Lab & OE Paper problem.
5th and 6th Sem

Aadikavi Shri Maharshi Valmiki University
Raichur - 584 133
SYLLABUS and COURSE STRUCTURE

of

PHYSICS

as per the Choice Based Credit System (CBCS) designed in accordance with of State Education Policy (SEP-2024)

Syllabus of V and VI Semester

Bachelor of Science (B. Sc. Physics)

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w.e.f.

Academic Year 2024-25 and onwards

Bachelor of Science (B. Sc.) Physics(SEP)

Curriculum Structure for Undergraduate Programme for 2024-25

Sl. No.	Course/Paper Code	Title of the Paper	Subject Category	Teaching Hours/ week	Semester End Exam.	Internal Assessment	Total Marks	Credits	Examination Duration
1	2	3	4	5	6	7	8	9	10
Semester-I									
1		Mechanics and Properties of Matter	**MC-T**	04	80	20	**100**	04	3 Hrs.
		Practical-I	**MC-P**	04	40	10	**50**	02	3 Hrs.
Semester-II									
2		Electricity and Magnetism	**MC-T**	04	80	20	**100**	04	3 Hrs.
		Practical – II	**MC-P**	04	40	10	**50**	02	3 Hrs.
Semester-III									
3		Thermal Physics and Statistical Mechanics	**MC-T**	04	80	20	**100**	04	3 Hrs.
		Practical – III	**MC-P**	04	40	10	**50**	02	3 Hrs.
Semester-IV									
4		Classical &Quantum Mechanics and Electronics	**MC-T**	04	80	20	**100**	04	3 Hrs.
		Practical – IV	**MC-P**	04	40	10	**50**	02	3 Hrs.
Semester-V									
5		Solid State Physics	**MC-T**	04	80	20	**100**	04	3 Hrs.
		Wave and Optics	**MC-T**	04	80	20	**100**	04	3 Hrs.
		Practical – V	**MC-P**	04	40	10	**50**	02	3 Hrs.
	Open Elective	Energy Source	**OEL/ OP-I**	03	40	10	**50**	02	2 Hrs
Semester-VI									
6		Nuclear & Particle Physics	**MC-T**	04	80	20	**100**	04	3 Hrs.
		Elements of Atomic, Molecular & Laser Physics	**MC-T**	04	80	20	**100**	04	3 Hrs.
		Practical – VI	**MC-P**	04	40	10	**50**	02	3 Hrs.
	Open Elective	Elements of Nanoscience	**OEL/ OP-II**	03	40	10	**50**	02	2 Hrs
	Skill	Project	**MC-Prj**	02	40	10	**50**	02	
	Grand total								

MC: *Major Course*;**MC-T:***Major Course Theory*;***MC*-P:***Major Course Practical*; ***MC*-Prj:** Project.

SEMESTER-V

Solid State Physics

No.of Credits-04, 64 Hours

Unit –1	**16 hours**
Crystal Structure: Concept of lattice, periodic crystal, unit cell, Bravais lattice, Crystal planes and Miller indices, Interplanar spacing in terms of Millers indices. X-ray diffraction, Bragg's law, Braggs spectrometer (construction and working), powder method, Structure of NaCl and KCl, Crystal binding: Ionic, covalent, metallic, molecular and hydrogen bonding, X-ray spectra; Moseley's law, Scattering of X-rays- Compton effect, Bragg's law and problems. **8hrs**	
Band Theory of Solids: Classification of solids: Conductors, semiconductors and Insulators Intrinsic and extrinsic semiconductors. Derivation of expression for Electron density, hole density and Electrical conductivity in intrinsic semiconductors, expression for Fermi level in intrinsic and extrinsic semiconductors. PN junction diode and problems. **8hrs**	
Unit –2	**16 hours**
Free Electron Theory of Metals: Study of electrical and thermal properties of metals, expression for electrical and thermal conductivities, Weidman Franz Law, Ohm's law, Drude and Lorentz theory, derivation of electron density of states, Concept of Fermi energy, expression for Fermi energy and kinetic energy of electron(at absolute zero temperature), Density of states for free electrons with derivation, qualitative discussion of lattice vibration and concept of phonon and problems.	
Unit –3	**16 hours**
Specific Heat of Solid: Dulong and Petit's law, Einstein's theory and Debye's theory of specific heats(derivation),Hall Effect: Experimental determination of Hall co-efficient and its application, Fermi- Dirac distribution. Problems. **6 hrs**	

