List of New Course(s) Introduced

Department : ***Pure and applied physics***

Programme Name : ***B.Sc. physics***

Academic Year : 2020-21

List of New Course(s) Introduced

Sr. No.	Course Code	Name of the Course
01.	PS/PHY/DSE-502L	Experimental Techniques
02.	PS/PHY/C-501P	Quantum Mechanics Lab
03.	PS/PHY/C-502P	Solid State Physics Lab
04.	PS/PHY/DSE-502P	Experimental Techniques LAB
05.	PS/PHY/DSE-501P	Nano Materials and Applications Lab
06.	PS/PHY/C-602L	Statistical Mechanics
07.	PS/PHY/C-602P	Statistical Mechanics Lab

Minutes of Meetings (MoM) of Board of Studies (BoS)

Academic Year : 2020-21	
School	: *School of Physical Sciences*
Department	: *Pure and Applied Physics*
Date and Time	: *July 13, 2018 – 11:30 AM; July 18, 2018 – 5:00 PM*
Venue	: *Smart Class Room*

The scheduled meetings of member of Board of Studies (BoS) of Department of Pure and Applied Physics, School of Studies of Physical Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur, were held to design and discuss the B. Sc. (Physics) Third year (V and VI Semesters), scheme and syllabi.

The following members were present in the meeting:

1. Prof. P K. Bajpai
2. Dr. H. S. Tewari
3. Prof. S. B. Kondawar (External Member)
4. Dr. M. N. Tripathi
5. Dr. P. Thakur
6. Dr. R. K. Pandey
7. Dr. T. G. Reddy
8. Dr. R. P. Prajapati
9. Dr. A. K. Gupta
10. Dr. M. P. Sharma
11. Dr. P. Das
12. Dr. T. Trivedi
13. Dr. S. P. Patel
14. Prof. R. Dhar (External member)

The committee discussed and approved the scheme and syllabi. The following Skill Enhancement courses were added in the B. Sc. (Physics) Third year (V and VI Semesters):

Experimental Techniques

Quantum Mechanics Lab
Solid State Physics Lab
Experimental Techniques LAB
Nano Materials and Applications Lab

Statistical Mechanics
Statistical Mechanics Lab

Signature & Seal of HoD

Scheme and Syllabus

Semester	Course Opted	Course Code	Name of the course	Credit	Hour / weak
I	Core-1	PS/PHY/C-101L	**Mathematical Physics-I**	4	4
	Core -1 Practical	PS/PHY/C-101P	**Mathematical Physics-I Lab**	2	4
	Core -2	PS/PHY/C-102L	**Mechanics**	4	4
	Core -2 Practical	PS/PHY/C-P-102P	**Mechanics Lab**	2	4
	Generic Elective -1 (GE- IA)	PS/PHY/GE-101	To be opted from the pool*	4	4
	Generic Elective - Practical	PS/PHY/GE-P-101	GE-101 practical as opted	2	4
	Ability Enhancement Compulsory Course (AECC)	PS/PHY/AE-101/EC	English Communication / MIL (Hindi Communication)	4*	4
	ECA	Open elective(Optional)	ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)
			TOTAL	24	28
II	Core-3	PS/PHY/C-203	**Electricity and Magnetism**	4	4
	Core -3 Practical	PS/PHY/CP-203	**Electricity and Magnetism Lab**	2	4
	Core -4	PS/PHY/C-204	**Waves and Optics**	4	4
	Core -4 Practical	PS/PHY/CP-204	**Waves and Optics Lab**	2	4
	Generic Elective -2 (GE-IB)	PS/PHY/GE-202/CHM	GE-102 (second course of the same subjected as opted in GE-101	4	4
	Generic Elective - Practical	PS/PHY/GE-P-202/CHM		2	4
	Ability Enhancement Compulsory Course (AECC)	PS/PHY/AE-201/ES	Environmental Science	4*	4
	ECA	Optional elective	ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)

