hours: 10]

Text Books:

TB1. Integrated Thermal Physics And Statistical Mechanics, J.P. Agarwal, Pragati Publication.
TB2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.

Reference Books:

RB1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
RB2. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G. L. Salinger. 1988, Narosa.

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	Describe laws of thermodynamics, thermodynamic potentials, kinetic theory of gases, theory of radiations, and statistical mechanics
CO2	Understand about Maxwell's thermodynamic relations, Planck's radiation law, Carnot's cycle, M-B, B-E, F-D Statistics, Stefan's law,
CO3	Explain Joule-Thompson Effect, Clausius- Clapeyron Equation, TdS equations, Mayer's formula, ensembles, Phase space, Wien's displacement law, Law of equipartition of energy and its applications to specific heat of gases
CO4	Analyze about Transport Phenomena, kinetic theory of gases, various laws of thermodynamics, Carnot's theorem
CO5	Estimate Work Done during Isothermal and Adiabatic Processes and compare M-B, B-E, F-D Statistics
CO6	Write the characteristics of black body radiation, various thermodynamic Processes, Entropy, Reversible & irreversible processes

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	1	2	2	2	2	2	3	2	2	2	2	3	2	1	2	2
CO3	2	3	2	3	2	2	2	2	3	2	3	2	2	2	2	2
CO4	1	1	2	2	2	1	2	1	2	3	2	3	2	1	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	2	2	2	2	1	1	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHL301**				
Course Name	**: Lab. Course based on BPHC301**				
Semester /Year	**: III / II**				
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to teach the students heat flow, black body radiation, thermal conductivity, thermo couple and null method by having the students perform hands on experiments supervised by a specialized instructor.

Course Contents **Total hours: 60**

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

Text Books:

TB1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.

TB2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11thEdition, 2011, Kitab Mahal, New Delhi.

Reference Books:

RB1. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal, 1985,Vani Publication

RB2. Practical Physics, Gupta Kumar, Pragati Publication.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Learn and Gain knowledge of measurement heat flow, black body radiation, Stefan's Constant, thermal conductivity
CO2	Understand about thermal conductivity of copper by Searle's and Angstrom's apparatus Platinum resistance thermometer
CO3	Apply and calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge,
CO4	Analyze the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system and variation of thermo emf across two junctions of a thermocouple with temperature
CO5	Evaluate the value of stefan's constant, Planck constant, temperature co-efficient of resistance by Stefan's, instrument, black body radiation, Platinum resistance thermometer respectively
CO6	Formulate the results of Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method, the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	2	2	2	2	3	2	3	1	2	2	2	3	2	3	2	3
CO3	2	3	2	3	2	2	2	2	3	3	3	2	2	2	2	2
CO4	1	2	2	2	2	1	2	1	1	3	2	3	2	1	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	1	1	2	2	1	1	2	2	2	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHC401**				
Course Name	**: Waves and Optics**				
Semester /Year	**: IV / II**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about Simple harmonic motion, its differential equation and its solution. Acquire knowledge and understanding of Interference and Diffraction. Understanding of Michelson's Interferometer.

Course Contents

Unit 1

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages, damped oscillations, forced vibrations and resonance. **[No. of Hours: 10]**

Unit 2

Superposition Principle and Sound: Oscillations having equal frequencies and Oscillations having different frequencies (Beats). Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses. Fourier's Theorem-Application to saw tooth wave and square wave – Intensity and loudness of sound – Decibels – Intensity levels – musical notes – musical scale. Acoustics of buildings: Reverberation and time of reverberation – Absorption coefficient – Sabine's formula -measurement of reverberation time. **[No. of Hours: 15]**

Unit 3

Waves motion and Optics: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity. Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. **[No. of Hours: 10]**

Unit 4

Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection:

Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings. Michelson's Interferometer and application. **[No. of Hours: 15]**

Unit 5

Diffraction and Polarization: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization. **[No. of Hours: 10]**

Text Books:

TB1. Integrated Wave and Optics, J.P. Agarwal, Pragati Publication.
TB2. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill

Reference Books:

RB1. Principles of Optics, B.K. Mathur, 1995, Gopal Printing

RB2. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication

RB3. University Physics. FW Sears, MW Zemanskyand HD Young13/e, 1986.Addison.

Course outcomes (Cos):

Upon successful completion of the course a student will be able to

CO1	Define and describe Oscillations, Superposition Principle and Sound, optics, interference, Diffraction and Polarization.
CO2	Understand about the concept of SHM, Newton's rings, Sabine's formula, polarization, Interference by division of amplitude and division of wavefront and Fresnel and Fraunhoffer diffraction.
CO3	Apply standing waves, zone plate, Lissajous figures, Michelson's Interferometer.
CO4	Analyse about the Fresnel and Fraunhoffer diffraction, Fourier's Theorem, Acoustics of buildings, Huygen's principle , Interference in Thin Films, damped oscillations, forced vibrations and resonance, Lissajous figures.
CO5	Evaluate the production of Plane polarized light, Circular and elliptical polarized light, Group velocity, Phase velocity , Group velocity, Phase velocity, principle of superposition of waves
CO6	Formulate the Characteristics of Diffraction grating, Newton's Rings, Half-period zones, single slit, double slit

