Central University of Jammu

Agenda and MoM

7th Board of Studies

Date : 27-09-2021

Department of Physics & Astronomical Sciences

जम्मू केंद्रीय विश्वविद्यालय

Central University of Jammu

राया-सूचानी (बागला),साम्बा-181143, जम्मू (जम्मू और कश्मीर)

Rahya-Suchani (Bagla), Samba-181143, Jammu (J & K)

Agenda for the Conduct of 7th Board of Studies meeting on Sep 27, 2021

The agenda of the meeting are the following:

1. Approval of Ph.D. research topics (Synopsis) of the candidates of the Department who have successfully completed their course work as recommended by DRC/RAC.

2. Adoption of V and VI Semester Syllabus and course matrix as per the SCHEME OF CHOICE BASED CREDIT SYSTEM(CBCS) FOR Six Semester (B.Sc. Honours) under B.Sc.(H)-M.Sc. (Physics) programme as per UGC.

3. Consider the Progress report of Ph.D. research Scholars.

4. Approval on the request of Dr. Jehova Jire L Hmar (Ex-faculty of the Department of Physics and Astronomical Sciences, CU Jammu) to act as Co-supervisor for Ph. D. student Surbhi Pathania after his relieving from Central University of Jammu and to allot new Ph.D. supervisor to her.

5. Addition of new Examiner(s) for various purposes like paper setter, UG/PG Project dissertation evaluation and Ph.D. thesis evaluation for various programmes of the department.

6. Any other matter with the permission of the chair.

Minutes of the 7th Board of Studies, Department of Physics & Astronomical Sciences, Central University of Jammu, held on Sep 27, 2021

The 7th Board of Studies meeting was held in the Department of Physics & Astronomical Sciences, Central University of Jammu, Samba through online/offine mode on Sep 27, 2021. The following members were present in the meeting:

1.	Dr. Suram Singh, Associate Professor & Head of the Department	Chairman
2.	Prof. Arun Bharti, (External Expert) Department of Physics, University of Jammu	Subject Expert
3.	Prof. Manoj Kumar Sharma, Professor , SPMS, TIET, Patiala.	Subject Expert
4.	Dr. Vinay Kumar, Associate Professor	Member
5.	Dr. Tapta K Roy, Assistant Professor, Department of Chemistry and Chemical Sciences	Member

In the beginning, Dr. Suram Singh, Head, Department of Physics and Astronomical Sciences, expressed his deep sense of happiness and gratitude for presence of all members in the meeting. He has given the introduction of all members to the board. He welcomes all external members who have attended the meeting despite of various busy schedules. Dr. Suram Singh also individually welcomes all other members, who have joined the meeting through online mode and hence to make the event academically successful and productive.

All agenda items were thoroughly discussed, and the following decisions were pointed:

Agenda 1. : Approval of Ph.D. research topics (Synopsis) of the candidates of the Department who have successfully completed their course work as recommended by DRC/RAC.

Decision: The BOS approved the Ph.D. research topics (synopsis) of the candidates of the Department who have successfully completed their course work. The details of synopsis is as per the details given below:

S. No.	Entry No.	Name of the Candidate	Supervisor	Research title for Ph.D.	Date of Admission
1	0152020	Rajan Singh	Dr. Vinay Kumar	Effect of Temperature on Alkaline Ortho phosphate Based Phosphors: Luminescence and Related Studies	30-11-2020
2.	0252020	Isha Charak	Dr. Vinay Kumar	Synthesis and Luminescence Studies of Rare Earth Ion Doped Borate Phosphors	27-11-2020

Agenda 2. : Adoption of V and VI Semester Syllabus and course matrix as per the SCHEME OF CHOICE BASED CREDIT SYSTEM(CBCS) FOR Six Semester (B.Sc. Honours) under B.Sc.(H)-M.Sc. (Physics) programme as per UGC.

Decision: The BOS recommends Adoption of V and VI Semester Syllabus and course matrix as per the SCHEME OF CHOICE BASED CREDIT SYSTEM(CBCS) FOR Six Semester (B.Sc. Honours) under B.Sc.(H)-M.Sc. (Physics) programme.

Agenda: 3: Progress report of Ph.D. research Scholars.

Decision: BOS found the research progress of Ph.D. work satisfactory for the following registered research scholar for the period March 2020 to Dec 2020 and for the period Jan 2021-June 2021, as per the details given below:

S. No	Entry No.	Name of the Candidate	Name of the Supervisor/Co-supervisor	Title of Ph.D Thesis
1.	0152019	Veerta Rani	Dr. Suram Singh, Associate Professor **(Supervisor)**	MICROSCOPIC STUDY OF QUASI PARTICLE STRUCTURE OF SOME HEAVY MASS ISOTOPIC CHAINS
2.	0252019	Manvi Rajput	Dr. Suram Singh Associate Professor **(Supervisor)**	STUDY OF SOME DEFORMED NUCLEI WITHIN THE NEUTRON RANGE 50<N<82
3.	0352019	Payal Khajuria	Dr. Vinay Kumar Associate Professor **(Supervisor)**	SYNTHESIS AND CHARACTERIZATION OF ALKALI-ALKALINE PHOSPHATE BASED NANOPHOSPHORS
4.	0452019	Surbhi Pathania	Dr. Jehova. Jire L. Hmar, Assistant Professor **(Supervisor)**	STUDY OF CONDUCTING POLYMER AND SEMICONDUCTOR-POLYMER NANOCOMPOSITES FOR MEMORY AND OPTOELECTRONIC DEVICES
5.	0552019	Naveen Kumar	Dr. Suram Singh **(Supervisor)** Dr. Avinash Chand Yadav, Assistant Professor, Department of Physics, BHU **(Co-supervisor)**	STUDY OF SCALING FEATURES FOR THE 1/f NOISE IN A CLASS OF SOC MODELS

Agenda: 3: To consider the request of Dr. Jehova Jire L Hmar (Ex-faculty of the Department of Physics and Astronomical Sciences, CU Jammu) to act as Co-supervisor for Ph. D. student Surbhi Pathania after his relieving from Central University of Jammu and to allot new Ph.D. supervisor to the candidate.