Magnetic Properties of Materials: Review of basic Formulae: Magnetic intensity, Magnetic induction, Permeability, Magnetic susceptibility, dia, para and ferro magnetism and its properties, qualitative explanations of classical (Langvein's theory) and quantum theory of paramagnetism (law Currie- Weiss law), discussion of B-H curve, hysteresis & energy loss. Problems. **10 hrs**
Unit –4 **16 hours**
Superconductivity: Introduction, elementary ideas of superconductivity and experimental facts-Zero Resistivity and critical temperature, Meissner effect, BCS theory of superconductor, Critical magnetic field, persistent current, London's equations. Type I and Type II super conductors, applications of superonductors, and problems.

References Books:

Sl No	Title	Name of Author	Publication	Year
1	Introduction to Solid State Physics	Charles Kittel	Global Publication	2018
2	Solid State Physics	Giuseppe Grosso and Giuseppe	Academic Press	2000
3	Modern Physics	R.Murigeshan	S,Chand Publication	2010
4	Elementary Solid State Physics	M. Ali Omar	Pearson Education	1975
5	Condensed Matter Physics	Ajay Kumar Saxena.	Laxmi Publications Pvt. Ltd	2000
6	Introduction to Superconductivity	Michael Tinkham	McGraw-Hill	2004
7	Solid State Physics	A J Dekker	, MacMillan India Ltd	2000
8	Essential of crystallography	, M A Wahab	Narosa Publications	2009

SEMESTER-V

WAVES AND OPTICS

No. of Credits – 04, 64 Hours

Unit –1	**16 hours**
Waves and Superposition of Harmonic Waves. **Waves:** plane and Spherical waves, Longitudinal and Transverse waves, Characteristics of wave motion,plane progressive waves, and its equation, wave equation for differential forms, particle and wave velocities, and relation between them, Energy transport of transverse wave, Expression for intensity of progressive wave. Problems.**6hrs**	
Superposition of Harmonic Waves: principle of superposition and linearity, superposition of two Collinear Harmonic Oscillator: Oscillation having Equal Frequency, Explanation of Lissajous Figures (amplitude un equal, same phase, phase of $\pi/4$), Composition of the harmonic motion with un equal frequency and different amplitude, transverse waves on astring. travelling and standing waves on a string. normal modes of a string. group velocity, phase velocity, plane waves, spherical waves, wave intensity, and problems.**10hrs**	
Unit –2	**16 hours**
Sound: Simple harmonic motion-forced vibrations and resonance - intensity and loudness of sound motion-decibles - intensity levels - musical notes. acoustics of buildings reverberation and time of reverberation - absorption coefficient - Sabine's formula - measurement of reverberation time -acoustic aspects of buildings. Newton's formula for velocity of sound and Laplace correction. beats &its application. Problems. **16hrs**	

Unit –3 16 hours
Wave optics: Theories of light, electromagnetic nature of light. definition and properties of wave front. Huygens principle. construction of wave front. **4hrs** **Interference of light**: Coherent sources, interference due to Division Of Wave front: Young's Double Slit Experiment, Expression for Fringe Width, Lloyd's single Mirror And Fresnel's Bi- prism. interference due to Division of Amplitude: Interference in Thin Films, interference due to Transmitted light, Wedge-Shaped Films. (Air Wedge), Newton's Rings, Theory of Newton's rings by Reflected and Transmitted light, Michelson interferometer, Measurement of a wavelength and Numericals. **12hrs**
Unit –4 16 hours
Diffraction: Idea of Form of Fringes, determination of wavelength, wavelength difference, refractive index and visibility of fringes. Fraunhofer diffraction, single slit, double slit, multiple slits or diffraction grating Fresnel diffraction: half-period zones. zone plate. Fresnel diffraction pattern of a straight edge slit and a wire using half-period zone analysis. Problems. **6hrs** **Polarization of light**: Types of polarization, transverse nature of light waves. plane polarized light, methods of polarization: polarization by reflection, refraction, scattering, absorption, double refraction in a calcite crystal, Brewster's law and its application, Huygens theory of positive and negative crystal, optical activity: Fresnel theory of quarter wave plate and half wave plate. Laurent half shaded polarimeter.Malus law, Super position of Waves linearly polarized at right angles, production of Elliptical and Circular polarized light, Application of polarized light. Cardinal points, Spherical and Chromatic aberrations in lenses. Hyugens and Ramsdons eye pieces and problems. **10hrs**