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	2	2	2	2	1	1	2	1	1	1	1
CO2	1	2	2	2	2	2	3	2	2	2	2	3	2	1	2	2
CO3	2	3	2	3	2	3	2	2	3	2	2	2	2	2	2	2
CO4	1	1	2	2	3	2	2	1	2	2	1	3	2	1	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	2	2	2	2	2	1	2	1	1	1	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHL401**			
Course Name	**: Lab. Course based on BPHC401**			
Semester /Year	**: IV / II**			
L	**T**	**P**	**C**	
0	**0**	**4**	**2**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to teach the students coupled oscillators, Tuning Fork, Schuster`s focusing, refractive index of the material, resolving power of a prism, Newton's Rings, Fresnel Biprism, single-slit, and plane diffraction grating by having the students perform hands on experiments supervised by a specialized instructor.

Course Contents **Total hours: 60**

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ2– T Law.
3. To study Lissajous Figures.
4. Familiarization with Schuster`s focusing; determination of angle of prism.
5. To determine the Height of a Building using a Sextant.
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
8. To determine the value of Cauchy Constants of a material of a prism.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of Mercury light using plane diffraction Grating.
14. To measure the intensity using photo sensor and laser in diffraction patterns of single and double slits.

Text Books:

TB1. Practical Physics, Gupta Kumar, Pragati Publication.
TB2. Advanced Practical Physics for students, B. L. Flint & H. T. Worsnop, 1971, Asia Publishing House.

Reference Books:

RB1. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
RB2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11thEdition, 2011, Kitab Mahal, New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe about the motion of coupled oscillators and observe the wavelength of Laser light using Diffraction of Single Slit
CO2	Observe the Height of a Building using a Sextan, the intensity using photo sensor and laser in diffraction patterns of single and double slits
CO3	Determine the wavelength of sodium light using Fresnel Biprism and Newton's ring, Resolving Power of a Prism, value of Cauchy Constants of a material of a prism
CO4	Analyse the wavelength of Mercury light using plane diffraction Grating
CO5	Evaluate Dispersive Power of the Material of a given Prism using Mercury Light, Refractive Index of the Material of a given Prism using Sodium Light
CO6	Formulate the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2– T Law and Familiarization with Schuster`s focusing, determination of angle of prism

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	2	2	3	2	3	2	3	2	2	2	2	3	2	2	3	3
CO3	3	3	2	3	2	2	2	2	3	2	3	2	2	2	2	2
CO4	3	2	3	2	2	1	2	1	2	3	2	3	2	2	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	2
CO6	2	1	2	2	1	1	2	1	1	2	1	2	3	3	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHD501**			
Course Name	**: Elements of Modern Physics**			
Semester /Year	**: V / III**			
L	**T**	**P**	**C**	
4	**0**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about Photoelectric effect, de Broglie hypothesis and various atomic models. Acquire knowledge and understanding of Schrodinger equation, nuclear properties, radioactive decay and processes.

Course Contents

Unit 1

Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. de- Broglie wavelength and matter waves; Davisson-Germer experiment. **[No. of Hours: 10]**

Unit 2

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. **[No. of Hours: 5]**

Unit 3

Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability current densities in one dimension.

[No. of Hours: 20]

Unit 4

One dimensional infinitely rigid box- energy eigen values and eigen functions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier. **[No. of Hours: 10]**

Unit 5

Size and structure of atomic nucleus and its relation with atomic weight; Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life; α decay; βdecay.

Fission and fusion: mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear Reactions **[No. of Hours: 15]**

Text Books:

TB1. Integrated Elements of Modern Physics, J.P. Agarwal, Pragati Publication.
TB2. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill

Reference Books:

RB1. Modern Physics, John R.Taylor, Chris D.Zafiratos, Michael A.Dubson,2009, PHI Learning

RB2. Six Ideas that Shaped Physics:Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill

RB3. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.

RB4. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Visualize quantum Mechanics and Bohr Atom Model, Quantum Systems and Heisenberg Uncertainty Principle, Matter Waves and Schrödinger Equation, Motion in a Potential Well, Radioactivity, Fission and fusion.
CO2	Understanding Radioactivity: stability of nucleus; Law of radioactive decay, De Broglie wavelength and matter waves; Davisson-Germer experiment, Bohr's model, nuclear forces, liquid drop model
CO3	Apply Compton scattering, semi-empirical mass formula and binding energy, packing fraction, expectation value, Mean life & half-life; One dimensional infinitely rigid box-energy eigenvalues andeigen functions.
CO4	Analyze α decay; βdecay, γ decay, Fission and fusion , Nuclear reactor,

	Planck's constant, Photoelectric effect, binding energy, packing fraction, expectation value, wave function
CO5	Evaluate Schrodinger equation, Heisenberg uncertaintyprinciple, laws of photoelectric emission, Rutherford model, Bohr's model, quantization rule and atomic stability.
CO6	Solve Probability and probability current densities in one dimension, binding energy, Mean life & half-life; calculation of energy levels for hydrogen like atoms and their spectra.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	1	3	2	2	2	2	3	2	2	2	2	3	2	3	2	2
CO3	2	3	2	3	2	2	2	2	3	2	3	2	2	2	2	2
CO4	1	1	2	2	2	1	2	1	2	3	2	3	2	1	3	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	2	2	2	2	1	1	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHL501**			
Course Name	**: Lab. Course based on BPHD501**			
Semester /Year	**: V / III**			
L	**T**	**P**	**C**	
0	**0**	**4**	**2**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to teach the students Boltzmann constant, work function of material, Planck's constant using LEDs, diffraction patterns of single and double slits, Photo-electric effect, and Millikan oil drop apparatus by having the students perform hands on experiments supervised by a specialized instructor.