Decision: BOS is of the opinion that Dr. Vinay Kumar as suitable Supervisor for already registered Scholar Ms. Surbhi Pathania and approved Dr. Vinay Kumar, Associate Professor, as Supervisor and Dr. Jehova Jire L Hmar, as Co-supervisor for Ph. D. student Ms. Surbhi Pathania.

S. No	Entry No.	Name of the Candidate	Name of the new Supervisor/Co-supervisor	Title of Ph.D Thesis
4.	0452019	Surbhi Pathania	Dr. Vinay Kumar, Associate Professor **(Supervisor) and** Dr. Jehova. Jire L. Hmar, Assistant Professor **(Co-Supervisor)**	STUDY OF CONDUCTING POLYMER AND SEMICONDUCTOR-POLYMER NANOCOMPOSITES FOR MEMORY AND OPTOELECTRONIC DEVICES

Agenda 4. Addition of new Examiner(s) for various purposes like paper setter, UG/PG Project dissertation evaluation and Ph.D. thesis evaluation for various programmes of the department.

Decision: The B OS recommends the list of Examiner(s) [for various purposes like paper setter, evaluator, thesis examiners] is updated.

It is also suggested to authorize the HO Dto include a suitable examiner in an emergent situation.

The meeting ends with votes of thanks.

Prof. Arun Bharti, (External Expert) Department of Physics, University of Jammu

Dr. Tapta K Roy, Assistant Professor (online)

Prof. Manoj Kumar Sharma, Professor , SPMS, TIET, Patiala.

Dr. Vinay Kumar, Associate Professor

Dr. Suram Singh, Associate Professor & Head of the Department 27/09/2021

Central University of Jammu

General Note for Paper Setting

1. The Question Papers for the Mid-Semester Examination shall be as follows:

- In four credit course, the paper shall be of 2 (two) hours duration and shall comprise the following sections:

Section	Type	No. of Questions	To Attempt	Marks per question	Marks
A	Objective	10	10	1	10
B	Short Answer type	5	3	6	18
C	Essay/Long Answer Type	2 (with internal choice)	2	11	22
				Total	**50**

Detailed description of the above table is:

a. Section A shall have 10 (Ten) objective type questions (Multiple choice) of one mark each. All questions in this section shall be compulsory (Total 10 Marks);

b. Section B shall have 5 (Five) Short Answer Questions (SAQ) of 6 (six) Marks each, out of which the examinees shall be required to attempt any three questions (Total 18 Marks);

c. Section C shall have 2 (Two) Essay/Long Answer Questions (one from each unit with internal choice), of 11 (Eleven) Marks each (Total 22 Marks); alternatively, if the course so requires, this section may comprise a case study of 11 marks and one question with internal choice of 11 Marks;

2. **The Question Papers for the End-Semester Examination shall be as follows:**

- In four credit course, the paper shall be of 3 (three) hours duration and shall comprise the following sections:

Section	Type	No. of Questions	Examinees To Attempt	Marks per question	Marks
A	Objective	10	10	1.5	15
B	Short Answer type	10 (two from each units)	5	8	40
C	Essay/Long Answer Type	5 (one from each Unit)	3	15	45
				Total	**100**

Detailed description of the above table is:

a. Section A shall have 10 (Ten) objective type questions (Multiple choice) of 1.5 mark each. All questions in this section shall be compulsory (Total 15 Marks);

b. Section B shall have 10 (Ten) Short Answer Questions (SAQ) (two from each unit) of 8 (eight) Marks each, out of which the examinees shall be required to attempt any five questions (Total 40 Marks);

c. Section C shall have 5 (Five) Essay/Long Answer Questions (one from each unit), of 15 (Fifteen) Marks each, out of which the examinees shall be required to attempt any 3 (three) questions (Total 45 Marks);

As a general rule, a course of one credit shall require a work load of thirty hours comprising:

(i) 10 hours of Lectures/organized Classroom Activities/ Contact Hours.

(ii) 05 hours of laboratory Work/ Practicals / field Work/ Tutorials/ Teachers-led activities.

(iii) 15 hours of other workload such as independent individual/ group work; obligatory/ optional work placement; literature survey/ library work; data collection/ field work; writing of papers/ projects/ dissertation/ thesis; seminars etc.

