

1.2.1

List of New Courses Introduced with Course Contents

Colour Codes				
Employability Contents	Green			
Entrepreneurship Contents	Light Blue			
Skill Development Contents	Pink			
Name of the Subjects/Related to all three Components (Employability/ Entrepreneurship/ Skill Development)	Yellow			

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

विभागाध्यक्षं/H.O.D. शुद्ध एवं अनुप्रयुक्त भौतिकी विभाग Dept. of Pure & Applied Physics गुरु घासीदास विश्वविद्यालय Guru Ghasidas Vishwavidyalaya बिलासपुर (छ.न.)/Bilaspur (C.G.)





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

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Seal of HoD

Guru Ghasidas Vishwavidyalay बिलासपुर (छ.ग.)/Bilaspur (C.G.)





Guru Ghasidas Vishwavidyalaya (A Central University Established by the Central Universities Act 2009 No. 25 of 2009) Koni, Bilaspur – 495009 (C.G.)

Scheme and Syllabus

Semester	Course Opted	Course Code	Name of the course	Cre dit	Hour / wea k
	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
I	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
	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
II	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)

गुरु घासीदास विश्वविद्यालय (७देश वितरेखकः अधिकः 200 इ. 25 वे अंतर्गः त्वावित वेद्रीय वितरेखकः) कोनी, बिलासपुर - 495009 (छ.ग.)



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			Total	24	28
	•				
SUMM days	IER Internship: 15	Optional elective	SwayamSwachhta / NSS / Industrial/ others	2	10 0
•					
	Core-5	PS/PHY/C-301L	Mathematical Physics-II	4	4
III	Core -5 Practical	PS/PHY/C-301P	Mathematical Physics-II Lab	2	4
	Core -6	PS/PHY/C-302L	Thermal Physics	4	4
111	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
			•		
	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
IV	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)
	2)		TOTAL	28	34
	Core-11		Quantum Mechanics & Applications	4	
	Core -11 Practical		Quantum Mechanics Lab	2	
	Core -12		Solid State Physics	4	
	Core -12 Practical		Solid State Physics Lab	2	

New Course Introduced

गुरु घासीदास विश्वविद्यालय (क्षेत्र विस्तिवाल अधिक 2008 ह. 25 के अंग्रेष लागित केईप विश्वविद्याल) कोनी, बिलासपुर - 495009 (छ.ग.)



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V	Discipline Specific Elective (DSE-1)	PS/PHY/DSE-501L	DSE-1: Experimental	4	4
			Techniques		
	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
	Core-13		Electro-magnetic Theory	4	4
	Core -13 Practical		Electro-magnetic Theory Lab	2	4
VI	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

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Koni, Bilaspur - 495009 (C.G.)

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.



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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.

विभागाध्यक्षमा १००४ ।

शुद्ध एवं अनुमयुक्त भूमितकी विभाग

पुरु धार्मी देवा विश्वविद्यालय

विलाग्य Ghasidas Yenwavidyahva

विलाग्य (इ.ग.)/होकिडेपा १००० ।

25/24/25(9)

गुरु घासीदास विश्वविद्यालय (क्ट्रीर विस्तिवास अधिम 200 ह 25 के आंध्र स्वासि केट्रीर विश्ववास) कोनी, बिलासपुर - 495009 (छ.ग.)



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Koni, Bilaspur - 495009 (C.G.)

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.

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- 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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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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Dept. of Pure & Applied Physics

Guru Ghasidas Yshwaridyalua

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

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 $e = 3.795 \text{ (eVÅ)}^{1/2}$, hc = 1973 (eVÅ) and $m = 0.511 \times 10^6 \text{ eV/c}^2$.

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

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

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 = $0.511 \times 10^6 \text{ eV/c}^2$, 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:

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

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 $m = 940 \text{ MeV/c}^2$, k = 100

MeV fm⁻², b = 0, 10, 30 MeV fm⁻³ In these units, ch = 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
$$\mu$$
 is the reduced mass of the two-atom system for the Morse potential
$$V(r) = D \left(e^{-2\alpha r'} - e^{-\alpha r'} \right), \qquad r' = \frac{r - r_o}{r}$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant

Also plot the corresponding wave function.

Take: $m = 940 \times 10^6 \text{ eV/C}^2$, D = 0.755501 eV, $\alpha = 1.44$, ro = 0.131349 Å

Criteria - I (1.2.1) New Course Introduced



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

विभागाध्यक्षमा (00)

Dept. of Pure & Applied Physics

Guru Ghasidas V Shwaidyalaya

किलायुर (ह.ग.) / Bilastur 1000

Koni, Bilaspur - 495009 (C.G.)

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 fourprobe method (from room temperature to 150 °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, 11th Ed., 2011, Kitab Mahal, New Delhi

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

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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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