Course Contents: **Total hours: 60**

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum Diode.
3. To determine value of Planck's constant using LEDs of at least 4 different colours.
4. To determine the ionization potential of mercury.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photo sensor and compare with incoherent source – Na light.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
9. To determine the value of e/m by magnetic focusing.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Text Books:

TB1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.

TB2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Reference Books:

RB1. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

RB2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11thEdition, 2011, Kitab Mahal, New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Learn and gain knowledge of PN diode, vacuum Diode, diffraction patterns, LEDs
CO2	Understand about work function of material of filament of directly heated vacuum Diode, value of Boltzmann constant using V-I characteristic of PN diode, absorption lines in the rotational spectrum of Iodine vapour
CO3	Apply the Photo-electric effect and calculate photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
CO4	Analyse Millikan oil drop apparatus and determine the charge of an electron, the absorption lines in the rotational spectrum of Iodine vapour
CO5	Evaluate the value of e/m by magnetic focusing, the wavelength of H-alpha emission line of Hydrogen atom, value of Planck's constant using LEDs of at least 4 different colours
CO6	Formulate the results of diffraction patterns of single and double slits using laser source and measure its intensity variation using Photo sensor and compare with incoherent source – Na light

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	1	1	2	2	2	2	2	2	1	1	1	1
CO2	1	3	2	2	3	2	3	3	2	2	2	3	2	3	2	3
CO3	2	2	2	3	2	2	2	2	2	3	3	2	2	2	2	2
CO4	1	2	1	2	2	1	2	2	1	2	2	3	2	1	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	2	2	1	1	1	1	2	2	1	1	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHD502**			
Course Name	**: Mathematical Physics**			
Semester /Year	**: V / III**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about special integral, calculus of functions, complex variables and their main emphasis is on applications in solving problems of interest to physicists.

Course Contents

Unit 1

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **[No. of Hours: 8]**

Unit 2

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. **[No. of Hours: 15]**

Unit 3

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations. **[No. of Hours: 10]**

Unit 4

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry.

[No. of Hours: 12]

Unit 5

Complex Analysis: 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. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula.

[No. of Hours: 15]

Text Books:

TB1. Harper C. Analytical Mathematics in Physics, Prentice Hall (1999).

TB2. Boas M.L. Mathematical Methods in the Physical Sciences, John Wiley & Sons, New York (1983).

Reference Books:

RB1. Mathematical Physics, B.S. Rajput, Pragati Publication
RB2. Mathematical Physics, H.K. Dass, S. Chand Publication
RB3. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
RB4. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
RB5. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
RB6. An Introduction to Ordinary Differential Equations, Earl A Coddington, 1961, PHI Learning.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Visualize Calculus of functions of more than one variable, Fourier Series, Frobenius Method and Special Functions, Some Special Integrals, Partial Differential Equations, Complex Analysis
CO2	Understanding Beta and Gamma Functions and Relation between them, Properties of Legendre Polynomials
CO3	Apply Cauchy's Integral formula, Euler's formula, De Moivre's theorem, Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry, Rodrigues Formula, Frobenius method
CO4	Analyze Beta and Gamma Functions and Relation between them, Properties of Legendre Polynomials, Periodic functions. Orthogonality of

	sine and cosine functions, Dirichlet Conditions, Expression of Integrals in terms of Gamma Functions. Error Function.
CO5	Evaluate Constrained Maximization using Lagrange Multipliers, Expansion of non-periodic functions over an interval, Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable
CO6	Solve Euler's formula, De Moivre's theorem, Roots of Complex Numbers, . Legendre, Bessel, Hermite and Laguerre Differential Equations, Cauchy's Inequality. Cauchy's Integral formula.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	1	1	2	2	1	1	2	2	1	1	1	1
CO2	2	2	1	2	2	2	3	2	2	2	3	3	2	1	2	2
CO3	2	3	2	3	2	2	2	3	2	2	2	2	2	2	2	2
CO4	1	2	1	1	2	1	2	2	2	1	2	3	2	1	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	1	1	2	2	1	1	2	2	1	1	2	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHL502**				
Course Name	**: Lab. Course based on BPHD502**				
Semester /Year	**: V / III**				
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to teach the students Computer architecture, Input/output devices, Binary and decimal arithmetic, errors and error analysis, C & C++ Programming fundamentals. Students learn hands on experience to solve physics problem using mathematical tools using computer programming.