CENTRAL UNIVERSITY OF JAMMU

Department of Physics and Astronomical Sciences

SCHEME OF CHOICE BASED CREDIT SYSTEM(CBCS) FOR Six Semester(B.Sc Honours) under B.Sc(H)-M.Sc. Degree programme in Physics

Semester	CORE COURSE (14)	Ability Enhancement Compulsory Course (AECC) (2)	Ability Enhancement Elective Course (AEEC) (2) (Skill Based)	Elective: Discipline Specific DSE (4)	Elective: Generic (GE) (4)
I	Mathematical Physics-I (4+2)	English M IL Communication (2)			Chemistry (4+ 2)
	Mechanics (4 + 2)				
II	Electricity & Magnetism (4+ 2)	Environmental Science (2)			Introduction to Computers (4+ 2)
	Waves and Optics (4 + 2)				
III	Mathematical Physics–II (4 + 2)		Renewable Energy and Energy Harvesting (2)		Astronomy and Astrophysics (4+ 2)
	Analog Systems & Applications (4+ 2)				
	Thermal Physics (4+ 2)				
IV	Mathematical Physics–III (4+ 2)		Basic of Computer Programming (2)		Atomic and Molecular Physics (4+ 2)
	Elements of Modern Physics (4+ 2)				
	Digital Systems and Applications (4+ 2)				
V	Quantum Mechanics And Applications (4+ 2)			DSE-1 (4+ 2)	
	Solid State Physics (4 + 2)			DSE-2 (4+ 2)	
VI	Electromagnetic Theory (4+ 2)			**DSE-3 & DSE 4** Project Dissertation (12)	
	Statistical Mechanics (4 + 2)				

Recommendation of Scheme/Courses Opted for Fifth and Six semesters

V	**Core course-XI**	Quantum Mechanics And Applications	4
	Core Course-XI Practical/Tutorial	Quantum Mechanics Lab	2
	Core course-XII	Solid State Physics	4
	Core Course-XII Practical/Tutorial	Solid State Physics Lab	2
	Discipline Specific DSE-1	Any two course out of DSE basket (4+2)	12
	Discipline Specific DSE-1 Practical/Tutorial		
	Discipline Specific DSE-2 Practical/Tutorial		
		Total Credit	**24**
VI	**Core course-XIII**	Electromagnetic Theory	4
	Core Course-XIII Practical/Tutorial	Electromagnetism Lab	2
	Core course-XIV	Statistical Mechanics	4
	Core Course- XIV Practical/Tutorial	Statistical Mechanics Lab	2
	Discipline Specific DSE-3 & DSE 4	Project dissertation	12
		Total Credit	**24**

List of DSE courses

(any two)

Sem	Course Type	Course Name	Teaching Mode	Credit
V	DSE-1	Nuclear and Particle Physics	Theory	4
		Nuclear and Particle Physics Lab	Practical	2
	DSE-2	Physics of Devices and Instrumentation	Theory	4
		Physics of Devices and Instrumentation Lab	Practical	2
	DSE-3	Nanomaterials and Applications	Theory	4
		Nanomaterials and Applications Lab	Practical	2
	DSE-4	Atmospheric Physics	Theory	4
		Atmospheric Physics Lab	Practical	2
	DSE-5	Experimental Techniques	Theory	4
		Experimental Techniques Lab	Practical	2
	DSE-6	Bio-Physics	Theory	4
		Bio-Physics Lab	Practical	2

Syllabus 5th Semester

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	Core
Course Name:	Quantum Mechanics and Applications	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

(The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.)

UNIT-I

Failure of Classical mechanics and origin of quantum Theory. Photon, photoelectric effect and Einstein's photoelectric equation Compton effect (theory and result). Inadequacy of old quantum theory, de-Broglie hypothesis. Davisson and Germer's experiment. Phase velocity, group velocity, Heisenberg's uncertainty principle. Time-energy and angular momentum, position uncertainty principle from de-Broglie wave, (wave-particle duality), Electron diffraction from a slit

UNIT-II

Schrodinger Equation: Description of a particle using wave packets. Spread of the Gaussian wave-packet for a free particle in one dimension Derivation of time dependent Schrodinger wave equation, eigen values, eigen functions, wave functions and its significance. Normalization of wave function, concept of observable and operator. Solution of Schrodinger equation for harmonic oscillator ground states and excited states.

UNIT-III

Application of Schrodinger equation in the solution of the following one-dimensional problems : Free particle in one dimensional box (solution of Schrodinger wave equation, eigen function, eigen values, quantization of energy and momentum, nodes and antinodes, zero point energy). One-dimensional potential barrier E >Vo (Reflection and Transmission coefficient).

UNIT-IV

Quantum mechanics of simple harmonic oscillator, Setting up the eigenvalue equation for the Hamiltonian. Energy levels and energy eigenfunctions in terms of Hermite polynomials (Solution to Hermite differential equation may be assumed). Ground state, zero-point energy & uncertainty principle. Quantum theory of hydrogen-like atoms

UNIT-V

Generalized Angular Momenta and Spin. Electron's magnetic Moment and Spin Angular Momentum. Gyromagnetic Ratio and Bohr Magneton and the g - factor. Energy associated with a magnetic dipole placed in magnetic field. Larmor's Theorem. Stern-Gerlach Experiment. Addition of angular momenta, Spectra of Hydrogen atom and its fine structure Fine structure splitting. L-S and J-J coupling scheme.