			Total	24	28
SUMMER Internship: 15 days		**Optional elective**	**SwayamSwachhta / NSS / Industrial/ others**	**2**	**100**
III	Core-5	PS/PHY/C-301L	**Mathematical Physics-II**	4	4
	Core -5 Practical	PS/PHY/C-301P	**Mathematical Physics-II Lab**	2	4
	Core -6	PS/PHY/C-302L	**Thermal Physics**	4	4
	Core -6 Practical	PS/PHY/C-302P	**Thermal Physics Lab**	2	4
	Core - 7	PS/PHY/C-303L	**Digital Systems and Applications**	4	4
	Core – 7 Practical	PS/PHY/C-303P	**Digital Systems &Applications Lab**	2	4
	Generic Elective -3 (GEII-A)		To be opted from the pool of GE	**4**	4
	Generic Elective - Practical			**2**	4
	Skill Enhancement Course (SEC - 1)		Physics Workshop Skills	**4***	2 (4)
			Total	**28**	34
IV	Core-8		**Mathematical Physics III**	4	4
	Core -8 Practical		**Mathematical Physics-III Lab**	2	4
	Core -9		**Elements of Modern Physics**	4	4
	Core -9 Practical		**Elements of Modern Physics Lab**	2	4
	Core - 10		**Analog Systems and Applications**	4	4
	Core -10 Practical		**Analog Systems & Applications Lab**	2	4
	Generic Elective -4 (GEII-B)		To be opted from the pool of Generic courses	4	4
	Generic Elective - Practical			4	4
	Skill Enhancement Course (SEC - 2)		**Electrical Circuits and Network Skills**	4*	2 (4)
			TOTAL	28	34
	Core-11		**Quantum Mechanics & Applications**	4	4
	Core -11 Practical		**Quantum Mechanics Lab**	2	4
	Core -12		**Solid State Physics**	4	4
	Core -12 Practical		**Solid State Physics Lab**	2	4

V	Discipline Specific Elective (DSE-1)	PS/PHY/DSE-501L	**DSE-1: Experimental Techniques**	4	4
	DSE-1 - Practical	PS/PHY/DSE-501P	**DSE-1 Lab: Experimental Techniques Lab**	2	4
	Discipline Specific Elective (DSE-2)	PS/PHY/DSE-502L	**DSE-2: Nano Materials and Applications**	4	4
	DSE-2 - Practical	PS/PHY/DSE-502P	**DSE-2 Lab: : Nano Materials and Applications Lab**	2	4
			TOTAL	24	32
VI	Core-13		**Electro-magnetic Theory**	4	4
	Core -13 Practical		**Electro-magnetic Theory Lab**	2	4
	Core -14		**Statistical Mechanics**	4	4
	Core -14 Practical		**Statistical Mechanics Lab**	2	4
	Discipline Specific Elective (DSE-3)	PS/PHY/DSE-503L	**DSE-3: Nuclear & Particle Physics**	4	4
	DSE-3 - Practical	PS/PHY/DSE-503P	**DSE-3 Lab: : Nuclear & Particle Physics Lab**	2	4

Subject: (DSE I) Experimental Techniques

Theory: 60 Lecture **Credits: 4**

UNIT -I

Measurements: Accuracy and precision. Significant figures. Error and uncertainty analysis.Types of errors: Gross error, systematic error, random error. Statistical analysis of data (Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square) and curve fitting. Gaussian distribution.

UNIT-II

Fluctuations and Noise in measurement system. S/N ratio and Noise figure. Noise in frequency domain. Sources of Noise: Inherent fluctuations, Thermal noise, Shot noise, 1/f noise.

Digital Multimeter: Comparison of analog and digital instruments. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy and resolution of measurement.

UNIT-III

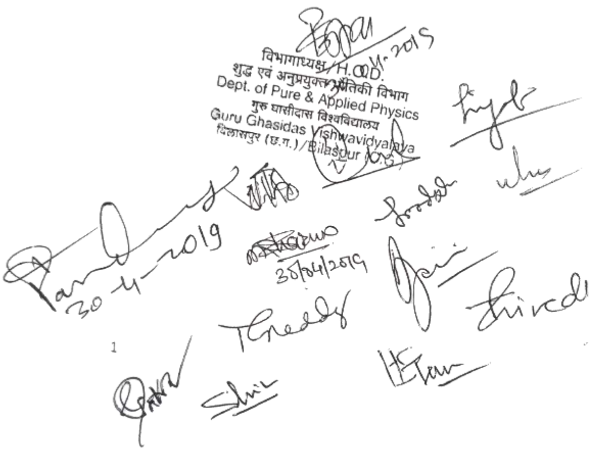
Electrical, Thermal and Mechanical system. Calibration. Transducers and sensors. Characteristics of Transducers. Transducers as electrical element and their signal conditioning. Temperature transducers: RTD, Thermistor, Thermocouples, Semiconductor type temperature sensors (AD590, LM35, LM75) and signal conditioning. Linear position transducers: Strain gauge, Piezoelectric. Inductance change transducer: Linear variable differential transformer (LVDT), Capacitance change transducers. Radiation Sensors: Principle of Gas filled detector, ionization chamber, scintillation detector.

UNIT-IV

Vacuum Systems: Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system- Chamber, Mechanical pumps, Diffusion pump & Turbo Modular pump, Pumping speed, Pressure gauges (Pirani, Penning, ionization).