Course Contents **Total hours: 60**

Unit 1

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming Fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While-Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D&2D) and strings, user defined functions, Structures and Unions,

	Idea of classes and objects
Programs: using C/C++ language	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending-descending order, Binary search.
Random number generation	Area of circle, area of square, volume of sphere, value of Pi (π)
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\alpha = \tan\alpha$; $I = Io[(\sin\alpha)/\alpha]2$ in optics
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. sin θ, cos θ, tanθ, etc.
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method	Given Position with equidistant time data to calculate velocity and acceleration and vice-versa. Find the area of B-H Hysteresis loop

Attempt following problems using Runge- kutta fourth order method:

1. Solve the coupled first order differential equations:
   for four initial conditions $x(0) = 0$, $y(0) = -1, -2, -3, -4$.
   Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$.

2. The differential equation describing the motion of a pendulum is $d2v/dt2 = -\sin(v)$. The pendulum is released from rest at an angular displacement α i.e. $v(0) = \alpha$, $v'(0) = 0$. Solve the equation for $\alpha = 0.1$, 0.5 and 1.0 and plot v as a function of time in the range $0 \leq t \leq 8\pi$. Also, plot the analytic solution valid for small v ($\sin(v)) = v$.

Text Books:

TB1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.

TB2. Schaum's Outline of Programming with C++. J. Hubbard, 20 00, McGraw-Hill Publications.

Reference Books:

RB1. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.

RB2. A first course in Numerical Methods, Uri M. Ascher and Chen Greif, 2012, PHI Learning.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Learn and Gain knowledge of Basics of scientific computing, Errors and error Analysis, C & C++ Programming fundamentals, Random number generation, Interpolation methods, Error estimation of linear interpolation, Numerical differentiation, and Integration
CO2	Understand about Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods, Random number generation, Interpolation methods, Error estimation of linear interpolation, Numerical differentiation, and Integration
CO3	Apply Bisection , Newton Raphson and Secant methods, Random number generation, Interpolation methods, Error estimation of linear interpolation, Numerical differentiation, and Integration in various problems
CO4	Analyse Basics of scientific computing, Errors and error Analysis, C & C++ Programming fundamentals, Random number generation, Interpolation methods, Error estimation of linear interpolation, Numerical differentiation, and Integration
CO5	Evaluate about Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods, Random number generation, Interpolation methods, Error estimation of linear interpolation, Numerical differentiation, and Integration, C & C++ Programming
CO6	Formulate the solution Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods, Random number generation, Interpolation methods, C & C++ Programming Error estimation of linear interpolation, Numerical differentiation, and Integration

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	1	2	2	2	2	2	1	2	2	1	1	1	1
CO2	2	2	2	2	3	2	3	2	2	2	2	3	2	3	2	3
CO3	1	1	1	2	2	2	2	3	2	2	3	2	2	2	2	2
CO4	1	2	1	3	2	1	1	2	1	1	2	3	2	1	1	3
CO5	2	2	2	2	1	1	2	2	1	2	2	2	1	1	2	2
CO6	1	2	1	2	3	2	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHD601**				
Course Name	**: Solid State Physics**				
Semester /Year	**: VI / III**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about the Crystal structure, Magnetic and Dielectric properties of materials and acquire basic knowledge and understanding of superconductors.

Course Contents

Unit 1

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor. **[No. of Hours: 10]**

Unit 2

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3law **[No. of Hours: 10]**

Unit 3

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. **[No. of Hours: 10]**

Unit 4

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mossotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Langevin-

Debye equation. Complex Dielectric Constant. **[No. of Hours: 15]**

Unit 5

Elementary band theory: Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth, Isotope effect. **[No. of Hours: 15]**

Text Books:

TB1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
TB2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

Reference Books:

RB1. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
RB2. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
RB3. Solid-state Physics, H.Ibach and H Luth, 2009, Springer
RB4. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Visualize Crystal Structure, Elementary Lattice Dynamics, Magnetic Properties of Matter, Dielectric Properties of Materials, Elementary band theory, superconductivity
CO2	Understanding Type I and type II Superconductors, London's Equation, Langevin-Debye equation, Brillouin Zones, Langevin Theory of dia – and Paramagnetic Domains, Discussion of B-H Curve. Hysteresis and Energy Loss.
CO3	Apply Unit Cell. Miller Indices. Reciprocal Lattice, Dia-, Para-, Ferri- and Ferromagnetic Materials, Einstein and Debye theories of specific heat of solids. T^3law,
CO4	Analyze Types of Lattices, Acoustical and Optical Phonons, P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient, Normal and Anomalous Dispersion, Diffraction of X-rays by Crystals. Bragg's Law.
CO5	Evaluate Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. B-H Curve. Hysteresis and Energy Loss, Isotope effect, Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors.