Reference Books

1. A Text book of Quantum Mechanics, P.M. Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
4. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
5. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
6. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	Core
Course Name:	Quantum Mechanics Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

PHYSICS PRACTICAL-C XI LAB

60 Lectures

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 wavefunctions. 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 = $0.511x10^6$ 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 = $0.511x10^6$ 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, 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 μ is the reduced mass of the two-atom system for the Morse potential

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

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 = 940x10^6eV/C^2, D = 0.755501 eV, α = 1.44, r_o = 0.131349 Å

Laboratory based experiments:

5. **To study the photoelectric effect.**
6. **Study of Electron spin resonance-determine magnetic field as a function of the resonance frequency.**
7. **Study of Zeeman effect: with external magnetic field; Hyperfine splitting.**
8. **To Show the tunnelling effect in tunnel diode using I-V characteristics.**
9. **Determination of e/m for the electron.**
10. **To determine the value of Planck's constant.**

Reference Books:

- Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Pub.
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.
- Elementary Numerical Analysis, K.E. Atkinson, 3rd Ed. 2007, Wiley India Edition
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
- Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444
- Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	Core
Course Name:	Solid State Physics	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

UNIT-I

Crystal Structure and Lattice vibrations: Solids: Amorphous and Crystalline Materials. Crystal structure. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Bragg's Law. Atomic and Geometrical Factor, 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. T3 law

UNIT-II

Elementary band theory: Wave Function in a periodic lattice and Bloch theorem, Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (4 probe method) & Hall coefficient.

UNIT-III

Dielectric and ferroelectric Properties of Materials: Polarization: Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Langevin-Debye equation. Optical Phenomena. Plasma Oscillations, Plasma Frequency, Plasmons, Ferroelectric Properties of Materials, Structural phase transition, Classification of crystals, Piezoelectric effect, Ferroelectric effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop

UNIT-IV

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.

UNIT-V

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation).

Reference Books

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India
3. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
4. Elementary Solid State Physics, M. Ali Omar, 1999, Pearson India
5. Solid State Physics by S. O. Pillai, New Age International, 2005.
6. Quantum Mechanics, Statistical Machanics and Solid State Physics, 2010,S.Chand& Company.
7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	Core
Course Name:	Solid State Physics Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

List of Practicals

1. To study PE hysteresis of ferroelectric crystal.
2. To study B Hhysteresis of ferromagnetic material.
3. Measurement of susceptibility of paramagnetic solution by Quink's tubemethod.
4. Measurement of magnetic susceptibility of solids.
5. Determination of variation of dielectric constant with frequency.
6. Measurement of hall voltage by four probe method.
7. To study temperature coefficient of a semiconductor (NTC thermistor).

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop,1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn,4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.,2011, Kitab Mahal.
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

List of DSE course

(any two)

Sem	Course Type	Course Name	Teaching Mode	Credit
V	DSE-1	Nuclear and Particle Physics	Theory	4
		Nuclear and Particle Physics Lab	Practical	2
	DSE-2	Physics of Devices and Instrumentation	Theory	4
		Physics of Devices and Instrumentation Lab	Practical	2
	DSE-3	Nanomaterials and Applications	Theory	4
		Nanomaterials and Applications Lab	Practical	2
	DSE-4	Atmospheric Physics	Theory	4
		Atmospheric Physics Lab	Practical	2
	DSE-5	Experimental Techniques	Theory	4
		Experimental Techniques Lab	Practical	2
	DSE-6	Bio-Physics	Theory	4
		Bio-Physics Lab	Practical	2

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	Core
Course Name:	Nuclear and Particle Physics	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

UNIT-I

Nuclear Properties: Mass, radius, angular momentum, magnetic moment, electric quadrupole moment, parity, estimation of mass, basic concepts of mass spectrographs, double focussing spectrograph, Coulomb scattering of a charged particle by a nucleus, Electron scattering by a nucleus, variation of nuclear radius with mass number A.

UNIT-II

Nuclear Binding : Constituents of the nucleus, Nuclear forces and its properties, Binding energy, mass defect, variation of binding energy with mass number A, Liquid drop model, Semiempirical mass formula, origin of various terms, stable nucleus and conditions for stability.

UNIT-III

Nuclear Reaction: Energy release in nuclear fission (using B E curve) spontaneous fission and potential barrier, liquid drop model, self sustaining chain reaction, neutron balance in a nuclear reactor, classification of reactors, uncontrolled reaction and atomic bomb, Nuclear Fusion: Energy released in nuclear fusion in stars, carbon-nitrogen and proton-proton cycle, problems of controlled fusion.

UNIT-IV

Particle Accelerator: Linear accelerator, cyclotron, synchrocyclotron, betatron, synchrotron, Electron Synchrotron, proton synchrotron, Nuclear detectors: Ionisation chamber, Proportional counter, G Mcounter, scintillation counters, solid state detectors, neutron detector.

UNIT-V

Subatomic Particles: Properties of particles, classification into leptons, mesons and baryons, matter and antimatter, conservation laws, fundamental interactions, quark model for the structure of matter.

Text/Reference Books:

1. Nuclear physics by Irving Kaplan, Oxford & IB H Pub., 1962.
2. Introduction to experimental Nuclear Physics by R. M. Singru, Wiley Eastern Pvt. Ltd.
3. Nuclear Physics by S. N. Ghoshal, S. Chand, 2006.
4. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd.,2008).
5. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill,1998).