Reference Books:

- Electronic circuits: Handbook of design and applications, U. Tietze and C. Schenk, 2008, Springer.
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1990, Mc-Grew Hill.



Experimental Techniques Lab

Practical Credit 2

1. Determine output characteristics of a LVDT & measure displacement using LVDT.
2. To study the characteristics of a Thermostat and determine its parameters.
3. Study of distance measurement using ultrasonic transducer.
4. Calibrate Semiconductor type temperature sensor (AD590, LM35, or LM75).
5. To measure the change in temperature of ambient using Resistance Temperature Device (RTD).
6. Create vacuum in a small chamber using a mechanical (rotary) pump and measure the chamber pressure using a pressure gauge.
7. Design and analyze the clippers and Clampers circuits using junction diode.

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Sub: Statistical Mechanics

Subject Code: PS/PHY/C-602L Credit-04 Theory Lectures (60)

UNIT I **(17 Lectures)**

Classical Statistics: Thermodynamic potentials, Macrostate & Microstate, Concept of Ensemble, Phase Space, Dynamical variable, Entropy, Partition Function, relation of partition function with Thermodynamic Functions, application of partition function. Thermodynamic Probability, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations.

UNIT II **(10 Lectures)**

Maxwell-Boltzmann Distribution Law, B-E distribution law, Fermi-Dirac Distribution Law (10 Lectures)

UNIT III **(15 Lectures)**

Fermi-Dirac Statistics: Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Fermi sphere, Electron gas in a Metal, Specific Heat of Metals.

UNIT IV **(18 Lectures)**

Bose-Einstein Statistics: Heat capacity, Bose Einstein condensation, Radiation as a photon gas, Quantum Theory of Radiation: Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.

Reference Books:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
2. Statistical mechanics by Kerson Huang (2Ed, Wiley, 1987)
3. Statistical Physics: Volume 5: Evgeny Lifshitz and Lev Landau
4. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
5. Statistical Mechanics by D. A. McQuarrie.

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30-4-2019

30/04/2019

Sub: Statistical Mechanics Lab

Subject Code: PS/PHY/C-602P Credit-02

1. Plot Planck's law for Black Body radiation and compare it with Wein's Law and Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
2. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases.
3. Plot Maxwell-Boltzmann distribution function versus temperature.
4. Plot Fermi-Dirac distribution function versus temperature.
5. Plot Bose-Einstein distribution function versus temperature.

Note: Use Scilab for solving the problems based on Statistical Mechanics like

Reference Books:

- Elementary Numerical Analysis, K.E.Atkinson, 3 r d Edn. 2007, Wiley India Edition
- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer

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QUANTUM MECHANICS LAB

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

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

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

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

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

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

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 $(eVÅ)^{1/2}$, m = 0.511×10^6 eV/c^2, and a = 3 Å, 5 Å, 7 Å. In these units ħc = 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:

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

For the anharmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$$

for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c^2, k = 100 MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3} In these units, cħ = 197.3 MeV fm. 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:

$$\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2\mu}{\hbar^2}[V(r) - E]$$

Where μ is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D\left(e^{-2\alpha r'} - e^{-\alpha r'}\right), \quad r' = \frac{r - r_o}{r}$$

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 = 940×10^6eV/C^2, D = 0.755501 eV, α = 1.44, ro = 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 show the tunneling effect in tunnel diode using I-V characteristics.
8. Quantum efficiency of CCDs

Reference Books:

- Schaum's outline of Programming with C++. J.Hubbard, 2000,McGraw-Hill Publication
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.
- An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ. Press
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer.
- Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
- Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:978-6133459274

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Subject: Solid State Physics Lab (Credit : 02)

Course objectives

The course introduces the students into basic experimental methods in solid state physics. Mainly methods of B-H curve tracing, Quincke's tube method, four probe method and Hall coefficient to be studied.

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 $_{o}$C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Outcomes

To provide the students with the ability to list and describe selected fundamental experimental techniques in solid state physics individually apply these techniques during measurement of important solid state quantities.

Essential Suggested :

- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11_{th} Ed., 2011, Kitab Mahal, New Delhi

Elements of Solid State Physics, J.P. Srivastava, 2_{nd} Ed., 2006, Prentice-Hall of India.

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1

Subject: (DSE II) Nano Materials and Applications Lab

Credits: Practicals-02

1. Synthesis of metal nanoparticles by chemical route.

2. Synthesis of semiconductor nanoparticles.

3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.

4. XRD pattern of nanomaterials and estimation of particle size.

5. To study the effect of size on color of nanomaterials.

6. To prepare composite of CNTs with other materials.

7. Growth of quantum dots by thermal evaporation.

9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.

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