CO6	Solve Unit Cell. Miller Indices. Reciprocal Lattice, Atomic and Geometrical Factor, Susceptibility. Polarizability. Clausius Mossotti Equation, Langevin-Debye equation, Complex Dielectric Constant.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	2	2	2	2	2	2	3	2	2	2	2	3	2	1	2	2
CO3	3	2	1	1	2	2	1	2	2	2	3	2	2	2	2	2
CO4	2	1	1	2	2	2	2	2	3	3	2	3	2	1	1	3
CO5	2	3	2	2	2	3	2	3	2	2	2	2	1	1	2	2
CO6	2	2	2	2	1	2	3	2	3	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHL601**				
Course Name	**: Lab. Course based on BPHD601**				
Semester /Year	**: VI / III**				
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to teach the students magnetic susceptibility, dielectric constant, refractive index and hall coefficient by having the students perform hands on experiments supervised by a specialized instructor.

Course Contents **Total hours: 60**

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. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)
6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four probe method (from room temperature to 150 °C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Text Books:

TB1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia
TB2. Publishing House.
TB3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publisher

Reference Books:

RB1. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011,Kitab Mahal, New Delhi
RB2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Learn and Gain knowledge of Magnetic susceptibility, Ferroelectric Crystals, Dielectric Constant, semiconductors, magnetic materials
CO2	Understand the concept and measure the Magnetic susceptibility of Solids, the resistivity of a semiconductor (Ge) crystal with temperature by four probe method
CO3	Apply the principle and calculate the Coupling Coefficient of a Piezoelectric crystal, the Hall coefficient of a semiconductor sample
CO4	Analyze and measure the Dielectric Constant of a dielectric Materials with frequency, the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance
CO5	Evaluate the refractive index of a dielectric layer using SPR, susceptibility of paramagnetic solution, Hysteresis loop of a Ferroelectric Crystal
CO6	Formulate and draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	2	1	1	2	2	1	2	2	1	1	1	1
CO2	2	2	2	2	3	2	3	2	2	2	2	3	2	3	2	3
CO3	2	3	3	3	2	2	2	2	3	3	3	2	2	2	2	2
CO4	1	2	3	2	3	2	1	1	2	3	2	3	2	1	1	3
CO5	2	2	2	2	2	1	1	2	2	2	2	2	1	1	2	2
CO6	1	1	2	1	2	3	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHD602**				
Course Name	**: Quantum Mechanics**				
Semester /Year	**: VI / III**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about the Time dependent and independent Schrodinger equation, Larmor's theorem, Zeeman effect and acquire basic knowledge of Spin orbit coupling and Vector model.

Course Contents

Unit 1

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigen values and Eigen functions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. **[No. of Hours: 10]**

Unit 2

Time independent Schrodinger equation-Hamiltonian, stationary states and energy Eigen values; expansion of an arbitrary wave function as a linear combination of energy Eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle. **[No. of Hours: 15]**

Unit 3

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions using Frobenius method. **[No. of Hours: 10]**

Unit 4

Quantum theory of hydrogen-like atoms: Time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wave functions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d, shells (idea only). **[No. of Hours: 10]**

Unit 5

Atoms in Electric and Magnetic Fields:- Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Atoms in External Magnetic Fields:- Normal and Anomalous Zeeman Effect.

Many electron atoms:- Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. Spin-orbit coupling in atoms-L-S and J-J couplings. **[No. of Hours: 15]**

Text Books:

TB1. A Text book of Quantum Mechanics, P.M.Mathews & K.Venkatesan, 2nd Ed., 2010, McGraw Hill
TB2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
TB3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.

Reference Books:

RB1. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
RB2. Quantum mechanics, SatyaPrakash, Swati Saluja, KedarNath, Ram Nath&Co.
RB3. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
RB4. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Visualize time dependent and independent Schrodinger equation, bound states in an arbitrary potential, Quantum theory of hydrogen-like atoms, Atoms in Electric and Magnetic Fields, Many electron atoms.
CO2	Understanding Spin-orbit coupling in atoms-L-S and J-J couplings , Time dependent Schrodinger equation and independent equation, Time independent Schrodinger equation in spherical polar coordinates, Stern-Gerlach Experiment.
CO3	Apply Normal and Anomalous Zeeman Effect, Pauli's Exclusion Principle, application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions.
CO4	Analyze Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions, Spectral Notations for Atomic States. Total Angular Momentum. Vector Model, Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem.
CO5	Evaluate uncertainty principle, Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions, application of barrier tunneling.
CO6	Solve commutation relation, angular momentum operator and quantum numbers; Radial wave functions, Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	1	2	2	2	2	2	3	2	2	2	2	3	2	3	3	2
CO3	2	3	2	3	2	2	2	2	3	2	3	2	2	2	2	2
CO4	1	1	2	2	2	1	2	1	2	3	2	3	2	1	1	3
CO5	2	3	2	2	2	2	2	2	2	2	2	2	1	1	2	2
CO6	2	2	2	2	1	1	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHL602**				
Course Name	**: Lab. Course based on BPHD602**				
Semester /Year	**: VI / III**				
	L	**T**	**P**	**C**	
	0	**0**	**4**	**2**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to teach the students to use C/C++/ Scilab for solving the following problems based on Quantum Mechanics. And to learn about electron spin resonance, Zeeman effect and quantum tunneling by having the students perform hands on experiments supervised by a specialized instructor.