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	Core
Course Name:	Nuclear Physics Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

1. Detection of γ radiation with a scintillation counter.
2. Quantitative observation of the Compton effect.
3. Demonstrating the tracks of α particles in a Wilson cloud chamber.
4. Rutherford scattering: measuring the scattering rate as a function of the scattering angle and the atomic number.
5. Deflection of beta radiation in a magnetic field.
6. Recording and calibrating a γ spectrum.
7. Determining the energy loss of α radiation in air.
8. Study the characteristics of a G.M counter Characteristics & Determine the Plateau Value.
9. Study the Absorption Factors using Different Thickness of Aluminium Sheets.
10. Study Half Life.
11. Inverse Law using Distribution Method.
12. To determine the end point energy of beta particle of a given radioactive source using gm counter .
13. Study the characteristics of a G.M counter and verify the inverse square law.
14. Study of β- absorption in aluminium foil using G.M counter.
15. Study of variation of modulus of rigidity of a given specimen as a function of temperature.
16. To reproduce the Binding Energy curve for whole mass range.
17. Semi empirical mass formula .
18. Any other experiments of the equivalent standard can be set.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	Core
Course Name:	Physics of devices and instrumentation	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

UNIT-1

Devices: Characteristic and Equivalent Circuits of UJT and JFET. Metal-semiconductor and metaloxide semiconductor junctions. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, Charge coupled devices.

UNIT-2

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters. Multivibrators: Astable and Monostable Multivibrators using transistors. Phase Locked Loop (PLL): Basic Principles, Phase detector (XOR and edge triggered), Voltage Controlled Oscillator (Basics, varactor). Loop Filter – Function, Loop Filter Circuits, transient response, lock and capture.

UNIT-3

Transducers and Sensors (Working principle, efficiency, applications): Active and passive transducers. Characteristics of Transducers. Transducers as electrical element and their signal conditioning. Temperature transducers: RTD, Thermistor. Position transducer: Strain gauge, Piezoelectric transducer. Inductance transducer: Linear variable differential transformer (LVDT), Capacitance transducer. Radiation Sensors: Principle of gas filled detector, ionization chamber, scintillation detector.

UNIT-4

Production of Vacuum: Meaning of vacuum and vacuum measuring units, vacuum ranges, pumping speed and pump down time. Vacuum Pumps: Mechanical pumps (Oil sealed rotary pump, Roots Pump, Molecular drag pump), Diffusion pump (Operating principles, back streaming, traps and baffles, performance ranges), Cryosorption pumps, Getter pumps (Chemical cleanup and sublimation pumps, Evapour ion pumps, Sputter ion pumps, Titanium sublimation pump)

UNIT-5

Vacuum Measurements: Measurement of low pressure Pressure gauges for low to high vacuum, Mc Leod manometer, Thermal conductivity gauges, Pressure gauges for high to ultrahigh vacuum, Hot cathode ionization gauges, Cold cathode ionization gauges, Operation of High-vacuum gauges.

Reference Books:

1. Physics of Semiconductor Devices, S.M. Sze & Know K. Ng, 3rd Ed., 2008, John Wiley and Sons.
2. Electronic devices and integrated circuits, Ajay Kumar Singh, 2011, PHI Learning Pvt. Ltd.
3. Measurement, Instrumentation and Experiment Design in Physics & Engineering, M. Sayer and A.Mansingh, 2005, PHI Learning Pvt. Ltd.
4. Vacuum Technology, A. Roth, (North Holland, Elsevier Science B.V. 1990) .
5. High Vacuum Techniques, J. Yarwood, (Chapman and Hall, London, 1967

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	Core
Course Name:	Physics of devices and instrumentation Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

This provides understanding of Physics of devices and instrumentals experiments.

1. Thermistor as sensor in temperature to voltage converter using OPAMP.
2. Thermistor as sensor in temperature to voltage converter using O PA M P
3. Temperature to frequency Conversion using 555 timer.
4. Positive and Negative Clipper using op-amp.
5. Second Order active Low Pass/High Pass filter (frequency response & phase relation).
6. To study Active Notch Filter (frequency response & phase relation)
7. Measurement of pressure, strain and torque using strain gauge.
8. Measurement of speed using Electromagnetic transducer.
9. Measurement of speed using photoelectric transducers
10. Measurement of Temperature using Temperature Sensors/RTD.
11. Designing of a RC Phase Shift Oscillator using op-amp.
12. Experiment on working of thermocouple. 4. Experiment on control of various functions using RTD.
13. To find out level of water using level transmitters.
14. Measurement of conductivity of test solutions using electrical conductivity meter.
15. A ØD Gmeter calibrator.
11. To study of Circular chart recorder
12. Calibration of pressure gauge using dead weight calibrator.

Note: Any other experiments of the equivalent standard can be set.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	DSE
Course Name:	Nanomaterials and Applications	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

UNIT-I

Nanoscale Systems: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences.

UNIT-II

Synthesis of Nanostructure Materials: Top down and Bottom up approach, Photolithography, Ball milling, Gas phase condensation, Vacuum deposition, Physical vapor deposition (PVD), Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD), Sol-Gel, Electrodeposition, Spray pyrolysis, Hydrothermal synthesis, Molecular beam epitaxy (MBE) growth of quantum dots.

UNIT-III

Characterization: X-Ray Diffraction (XRD), Optical Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM).

UNIT-IV

Optical Properties: Coulomb interaction in nanostructures, Concept of dielectric constant for nanostructures, Excitons in direct and indirect band gap semiconductor nanocrystals, Radiative processes: General formalization-absorption, emission and luminescence, Optical properties of heterostructures and nanostructures, thermionic emission, Coulomb blockade, Deep level and surface defects.

UNIT-V

Applications of nanoparticles: Quantum dots, nanowires and thin films for photonic devices (LED, solar cells), Single electron transfer devices (no derivation), CNT based transistors, Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well, Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

Reference books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)
3. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).
5. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier, 2007).
6. Bharat Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004).

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	DSE
Course Name:	Nanomaterials and Applications Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

This provides understanding of experiments for Nanomaterials and Applications.