Reference Books:

Sl No	Title	Authour	Publication	Year
1	optics text book	Brijilal and Subramanyam	S.Chand publications	2006
2	College Physics for B.Sc.	N.Sundararajan,George thomas,Sayyedazeez	United Publication	2002
3	Optics	Ajoyghatak	S.Chand publications	2008
4	A text Book of Sound	Brijilal and Subramanyam	S.Chand publications	1985
5	Engineering Physics	R K Gour And S L Gupta	Dhanpat Rai & Co. (P) Ltd.	2012

Practical Content

List of Experiments to be performed in the Laboratory (Minimum of 10 Experiments)

Solid State Physics and Waves and Optics

No. of Credits: 02

1	Measurement of heat capacity of metals.
2	To Measurement of Susceptibility of paramagnetic solution.
3	To determine the inter planar Spacing d and structure Factor s using X-ray powder Diffraction film.
4	To the temperature co-efficient of resistance of semiconductor.
5	To Draw the B-H Curve of iron and determine the energy loss from Hysteresis.
6	To measure the resistivity of a semiconductor (Ge) Crystal with temperature by Four Probe Method(Room Temperature) and determine its Band Gap.
7	To Determine the energy gap of a semiconductor.
8	Temperature coefficient of resistance and energy gap of thermistor.
9	Solar cell characteristics – Open circuit voltage – short circuit current – efficiency.
10	Study of Hall effect in a metal.
11	Determination of Fermi energy of a metal.
12	Velocity of sound through a wire using Sonometer.
13	Frequency of AC using Sonometer.
14	Study of Lissajous Figures.
15	To determine the thickness of a thin paper by measuring the width of the

	interference fringes produced by a wedge-shaped film.
16	To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2- T Law.
17	To determine the Refractive Index of the Material of a given Prism using Mercury Light.
18	To determine Dispersive Power of the Material of a given Prism using Mercury Light.
19	To determine the value of Cauchy Constants of a material of a prism.
20	To determine the Resolving Power of a Prism.
21	To determine wavelength of sodium light using Newton's Rings.
22	To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating.
23	To determine the Resolving Power of a Plane Diffraction Grating.

Reference Books:

Sl. No	Title	Name of Author	Publication	Year
1	Experiment In Physics	B. Saraf	Vikas Publicatios	1975
2	Advanced Practical Physics	S.P. Singh	Pragati Prakashan	1969
3	Physics Practicals	C. L. Arrora	S.Chand	2010
4	Experiments In Modern Physics.	Melissons		1966
5	Physics Lab. Manual	Misra and Misra	South Asian Publishers	2000
6	Practical Physics	Gupta and Kumar	Pragati Prakashan	1976

Open Elective Paper

Energy Sources

No. of Credits 02; 32 Hours

Unit –1	8 hours
Non-Renewable Energy Sources Energy concept-sources in general, its significance &necessity,Classification of energy sources: Primary and Secondary energy,Commercial andNon-commercial energy, Renewable and Non-renewable energy,Conventional and Non-Conventional energy, Based on Origin- Examples and limitations.Importance of Non-commercial energy resources.	
Unit –2	**8 hours**
Renewable Energy Need of renewable energy, Overview of developments in Off-shore Wind Energy, Tidal Energy,Wave energySystem, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical Conversion, biogas generation, geothermal energy, tidal energy, Hydroelectricity.	
Unit –3	**8 hours**
Conventional Energy Sources Fossil fuels & Nuclear energy- production & extraction,Usage rate and limitations. Impact on environment and their issues & challenges.Overview of Indian & world energy scenario with latest statistics- consumption & Necessity. Need of eco-friendly & green energy & their related technology.	
Unit –4	**8 hours**
Solar energy Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation,solar cooker, solar green houses, solar cell-brief discussion of each. Need and characteristics of photovoltaic (PV) systems,PV models and equivalent circuits, and sun tracking systems.	