Course Contents **Total hours: 60**

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$d^2y/dr^2 = A(r)u(r)$, $A(r) = 2m/\hbar^2\,[V(r) - E]$ where $V(r) = -e^2/r$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues andplot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is -13.6 eV. Take $e = 3.795\ (eVÅ)^{1/2}$, $\hbar c = 1973$ (eVÅ) and $m = 0.511 \times 10^6 eV/c^2$.

2. Solve the s-wave radial Schrodinger equation for an atom:

$d^2y/dr^2 = A(r)u(r)$, $A(r) = 2m/\hbar^2\,[V(r) - E]$

Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

$$V(r) = -e^2(1/r)e^{-r/a}$$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wave function. Take $e = 3.795\ (eVÅ)^{1/2}$, $m = 0.511 \times 10^6 eV/c^2$, and a = 3 Å, 5 Å, 7 Å. In these units $\hbar c = 1973$ (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$d^2y/dr^2 = A(r)u(r)$, $A(r) = (2m/\hbar^2)\,[V(r) - E]$

For the anharmonic oscillator potential

$V(r) = k r^2 + br^3$

for the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940MeV/c^2, k = 100 MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3}In these units, ch = 197.3 MeVfm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen Molecule:
$d^2y/dr^2=A(r)u(r)$, $A(r) = (2\mu/\hbar^2)\,[V(r) - E]$
where μ is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D(e^{-2\alpha r'} - e^{-\alpha r'}),$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.
Take: m = 940x10^6eV/C2, D = 0.755501 eV, α = 1.44, r_o = 0.131349 Å

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.

Text Books:

TB1. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Publications.
TB2. Numerical Recipes in C: The Art of Scientific Computing, W.H.Press et al.,3rdEdn., 2007, Cambridge University Press.
TB3. Elementary Numerical Analysis, K.E.Atkinson, 3rdEd n. , 2007 , Wiley India Edition.

Reference Books:

RB1. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V.Fernández.2014 Springer ISBN: 978-3319067896
RB2. Scilab by example: M. Affouf2012ISBN: 978-1479203444
RB3. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand and Company, New Delhi ISBN: 978-8121939706
RB4. Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 978-6133459274A
RB5. Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define and describe the problems based on quantum mechanics, Electron spin resonance, Zeeman effect, quantum tunneling effect, tunnel diode
CO2	Gain understanding of solving the Schrodinger problems based on quantum mechanics, Zeeman effect, tunnel diode, electron spin resonance
CO3	Apply quantum tunnelling effect with solid state device, Schrodinger equation to quantum problems,
CO4	Analyse the exposure of Zeeman effect with an external magnetic field; Hyperfine splitting, Schrodinger equation for various problems.
CO5	Evaluate the solutions of Schrodinger equation, Zeeman effect problems, Electron spin resonance
CO6	Formulate the results of quantum tunnelling effect, Zeeman effect, Schrodinger equation problems, electron spin response.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1	1	2	2	2	1	2	2	1	1	1	1
CO2	1	2	2	2	3	2	3	2	2	2	2	3	2	3	3	2
CO3	2	3	2	3	2	2	2	2	3	3	3	2	2	2	2	2
CO4	1	1	2	2	2	1	2	1	2	3	2	3	2	1	1	3
CO5	2	2	2	2	2	2	2	2	3	2	2	2	1	1	2	2
CO6	2	2	2	2	1	1	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Skill Enhancement Courses

(Any one of the following may be opted in Semester III or IV or V & one more course may be opted in VI Semester)

Course code	**: BPHS302**				
Course Name	**: Computational Physics**				
Semester /Year	**: III/ II**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. Highlights the use of computational methods to solve physical problems. Use of computer language as a tool in solving physics problems (applications).

Course Contents

Unit 1

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor.

[No. of Hours: 5]

Unit 2

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.

[No. of Hours: 7]

Unit 3

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.

[No. of Hours: 13]

Unit 4

Programming:

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using exp(x) series evaluated at x=1

[No. of Hours: 10]

Unit 5

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.

[No. of Hours: 10]

Unit 6

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.

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of 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 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 horizontally.
8. Creating an input Gnuplot file for plotting a 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 particle in a central force field and plot the output for visualization.

[No. of Hours: 15]

Text Books:

TB1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
TB2. Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI).

Reference Books:

RB1. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
RB2. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
RB3. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
RB4. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999)
RB5. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
RB6. Elementary Numerical Analysis, K.E. Atkinson, 3rd E d n. 2007, Wiley India Edition

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define and describe Algorithms and Flowcharts, Scientific Programming, Scientific word processing, Visualization, Equation representation.
CO2	Understand about the FORTRAN, Algorithms and Flowcharts, LaTeX word processor, Gnuplot.
CO3	Apply Gnuplot, FORTRAN, LaTeX, flowchart in programming
CO4	Analyse sin (x) as a series, Operators, Expressions, Euler number
CO5	Evaluate the results of scientific programming, FORTRAN, Algorithms and Flowcharts, LaTeX word processor, Gnuplot programming.
CO6	Formulate the expressions of Algorithms and Flowcharts, Scientific Programming, Scientific word processing, Visualization, Equation representation in various problems.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	1	1	2	2	1	2	1	1	2	1	1	1
CO2	1	2	2	2	2	2	3	2	2	2	2	2	2	1	2	2
CO3	2	3	2	3	2	2	2	3	2	3	2	2	3	2	2	2
CO4	1	1	2	2	2	1	2	1	2	2	2	1	1	1	1	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2
CO6	2	2	2	2	1	1	2	2	2	2	1	1	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHS402**			
Course Name	**: Radiation Safety**			
Semester /Year	**: IV/ II**			
L	**T**	**P**	**C**	
4	**0**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is for awareness and understanding regarding radiation hazards and safety. To make students aware about basics of nuclear physics, interaction of charged particles, radiation detection and nuclear waste and disposal management.