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.
8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
10. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.
11. Fabricate a PN diode by diffusing Al over the surface of n-type Si and study its *V-I* characteristic.

Reference Books:

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

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	DSE
Course Name:	Atmospheric Physics	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

UNIT-I

General features of Earth's atmosphere: Thermal structure of the Earth's Atmosphere, Ionosphere, Composition of atmosphere, Hydrostatic equation, Atmospheric Thermodynamics, Greenhouse effect and effective temperature of Earth, Local winds, monsoons, fogs, clouds, precipitation, Atmospheric boundary layer, Sea breeze and land breeze. Instruments for meteorological observations, including RS/RW, meteorological processes and different systems, fronts, Cyclones and anticyclones, thunderstorms.

UNIT-II

Atmospheric Dynamics: Scale analysis, Fundamental forces, Basic conservation laws, The Vectorial form of the momentum equation in rotating coordinate system, scale analysis of equation of motion, Applications of the basic equations, Circulations and vorticity, Atmospheric oscillations, Mesoscale circulations, The general circulations, Tropical dynamics.

UNIT-III

Atmospheric Waves: Surface water waves, wave dispersion, acoustic waves, buoyancy waves, propagation of atmospheric gravity waves (AGWs) in a nonhomogeneous medium, Lamb wave, Rossby waves and its propagation in three dimensions and in sheared flow, wave absorption, non-linear consideration.

UNIT-IV

Atmospheric Radar and Lidar: Radar equation and return signal, Signal processing and detection, Various type of atmospheric radars, Application of radars to study atmospheric phenomena, Lidar and its applications, Application of Lidar to study atmospheric phenomenon. Data analysis tools and techniques.

UNIT-V

Atmospheric Aerosols: Spectral distribution of the solar radiation, Classification and properties of aerosols, Production and removal mechanisms, Concentrations and size distribution, Radiative and health effects, Observational techniques for aerosols, Absorption and scattering of solar radiation, Rayleigh scattering and Mie scattering, Bouguert-Lambert law, Principles of radiometry, Optical phenomena in atmosphere, Aerosol studies using Lidars.

Text/Reference Books:

1. Fundamental of Atmospheric Physics – Murry L Salby; Academic Press, Vol 61, 1996
2. The Physics of Atmosphere – John T. Houghton; Cambridge University press; 3rd edn. 2002.
3. An Introduction to dynamic meteorology – James R Holton; Academic Press, 2004
4. Radar for meteorological and atmospheric observations – S Fukao and K Hamazu, Springer Japan, 2014

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	DSE
Course Name:	Atmospheric Physics Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

List of Practicals:

1. Numerical Simulation for atmospheric waves using dispersion relations
2. Atmospheric gravity waves
   (b) Kelvin waves
   (c) Rossby waves, and mountain waves
3. Offline and online processing of radar data
   (a) VHF radar,
   (b) X-band radar, and
   (c) UHF radar
4. Offline and online processing of LIDAR data
5. Radiosonde data and its interpretation in terms of atmospheric parameters using vertical profiles in different regions of the globe.
6. Handling of satellite data and plotting of atmospheric parameters using radio occultation technique
7. Time series analysis of temperature using long term data over metropolitan cities in India – an approach to understand the climate change

Any other experiments of the equivalent standard can be set.

Reference Books:

1. Fundamental of Atmospheric Physics – Murry L Salby; Academic Press, Vol 61, 1996
2. The Physics of Atmosphere – J.T. Houghton; Cambridge Univ. Press; 3rd edn. 2002.
3. An Introduction to dynamic meteorology – James R Holton; Academic Press, 2004
4. Radar for meteorological and atmospheric observations – S Fukao and K Hamazu, Springer Japan, 2014.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	DSE
Course Name:	Experimental Techniques	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

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. Guassian distribution.

UNIT-II

Signals and Systems: Periodic and aperiodic signals. Impulse response, transfer function and frequency response of first and second order systems. 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, Methods of safety grounding.

UNIT-III

Transducers & industrial instrumentation (working principle, efficiency, applications): Static and dynamic characteristics of measurement Systems. Generalized performance of systems, Zero order first order, second order and higher order systems. Electrical, Thermal and Mechanical systems. Calibration. Transducers and sensors. Characteristics of Transducers. Temperature transducers: RTD, Thermistor, Thermocouples, Semiconductor type temperature sensors (AD590, LM35, LM75) and signal conditioning. Linear Position transducer: 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

Digital Multimeter, Impedance Bridges and Q-meter: Comparison of analog and digital instruments. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy and resolution of measurement. Block diagram and working principles of RLC bridge.Q-meter and its working operation. Digital LCR bridge.

UNIT-V

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).