Open Elective Paper
Energy Sources
No. of Credits 02; 32 Hours

Unit –1	16 hours
Renewable and Non-Renewable Energy Sources Energy concept-sources in general, its significance &necessity, Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, ,Conventional and Non-Conventional energy, Based on Origin- Examples and limitations. Importance of Non-commercial energy resources, Need of renewable energy, Wind Energy, Tidal Energy, Ocean Thermal Energy Conversion, biomass, biochemical Conversion, biogas generation, geothermal energy, Hydroelectricity.	
Unit –2	**16 hours**
Conventional and Solar Energy Sources Fossil fuels & Nuclear energy- production & extraction, Usage rate and limitations, Impact on environment and their issues & challenges, Need of eco-friendly & green energy & their related technology, Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell-brief discussion of each. Need and characteristics of photovoltaic (PV) systems,PV models and equivalent circuits, and sun tracking systems.	

References Books:

Sl. No.	Book Title	Author Name	Publication	year
01	Fuelcell Techonology	Hoogers G	CRC Press	2003
02	Fuelcell and their application	Karl Kordesch &Gunter R.Simader	VCH Publisher	2001. 1ed
03	Energy Harvesting Technologies	Shashank Priya and Daniel J. Inman	Springer nature link	2009
04	Renewable Energy and Energy Harvesting	Binapani Satpathy	Kalyani Publishers	2018

References Books:

Sl. No.	Book Title	Author Name	Publication	year
01	Fuelcell Techonology	Hoogers G	CRC Press	2003
02	Fuelcell and their application	Karl Kordesch &Gunter R.Simader	VCH Publisher	2001. 1ed
03	Energy Harvesting Technologies	Shashank Priya and Daniel J. Inman	Springer nature link	2009
04	Renewable Energy and Energy Harvesting	Binapani Satpathy	Kalyani Publishers	2018

SEMESTER-VI

Nuclear and Particle Physics

No of Credits – 04, 64 Hours

Unit –1	16 hours
General Properties of Nuclei: Introduction to Nucleus, Constituents of nucleus and their intrinsic properties, General properties of Nucleus, Theory of Rutherford's α-Scattering, Nuclear forces and its characterstics, Yukawa's Meson theory of Nuclear Force, Mass defect and binding energy, Binding energy per Nucleon, Nuclear stability, Packing fraction and stability, Nuclear density, angular momentum, parity, magnetic moment, electric moments, Nuclear Models, (Qualitative explanation of Shell model and Liquid drop model)and Problems.	
Unit –2	**16 hours**
Radioactivity decay: Radioactivity: definition of radioactivity, half-life, mean life, radioactivity equilibrium (a) Alpha decay: basis of α-decay processes, theory of α emission (brief), Gammow factor, Geiger-Nuttall law. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.(c) Gamma decay: Gamma ray's emission and kinematics, internal conversion (Definition).	
Unit –3	**16 hours**
Interaction of Nuclear Radiation with matter Gamma ray interaction through matter, photoelectric effect Compton scattering, pair production, Energy loss due to ionization (quantitative description of Bethe Block formula), energy loss of electrons, **Detector for Nuclear Radiations:** Gas detectors: Estimation of electric field, mobility of particle, for ionization chamber and GM counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (Concepts of charge carrier and mobility) qualitative only, Accelerators: Cyclotrons and Synchrotrons.	

Unit –4	16 hours
Elementary Particles: Introduction to the elementary particles, Classification of Elementary Particles, Particle and anti-particles, Particle Interaction, Quantum Numbers, Quark as the Building block of Hardons, Colour degree of Freedom. Interaction of Charged particles with Matter: Rate of Loss of Energy of a charged particle Transferring a material medium, Neutron Decay, Stability of proton, Detection of Neutrino, Calculation of energy of photon in γ-decay.	

Reference:

Sl No.	Tittle of the Book	Name of Authour	Publication	Year
1	Nuclear Physics	D C Thayal	Himalaya Publishing House,Mumbai.5e	2o22
2	Concept of Nuclear Physics	Benard L,Cohen	Tata Mcgraw Hill	1998
3	Modern Physics	R.Murugeshan,Sivaprasath	S.Chand Publication,18e	2017
4	Introductory Nuclear Physics	Kenneth S.krane	Wiley India Pvt Ltd	2008
5	Introduction to Elementary Particle	D.Griffith	Johan Wiley & Son's	2008
6	Quarks and Leptons	F.Halzen,& A D Martin	Wiley india, New Delhi	2008
7	Radiation Detection and measurement,	G F Knoll	Johan Wiley & Son's	2000
8	Elementry Particles	J M Longo	Mcgraw Hill Neyork , 2e	1973
9	Nuclear Radation Detectors	S S Kapoor & VSRamamurthy	Wiley-Eastern NewDelhi.	1986

SEMESTER-VI

Elements of Atomic, Molecular and Laser Physics

No. of Credits 04: 64 Hours

Unit –1	**16 hours**
Atomic Physics: Thomson's atomic model; Rutherford atomic model – Model, Theory of alpha particle scattering, Rutherford scattering formula; Bohr atomic model – postulates, Derivation of expression for radius, total energy of electron; Origin of the spectral lines; Spectral series of hydrogen atom; Effect of nuclear motion on atomic spectra – derivation; Ritz combination principle; Correspondence principle; Critical potentials – critical potential, excitation potential and ionization potential; Atomic excitation and its types, Franck-Hertz experiment; Sommerfeld's atomic model – model, Derivation of condition for allowed elliptical orbits. Problems.	
Unit –2	**16 hours**
Molecular Physics: Types of molecules based on their moment of inertia; Types of molecular motions and energies; Born-Oppenheimer approximation; Origin of molecular spectra; Nature of molecular spectra; Theory of rigid rotator – energy levels and spectrum, Qualitative discussion on Non-rigid rotator and centrifugal distortion; Theory of vibrating molecule as a simple harmonic oscillator – energy levels and spectrum; Electronic spectra of molecules – fluorescence and phosphorescence; Raman effect – Stoke's and anti-Stoke's lines, characteristics of Raman spectra, classical and quantum approaches, Experimental study of Raman effect; Applications of Raman effect. Problems.	
Unit –3	**16 hours**
Laser Physics: Ordinary light versus laser light; Characteristics of laser light; Interaction of radiation with matter – Induced absorption, spontaneous emission and stimulated emission with mention of rate equations; Einstein's A and B coefficients – Derivation of relation between Einstein's coefficients and radiation energy density; Possibility of amplification of light; Population inversion; Methods of pumping; Metastable states; Requisites of laser – energy source, active medium and laser cavity; Difference between Three level and four level lasers with examples; Types of lasers with examples; Construction and Working principle of Ruby Laser and He-Ne Laser; Application of lasers (qualitative) in science & research, isotope separation, communication, fusion,	

Unit –4	16 hours
Optical Fibres and Optical Instruments: Introduction definition, Propagation mechanism, angle of acceptance, Numerical aperture, Modes of propagation and Types of optical fibers. Attenuation: Causes of attenuation and Mention of expression for attenuation coefficient. Discussion of block diagram of point-to-point communication. Merits and demerits, Numerical problems.	

Reference Books:

Sl no.	Tittle of the Book	Author Name	Publication	year
1	Physics of Atoms and Molecules.	B.H. Bransden & C.J. Joachain:	John Wiley & Sons, Inc., New York.	2003
2	An Introduction to Atomic and Molecular Physics	Dr. Vinod Kumar Singh & Dr. Gaurav Mishra	P.K. Publishers and Distributors	2021
3	The Fundamentals of Atomic and Molecular Physics	Robert L. Brooks	Springer Science & Business Media	2014
4	Modern Physics	R.Murugeshan,Sivaprasath	S.Chand Publication,18e	2017
5	Modern physics	*S.N. Ghoshal*	S.Chand Publication,	
6	Atomic and Molecular Physics	*Rajkumar*	Campus Books International	2003
7	Lasers:*Fundamentals and Applications.*	Ajoy Ghatak & K. Thyagarajan	Springer nature link	2010

Practical Content

List of Experiments to be performed in the Laboratory (Minimum of 10 Experiments)

Nuclear and Particle Physics and Elements of Atomic, Molecular & Laser Physics

No. of Credits: 02

1	To Determination of the operating voltage, plateau length, and slope for a GM tube.
2	Studying the absorption of β-particles in Aluminum (Al) foils to determine the mass attenuation coefficient.
3	To Verify Inverse Square Law of Radiation Using Photo electric Effect.
4	ToVerify the inverse Square Law using G M Counter.
5	Measuring the charge-to-mass ratio by Specific charge of an Electron by e/m Method.
6	To Determine the planks Constant 'h' by using Photo Cell Method.
7	To Determine the dead time of G M Counter By Single source Method
8	To Determine the Half-life Period of a given Source
9	Finding the energy of a beta source Tl-204 using absorption techniques.
10	Studying attenuation of (gamma)Y-rays (using ^{137} Cs or similar sources) in Lead (Pb) foils.
11	To determine Planck's constant using Photocell.
12	To determine Planck's constant using LED.
13	To determine wavelength of spectral lines of mercury source using spectrometer.
14	To determine the value of Rydberg's constant using diffraction grating and hydrogen discharge tube.
15	To determine fine structure constant using fine structure separation of sodium D-lines using a plane diffraction grating.
16	To determine the value of e/m by Magnetic focusing or Bar magnet.
17	To determine the ionization potential of mercury.
18	To determine the force constant and vibrational constant for the iodine molecule from its absorption spectrum.
19	To determine the wavelength of laser using diffraction by single slit/double slits.
20	To determine wavelength of He-Ne laser using plane diffraction grating.

Reference Books:

Sl. No	Title	Name of Author	Publication	Year
1	Experiment In Physics	B. Saraf	Vikas Publicatios	1975
2	Advanced Practical Physics	S.P. Singh	Pragati Prakashan	1969
3	Physics Practicals	C. L. Arrora	S.Chand	2010
4	Experiments In Modern Physics.	Melissons		1966
5	Physics Lab. Manual	Misra and Misra	South Asian Publishers	2000
6	Practical Physics	Gupta and Kumar	Pragati Prakashan	1976

Open Elective Paper

Elements of Nanoscience

No. of Credits 02: 32 Hours

Unit –1	16hours
Introduction to Nanoscience: Length scales surface, size, shape and assembly effects. Classification of nanostructured materials, nanoparticles-quantum dots, nanowires-ultra-thin films, Variation of physical properties from bulk to thin films to nanomaterials - confinement of electron energy states in 0D,1D,2D and 3D systems, density of states equation and graph (qualitative treatment). **Carbon Clusters:** Fullerene, graphene and carbon nanotube-Single wall carbon nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT). Mechanical, Electronic, Optical, Magnetic and Thermal properties of nanomaterials (qualitative).	
Unit –2	**16 hours**
General Methods of Preparation and Applications of Nanomaterials: Top-down Techniques: Mechanical Griding (Ball milling), Lithography, Etching and Erosin. Bottom-up Techniques: Co-Precipitation, Colloidal routes, Chemical vapour phase deposition, MOCVD, Plasma CVD. Physical Vapour Deposition: Sputtering thermal evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE, Energ storage, molecular switches, sensors, LEDs, medical diagnostics, drug delivery, Bioimaging-Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS).	

Reference Books:

Sl No	Title of Book	Authour	Publication	Year
1	Nanotechnology	G,Timp	AIP Press/ Springer	1999
2	The Hand book of Nano tecnology	Akhlesh Lakhtakia	Prentice-Hall of india(pvt) Ltd New Delhi	2007
3	Chemistry of Nano Material.	CNR Rao	Springer in Nature	2004
4	Nano Materials	A.K.Bandyopadhyay	New Age Publishers	2010

Members of Board of Studies (BoS – U.G.) in Physics:

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