Course Contents

Unit 1

Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half-life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission. **[No. of Hours: 10]**

Unit 2

Interaction of Radiation with matter: Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, **Interaction of Photons** – Photoelectric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients. **[No. of Hours: 10]**

Unit 3

Interaction of Charged Particles: Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung).
Interaction of Neutrons- Collision, slowing down and Moderation. **[No. of Hours: 10]**

Unit 4

Radiation detection and monitoring devices:
Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC).
Radiation detection: Basic concept and working principle of *gas detectors* (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), Scintillation Detectors (Inorganic and Organic Scintillators), Solid States Detectors and Neutron Detectors, Thermo luminescent Dosimetry. **[No. of Hours: 15]**

Unit 5

Radiation safety management: Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management.
Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. *Industrial Uses:* Tracing, Gauging, Material Modification, Sterization, Food preservation. . **[No. of Hours: 15]**

Text Books:

TB1. B.R. Martin : Nuclear & Particle Physics

TB2. Tayal, D.C.,Nuclear Physics, Himalaya Publishing House, Mumbai

TB3. Nuclear & Particle Physics-B.R. Martin & G. Shaw

Reference Books:

RB1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995)
RB2. G.F. Knoll, Radiation detection and measurements
RB3. Thermoluninescense Dosimetry, Mcknlay, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
RB4. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". John Wright and Sons, UK, 1989.
RB5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981.
RB6. A. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc. New York, 1981.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define and describe Basics of Atomic and Nuclear Physics, Interaction of Radiation with matter, Interaction of Charged Particles, Interaction of Charged Particles, Radiation detection and monitoring devices Radiation safety management
CO2	Understand about the concepts of Atomic and Nuclear Physics, Interaction of Radiation with matter, Interaction of Charged Particles, Interaction of Charged Particles, Radiation Quantities and Units, Radiation detection Radiation safety management
CO3	Apply nuclear techniques, radiation detection methods, radiation safety management in various problems.
CO4	Analyse radiation safety measures, radiation detection methods, interaction of charged particles, Interaction of Radiation with matter.
CO5	Evaluate the working of gas detectors, ICRP, nuclear techniques
CO6	Write the characteristics of basics of atomic and nuclear Physics, Radiation Quantities and Units

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	1	1	2	2	2	1	2	2	2	2	2	1
CO2	2	2	2	2	2	2	3	2	2	2	2	3	3	2	2	2
CO3	2	3	2	3	2	2	2	2	3	2	3	2	2	2	3	2
CO4	2	2	2	2	2	1	2	1	2	3	2	3	2	1	2	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO6	2	2	1	2	1	1	2	1	1	2	1	2	2	1	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHS503**			
Course Name and Filters)	**: Electronics –I (Network Theorems, Solid state Devices, Rectifiers**			
Semester /Year	**: V / III**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to make the student aware about the working of different Electronic devices used in daily life being used in different electronic appliances and also to provide knowledge and understanding of Boolean algebra and various logic gates.

Course Contents

Unit 1

Network analysis and Network Theorem

Kirchhoff's Law, Series parallel corrections, Network Theorems, Superposition, Reciprocity, Theremins, Norton's Maximum power, Transfer Theorem, Low pass and High pass filters, Four terminal Network, Electronic Measuring Instruments: VTVM, CRO. **[No. of Hours: 20]**

Unit 2

Solid State Devices

Electronics Devices: General idea of Diode, Triode, Tetrode, Pentode and their characteristics, intrinsic and extrinsic n-type and p-type semiconductors, P-N junction, Semiconductor junction diode, point contact, Zener, Varactor, Tunnel diode , Photodiode, Light emitting diode, Junction. Transistors, Transistor operation, characteristic Curves, common emitter, common base and common collector configurations, current amplification, Field effect transistor. **[No. of Hours: 20]**

Unit 3

Rectifiers and Filters

HW, FW and bridge rectifiers, Filter circuits(Series L, Shunt C.L-Section-II).Unregulated PS Regulated PS Voltage regulation by Zener diode, Voltage multiplier, Binary ,Decimal, Hexadecimal and Octal number systems and interconversions, BCD, Elementary idea of logic gate and Boolean algebra. **[No. of Hours: 20]**

Text Books:

TB1. Basic Electronics, B.L. Theraja, S. Chand Publication.
TB2. Principles of Electronics, V.K. Mehta, Rohit Mehta, S. Chand Publication.
TB3. Handbook of Electronics, Gupta Kumar, Pragati Publication.