Text/Reference Books:

1. Measurement, Instrumentation and Experiment Design in Physics and Engineering, M. Sayer and A. Mansingh, PHI Learning Pvt. Ltd.
2. Experimental Methods for Engineers, J.P. Holman, McGraw Hill
3. Introduction to Measurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt. Ltd.
4. Transducers and Instrumentation, D.V.S. Murty, 2nd Edition, PHI Learning Pvt. Ltd.
5. Instrumentation Devices and Systems, C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill
6. Principles of Electronic Instrumentation, D. Patranabis, PHI Learning Pvt. Ltd.
7. Electronic circuits: Handbook of design & applications, U.Tietze, Ch.Schenk, Springer

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	V	**Type:**	DSE
Course Name:	Experimental Techniques Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

List of Practicals:

1. Determine output characteristics of a LVDT & measure displacement using LVDT
2. Measurement of Strain using Strain Gauge.
3. Measurement of level using capacitive transducer.
4. To study the characteristics of a Thermostat and determine its parameters.
5. Study of distance measurement using ultrasonic transducer.
6. Calibrate Semiconductor type temperature sensor (AD590, LM35, or LM75)
7. To measure the change in temperature of ambient using Resistance Temperature Device (RTD).
8. Create vacuum in a small chamber using a mechanical (rotary) pump and measure the chamber pressure using a pressure gauge.
9. Comparison of pickup of noise in cables of different types (co-axial, single shielded, double shielded, without shielding) of 2m length, understanding of importance of grounding using function generator of mV level & an oscilloscope.
10. To design and study the Sample and Hold Circuit.
11. Design and analyze the Clippers and Clampers circuits using junction diode.
12. To plot the frequency response of a microphone.
13. To measure Q of a coil and influence of frequency, using a Q-meter.

Text/Reference Books:

1. Electronic circuits: Handbook of design and applications, U. Tietze and C. Schenk, 2008, Springer
2. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1990, Mc-Graw Hill
3. Measurement, Instrumentation and Experiment Design in Physics & Engineering, M. Sayer and A. Mansingh, 2005, PHI Learning.

Int. B.Sc.(H)-M.Sc. Physics			
Semester:	V	**Type:**	DSE
Course Name:	**Bio-Physics**	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

UNIT - I

Building Blocks & Structure of Living State: Atoms and ions, molecules essential for life, what is life. **Living state interactions:** Forces and molecular bonds, electric & thermal interactions, electric dipoles, Casimir interactions, domains of physics in biology.

UNIT - II

Heat Transfer in biomaterials: Heat Transfer Mechanism, The Heat equation, Joule heating of tissue. **Living State Thermodynamics:** Thermodynamic equilibrium, first law of thermodynamics and conservation of energy. Entropy and second law of thermodynamics, Physics of many particle systems, two state systems, continuous energy distribution, Composite systems, Casimir contribution of free energy, Protein folding and unfolding.

UNIT - III

Open systems and chemical thermodynamics: Enthalpy, Gibbs Free Energy and chemical potential, activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Haemoglobin.

UNIT - IV

Diffusion and transport: Maxwell-Boltzmann statistics, Fick's law of diffusion, sedimentation of Cell Cultures, diffusion in a centrifuge, diffusion in an electric field, Lateral diffusion in membranes, Navier stokes equation, low Reynold's Number, Transport, Active and passive membrane transport

UNIT - V

Fluids: Laminar and turbulent fluid flow, Bernoulli's equation, equation of continuity, venture effect, Fluid dynamics of circulatory systems, capillary action. **Bioenergetics and Molecular motors:** Kinesins, Dynein's, and microtubule dynamics, Brownian motion, ATP synthesis in Mitochondria, Photosynthesis in Chloroplasts, Light absorption in biomolecules, vibrational spectra of bio-biomolecules.

Reference Books:

1. Introductory Biophysics, J. Claycomb, JQP Tran, Jones & Bartlett Publishers
2. Aspects of Biophysics, Hughe S W, John Willy and Sons.
3. Essentials of Biophysics by P Narayanan, New Age International

Int. B.Sc.(H)-M.Sc. Physics			
Semester:	V	**Type:**	DSE
Course Name:	Bio-Physics Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

List of Practical

1. Presentation of Statistical data by Histogram, Ogive curves, Pie diagram frequency tables, graphs (5 assignments).
2. Measurement of central tendencies: - Arithmetic & Geometric mean, Mode and Median. (5 assignments).
3. Haemoglobin content estimation.
4. Understanding the working of a manual Hg Blood Pressure monitor and measure the Blood Pressure.
5. Understanding the working of a manual optical eye-testing machine and to learn eye-testing procedure.
6. Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard.
7. Correction of Hypermetropia/Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard.
8. Qualitative tests for Glucose, Fructose, Ribose, Maltose.
9. Test for cholesterol.
10. To learn a) use of microscope b) principles of fixation and staining; To familiarize with bright field, phase contrast, fluorescence & polarizing, microscopes. and micrometry.
11. Determination of ESR.
12. Determination of Clotting time.
13. Determination of Bleeding time.
14. Determination of Blood group.

Reference Books:

1. Basic Radiological Physics, Dr. K. Thayalan - Jaypee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
2. Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincott Williams and Wilkins (1990)
3. Physics of Radiation Therapy: F M Khan - Williams and Wilkins, 3 rd. edition (2003)
4. The essential physics of Medical Imaging: Bush Berg, Seibert, Leidholdt and Boone
5. Lippincott Williams and Wilkins, Second Edition (2002)
6. The Physics of Radiology-H E Johns and Cunningham. Casey E.J. (1967),
7. Biophysics, concepts and mechanisms. Affiliated East west Press. Hughes W. (1979), Aspects of Biophysics, John willey and sons.
8. Lehninger A. (1981), Biochemistry, Butter Worth Publication.
9. Pesce A.J., Rosen C.G and Pasty T.L., Fluorescence Spectroscopy: An introduction for Biology and Medicine, Marcel Dekkar.

6th Semester Syllabus

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	VI	**Type:**	Core
Course Name:	Electromagnetic Theory	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

(The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.)

UNIT-I

Maxwell's equations: Maxwell's equations. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.

UNIT-II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

UNIT-III

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection.

UNIT-IV

Polarization: Electromagnetic origin of Wave Optics Description of Linear, Circular and Elliptical Polarization. Origin of Double-Refraction: Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula.

UNIT-V

Rotatory polarization: Polarization in uniaxial crystals Uniaxial and Biaxial Crystals. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & analysis of polarized light. Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation.

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Optics, E. Hecht, 2016, Pearson.
3. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
4. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
5. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
6. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
   Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
7. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	VI	**Type:**	Core
Course Name:	Electromagnetic Theory Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

List of Practical

1. To determine Brewster's angle for air-glass interface using a prism.
2. To study Fresnel's law by the reflection on the surface of a prism.
3. To verify the Malus law using a pair of polaroid.
4. To study the specific rotation of optically active solution using polarimeter.
5. Determination of wavelength and velocity of ultrasonic waves ion a liquid (kerosene, Xylene etc).
6. To analyze elliptically polarized light by using babinate compensator.
7. To determine dispersive power and resolving power of a plane diffraction grating.

Note: Any other experiments of the equivalent standard can be set

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	VI	**Type:**	Core
Course Name:	Statistical Mechanics	**Course Code:**	
Credits:	4	**L T P:**	3-1-0

(The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.)

UNIT-I

Classical Statistics : Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature.

UNIT II

Classical Theory of Radiation: Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law. Ultraviolet Catastrophe.

UNIT III

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.

UNIT IV

Bose-Einstein Statistics, B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law.

UNIT V

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

Reference Books

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed.,1996, Oxford University Press.
2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill.
3. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall.
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Fran-cis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
6. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press.
7. Statistical Mechanics - an elementary outline, A. Lahiri, 2008, Universities Press.

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	VI	**Type:**	Core
Course Name:	Statistical Mechanics Lab	**Course Code:**	
Credits:	2	**L T P:**	0-0-4

Use C/C++/Scilab/other numerical simulations for solving the problems based on Statistical Mechanics.

List of Practicals

1. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
    a. Study of local number density in the equilibrium state (i) average; (ii) uctuations
    b. Study of transient behavior of the system (approach to equilibrium)
    c. Relationship of large N and the arrow of time
    d. Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution
    e. Computation and study of mean molecular speed and its dependence on particle mass
    f. Computation of fraction of molecules in an ideal gas having speed near the most probable speed

2. Computation of the partition function Z (β) for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and afinite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose- Einstein statistics:

    a. Study of how Z (β), average energy <E>, energy fluctuation ΔE, specific heat at constant volume Cv, depend upon the temperature, total number of particles N and the spectrum of single particle states.
    b. Ratios of occupation numbers of various states for the systems considered above
    c. Computation of physical quantities at large and small temperature Tand comparison of various statistics at large and small temperatureT .

3. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and low temperature.

4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases.
5. Plot the following functions with energy at different temperatures
    a. Maxwell-Boltzmann distribution
    b. Fermi-Dirac distribution
    c. Bose-Einstein distribution

Note: Any other experiments of the equivalent standard can be set

Int. B.Sc.(H)-M.Sc. Physics			
Semester :	VI	**Type:**	Core
Course Name:	Project dissertation	**Course Code:**	
Credits:	12		

A Departmental Committee will distribute the topics for minor project according to the skill and merit of the students.

Annexure

List of examiners for Evaluation of Ph.D. Thesis in the specialization of Material Science/ Condensed Matter Physics

Department of Physics and Astronomical Sciences

S. No.	Name of the Faculty	Affiliation	Contacts
1.	Prof. Naresh Padha	Department of Physics, University of Jammu,Jammu	Email: nareshpadha@jammuuniversity.in Mob:9419182875
2.	Prof .Vivek Gupta	Department of Physics, University of Jammu, Jammu	Email: vivek_gupta2k2@hotmail.com Mob:9419102467
3.	Prof. Ravi Kumar	Centre of Material Science and Engineering NIT Hamirpur H.P..-177 005 India	Mobile: 9814941401 Email: ranade65@gmail.com
4.	Prof. Atul Khanna	Department of Physics, Guru Nanak Dev University Amritsar	Email: atul.phy@gndu.ac.in Mob: 7973668032
5.	Prof. Sanjeev Aggarwal	Department of Physics, Kurukshtera University, Kurukshatra- Haryana	Email : write2sa@gmail.com Phone : 01744238410
6.	Prof. Mukesh Kumar	Department of Physics Lovely professional University, Phagwara	Mob: 7889154619 moka.esh9@gmail.com
7.	Prof. K. C. Juglan	Department of Physics Lovely professional University, Phagwara	09357734302 Email: kc.juglan@lpu.co.in , kailashjuglan@gmail.com
8.	Prof. S. K. Sharma	Department of Physics Central University of Punjab	Email:surender76@gmail.com, Mob: 6280427174
9.	Dr. Fouran Singh	Scientist F, IUAC New Delhi	Email: fouran@gmail.com Mob: +919868204083
10.	Prof. S . J. Dhoble	Department of Physics RTM Nagpur University Campus,Nagpur-440033, Maharashtra India	Mob: 9822710204 Email: sjdhoble@rediffmail.com
11.	Dr. Shyreyas S Pitale	Scientist "G" (Equivalent to Professor) Crystal Technology Laboratory, Technical Physics Division Bhabha Atomic Research Centre (BARC)	Mob: 09757180157 Email(s): spitale@barc.gov.in

		Trombay, Mumbai-400 085, India	
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