Reference Books:

RB1. Digital Circuits and Systems, Venugopal, 2011, Tata McGraw Hill.
RB2. Electronic Devices and Circuits, S. Salivahanan & N. S.Kumar, 3rd Ed.,2012, Tata McGraw Hill.
RB3. Digital Principles and Applications, A.P. Malvino , D.P. Leach & Saha,7th Ed., Tata McGraw Hill
RB4. Fundamentals of Digital Circuits , A. Anand kumar, 2nd Edition,2009, PHI Learning Pvt. Ltd.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Visualize network analysis and Network Theorem, Solid State Devices, Rectifiers and Filters.
CO2	Understanding network Theorems, CRO, VTVM, Diode, Triode, Tetrode, Pentode and their characteristics, Transistors, common emitter, common base and common collector configurations, current amplification.
CO3	Apply HW, FW rectifiers, , Low pass and High pass filters, Binary ,Decimal, Hexadecimal and Octal number systems and interconversions.
CO4	Analyze logic gate and Boolean algebra, Kirchhoff's Law, Series parallel corrections, intrinsic and extrinsic n-type and p-type semiconductors, P-N junction, Semiconductor junction diode
CO5	Evaluate Four terminal Network, Zener, Varactor, Tunnel diode , Photodiode, Light emitting diode, Junction, P-N junction.
CO6	Solve Binary ,Decimal, Hexadecimal and Octal number systems and interconversions, Low pass and High pass filters

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2	1	2	2	1	1	1	2	2	1	1	1	1
CO2	2	3	2	2	2	2	3	2	2	2	2	3	2	1	2	2
CO3	2	2	2	3	2	3	2	2	2	2	3	2	2	2	2	2
CO4	1	2	1	2	3	2	3	2	1	3	2	3	2	1	1	3
CO5	2	2	2	2	2	2	2	1	2	2	2	2	1	1	2	2
CO6	1	2	1	1	2	1	2	3	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BPHS603**			
Course Name	**: Electronics-II (Amplifiers and oscillators)**			
Semester /Year	**: VI / III**			
L	**T**	**P**	**C**	
4	**0**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course is to provide an understanding about the Transistor amplifier, Power amplifier, Multivibrators and their physical significance. To provide knowledge and understanding of Negative feedback and its advantages.

Course Contents

Unit 1

Transistor Amplifier

Classification, Basic Amplifier, Load Line, Transistor biasing, Transistor equivalent circuit (h-Parameter). Single stage transistor amplifier, (common emitter, common base) FET amplifier, R.C coupled transistor amplifier, Impedance coupled and Transformer coupled amplifier, Noise and distortion in amplifiers, Power amplifiers (Class A Push pull class B and class C) Decibel, Frequency response bandwidth. **[No. of Hours: 30]**

Unit 2

Feedback Amplifiers and Oscillators

Classification, Negative feedback and its advantages, Feedback amplifiers (Voltage and current) Positive feedback oscillators (RC phase shift and Wein bridge, Hartley, Colpitt, tuned collector, tuned base) Oscillator, Negative resistance (tuned diode oscillator),Crystal oscillators, Stability, Relaxation oscillators-Multivibrators (astable, monostable and bistable)

[No. of Hours: 30]

Text Books:

TB1. Basic Electronics, B.L. Theraja, S.Chand Publication
TB2. Principles of Electronics, V.K. Mehta, Rohit Mehta, S.Chand Publication
TB3. Handbook of Electronics, Gupta Kumar, Pragati Publication

Reference Books:

RB1. Digital Circuits and Systems, Venugopal, 2011, Tata McGraw Hill.
RB2. Electronic Devices and Circuits, S. Salivahanan& N. S.Kumar, 3rd Ed.,2012, Tata McGraw Hill.

RB3. Digital Principles and Applications, A.P. Malvino , D.P. Leach & Saha,7th Ed., Tata McGraw Hill
RB4. Fundamentals of Digital Circuits, A. Anand kumar, 2nd Edition,2009, PHI Learning.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define and describe transistor amplifier, feedback amplifiers and oscillators
CO2	Understand about power amplifiers, feedback amplifiers R.C coupled, Impedance coupled and Transformer coupled amplifiers, multivibrators
CO3	Explain the working of crystal oscillator, positive feedback oscillators, negative resistance oscillators and various transistor amplifiers
CO4	Analyse the working of FET amplifier, relaxation oscillators, Single stage transistor amplifier, Noise and distortion in amplifiers
CO5	Evaluate the applications of various oscillators, transistor amplifier, power amplifiers and feedback amplifiers
CO6	Write the Classification of Basic Amplifier, characteristics of Load Line, Transistor biasing, Transistor equivalent circuit.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	2	1	1	1	1	2	1	2	2	1	1	1	1
CO2	1	2	2	3	2	3	2	3	2	2	2	3	2	3	2	3
CO3	2	3	3	2	2	2	2	2	3	3	3	2	2	2	2	2
CO4	1	3	2	3	2	1	1	3	2	3	2	3	2	1	1	3
CO5	2	2	2	2	1	1	2	2	2	2	2	2	1	1	2	2
CO6	2	2	2	2	1	1	2	1	1	2	1	2	3	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated