SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with "A" grade by NAAC

Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai – 600 119

www.sathyabama.ac.in

School of Science and Humanities

Department of Physics (DST-FIST Sponsored)

BOARD OF STUDIES

Minutes of Meeting

Date: 15/4/2019 **(10.00 AM – 1.30 PM)** Venue: Board Room, VC Office

Agenda of Meeting:

Reframing the theory and lab syllabus for M. Sc, B. Sc and B.E/B.Tech.

Minutes:

Board of studies meeting of Department of Physics was held on 15th April 2019 between 10 am to 1.30 pm at Board Room of VC's Office. Head of the Department addressed the gathering about the programmes and courses offered by the Department of Physics. He projected the syllabus of M.Sc., B.Sc. and B.E./B.Tech. The external members had gone through the syllabus and their suggestions are listed below:

I B.E/ B.Tech Theory

Based on the suggestions given by the board members, a new syllabus is framed which is common for all I year B.E /B.Tech.

- **I B.E/ B.Tech Lab**
  - Recommended to do six experiments instead of ten experiments.

- **B.Sc (Physics) Theory**
  1. Mathematical physics, in unit 3 cylindrical coordinate system is removed and surface geometry is added. In Unit 4, arbitrary period expansion of non-periodic functions is removed and Sum of Fourier series and Parseval's identity (statement only) is included. In unit 5, error Function is removed.
  2. In atomic physics in the unit 2, De Broglie Wavelength; Heisenberg's Uncertainty Principle; Atomic Spectra; Bohr's Atomic Model is removed. Included the Principal quantum number, Orbital angular momentum quantum number (or azimuthal quantum number), Magnetic quantum number and the electron spin quantum number. In the unit 5, - Recombination Radiation and Calculate the energy of the absorbed photons and find the energy of the transitions resulting in radiation at visible wavelengths.is included.

- **B.Sc (Physics) Lab**

    1. Two new experiments are included in mechanics lab.
    2. MATHEMATICAL PHYSICS (SPH4215) LAB is added in Final year.
    3. ENCODER and DECODER Experiments added in DIGITAL AND ANALOG ELECTRONICS LAB (SPH4216). Electronics Lab - In expensive – simulation based experiments need to be included.

- **M.Sc (Physics) Theory**

    1. In semester- I, Solid State Physics - I is removed and Material Science is included.
    2. Numerical methods and computer programming – C++ programming is to be removed. MATLAB and LABVIEW to be included.
    3. In semester – II, Microprocessor, Microcontroller and Embedded System – the deleted units are Microcontroller (8051), Advanced Microcontroller, Hardware and Software. The added units are ARM microcontroller, Python programming and IoT and Embedded system design and development.
    4. In semester III, Solid state physics – II is removed and Condensed Matter Physics is included.
    5. A new course on 'Introduction to Research Methodology' in M. Sc Programme of 2 credits has been introduced in the 3rd semester.
    6. Elective subjects added – Energy Materials, Industry 4.0, Intellectual Property Law, Introduction to Computational Materials Science, Thin Film Technology, Physics of Dielectrics and Radiation Physics. High Pressure Physics and Nonlinear Dynamics courses to be removed.

- **M.Sc (Physics) Lab**

    1. "General Physics lab – I" is revised and some new experiments are added and renamed as "General Physics lab"
    2. General Physics Lab - The following experiments may be included - Meyer disc-Viscosity of a liquid, Acoustic Diffraction, Cornu's Method – Determination of Elastic Constants of Transparent Materials (Elliptical fringes), Fabry-Perot etalon interferometer, Arc spectra, Stefan's Constant.
    3. General Physics lab II revised and named as Advanced Physics Lab - The following experiments may be included - Impedance measurement thermal based transmittance/ absorbance characteristics of PV cells/thin films.
    4. Minimum of 15 experiments need to be exercised for General Physics Lab and Advanced Physics Lab; 10 experiments for Electronics lab and microprocessor lab.

The members had the brain storming discussion and interaction among them. BOS members reviewed and resolved to approve the syllabus offed by the department of Physics.

Members Present:

S.No	Board of Studies Members
1	**Dr. T.S. Natarajan**, Department of Physics, IIT Madras/ IIT Tirupati.
2	**Dr. N. Vijayan,** Senior Scientist Crystal Growth and X-Ray Analysis Section, CSIR-National Physical Laboratory, New Delhi-110012.
3	**Dr. D. Siva Prahasam**, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Centre for Automated Energy Materials, IITM Research Park, Taramani.
4	**Dr. S. Ravichandran** Professor & Head / Department of Physics Sathyabama Institute of Science & Technology, Chennai.
5	**Dr. Helen Marina Albert.** Professor/ Department of Physics Sathyabama Institute of Science & Technology, Chennai.
6	**Dr. C. Rameshkumar,** Associate Professor/ Department of Physics Sathyabama Institute of Science & Technology, Chennai.

External members	Signature	Internal members	signature
Dr.N.Vijayan	[signature]	Dr.S.Ravichandran	[signature]
Dr.T.S.N.Natarajan	[signature]	Dr.HelenMerina Albert	[signature]
Dr. D.SivaPrahasam	[signature]	Dr.C.Ramesh Kumar	[signature]

SPH5601	MATERIALS SCIENCE	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To acquire enveloping knowledge of physics, chemistry, metallurgy and mathematics to know wider field of materials science this is an interdisciplinary subject.
- Also to motivate the students to pursue research in the field of materials science.

UNIT 1 CHARACTERISATION OF MATERIALS 12 Hrs.

Introduction, **Structural characterization -** X-ray diffraction, Laue's method, Bragg's law, Determination of crystal structure by Bragg's Spectrometer and powder X-ray diffractometer (Debye Scherrer camera) with principle, construction and working. **Microstructural characterization –** electromagnetic lens system, Determination of surface morphology by Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM) with principle, construction, working. **Microhardness testing** –Determination of microhardness by Vickers hardness test and knoop hardness test with principle construction, working, formula. **Nano hardness test –** Determination of nano hardness by AFM.

UNIT 2 METALSALLOYS 12 Hrs.

Introduction, Classification of metal alloys-Ferrous and Non Ferrous Alloys, **Ferrous Alloys-** classification, composition, properties and applications; **Synthesization of alloy steels –** construction and working of Electric Furnace process (Heroult furnace); **Phase diagram–** definition and its significance; micro structure-definition, types of micro structures–ferrite, cementite, pearlite, austenite, martensite with diagrams; Iron-Carbon Alloy Phase diagram – graphical description and explanation with all the necessary parameters. **Non-Ferrous Alloys -** Aluminum, Copper, Titanium, Magnesium alloys - composition, properties and applications. **Shape Memory Alloys** –Shape memory effect- mechanism and transformation temperature types of SMA - one way and two way shape memory effect; characteristics of SMA- hysteresis, pseudo-elasticity, super elasticity; characterization of shape memory alloys – explanation with reference to Differential Scanning Calorimetry, resistivity, transformation temperature, tensile test; Advantages and disadvantages of SMA, General applications.

UNIT 3 CERAMICS, COMPOSITES AND POLYMERS 12 Hrs.

Ceramics: Structural features – Types of ceramics, Production techniques - Mechanical properties - Industrial ceramics like tungsten carbide, silica-alumina, zirconia, silicon carbide and sialons. **Composites:** Definition of composites - Continuous and Discontinuous fiber composites-Polymer and matrix-based composites - Examples of commercial composites. Structural features of polymer materials - Mechanism s of polymerization and types of polymers- Thermoplastics - rubbers and elastomers - mechanical, physical and chemical properties - Cellular plastics - Liquid crystal polymers .

UNIT 4 ELECTRONIC MATERIALS 12 Hrs.

Introduction Purification of electronic materials - Crystal growth and doping techniques (an overview) - Epitaxial growth - Impurity diffusion - Ion implantation - Junction formation - Metallization - Lithography (an overview) - Contact formation.

UNIT 5 NANO MATERIALS 12 Hrs.

Introduction, Top down and bottom up approach, synthesis and properties, Nanomagnetic-OMR, GMR, TMR, Nano semiconductors-quantum cascade laser, quantum dot-optical memory, Blockade device, quantum well.

Max. 60 Hours

Course Outcomes:

Having successfully completed this course, students will be able to

CO1: Characterize the materials by AFM,TEM, SEM,XRD etc.
CO2: Describe the nature and types of alloys and understand its applications
CO3: Develop the systemby using ceramics, composites and polymers to the modern society
CO4: Understand the Crystal growth and Lithography techniques
CO5: ApplyNano materials in appropriate application.

TEXT / REFERENCEBOOKS

1. J.C.Anderson, K.D.Leaver, R. D. Rawlings and J.M.Alexander, Materials Science, 4th Edition, Chapman-Hall, London, 1990.
2. V. Raghavan, Materials Science and Engineering, 3rd Ed. Prentice-Hall India, New Delhi, 1993.
3. C. M. Srivastava and C. Srinivasan, Science of Engineering Materials, Wiley-Eastern Ltd., New Delhi, 1987.
4. G. K. Narula, K. S. Narula and V. K. Gupta, Materials Science, Tata McGraw-Hill, 1988.
5. Z. D. Jaberezki, The Nature and Properties of Engineering Materials, Wiley Eastern.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SPHA5203	NUMERICAL METHODS AND COMPUTER PROGRAMMING	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To provide the understanding of numerically obtained roots of nonlinear equations and system of linear equations.
- Also to apply programming practices into mathematical computing to solve mathematical problems effectively.

UNIT 1 SYSTEM OF EQUATIONS **12 Hrs.**

Roots of equations-Methods of bisection and false position-Newton-Raphson method-solution of simultaneous linear algebraic equations-Gauss elimination-Gauss Jordan methods-matrix inversion and LU decomposition methods-Gauss-Seidel iterative method-Eigen values of matrices-Power method and Jacobi's method.

UNIT 2 INTERPOLATION, CURVE FITTING AND STATISTICS **12 Hrs.**

Newton's forward and backward interpolation formulae-Lagrange's method-Lagrange's inverse interpolation-curve fitting-principle of least squares-correlation and regression analysis-sampling distributions-small and large samples-tests of hypothesis-Student's distribution-Chi square distribution.

UNIT 3 NUMERICAL DIFFERENTIATION AND INTEGRATION **12 Hrs.**

Newton's forward and backward difference formulae-numerical integration-Trapezoidal rule and Simpson's rule-numerical solution of ordinary differential equations-Taylor series-Euler's method, improved and modified methods-Runge-Kutta methods-Milne's predictor-corrector method.

UNIT 4 C PROGRAMMING **12 Hrs.**

Introduction, operator, expressions, variables, input, output statements, control statements, functions, arrays, categories of functions, programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials / non-linear equations by the Newton-Raphson method, (c) Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.

UNIT 5 INTRODUCTION TO LABVIEW and MATLAB **12 Hrs.**

Introduction to LABVIEW tools palette, controls & functions palette, data types, conversion – front panel, block diagram construction, parallel data flow, create indicators/controls/constants math operations, booleans, arrays, case structures, sequences – for loops, while loops – I/O reading and writing to files, paths, graphing, timed loops, signal generation/processing, waveform types, connecting to hardware, DAQ, serial, GPIB, TCP/IP and USB interface

Max. 60 Hours

Course Outcomes:

Having successfully completed this course, students will be able to
CO1: Understand the numerically obtained roots of nonlinear equations and system of linear equations
CO2: Apply the programming concept in physics related mathematical problems,
CO3: Apply the object oriented concept in real time mathematical problems.
CO4: Apply C- programming concept in physics related mathematical problems
CO5: Apply Labview and Matlab tools to understand the basic concept in physics by programming in a real way.

TEXT / REFERENCEBOOKS

1. M.K. Venkatraman, Numerical Methods in Science and Engineering, National Publishing company, Madras, 1996.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, New Delhi, 1992.
3. Kernighan and Ritchie, The C Programming language, Prentice Hall of India, 1999.
4. B.S. Gottfried, Programming with C, Tata McGraw Hill, 2000.
5. V. Rajaraman, Computer Programming in FORTRAN, Prentice Hall of India, New Delhi, 1994.
6. P.Dey and M.Ghosh, Computer fundamentals and Programming in C, 2nd edition, Oxford University Press, 2006.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 mark each - No choice. **30 Marks**

PART B:2 Questions from each unit of internal choice, each carrying 14 marks**.** **70 Marks**

SPHA5301	CONDENSED MATTER PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide depth of knowledge and to improve the understanding capability about crystal structure.
- It is intended to describe the bonding nature, optical and dielectric properties of solids.
- Also to motivate the students to pursue research in the field of condensed matter physics.

UNIT 1 CRYSTAL BINDING **12 Hrs.**

Force between atoms-cohesive energy-calculation of cohesive energy bonding in solids-ionic, covalent, metallic, and molecular –hydrogen bonded crystals-binding energy of ionic crystals-Madelung constant- Lattice Energy - Born Mayer potential –Thermo chemical Born-Haber cycle. Crystal Defects: Point, line, surface and volume defects.

UNIT 2 LATTICE DYNAMICS **12 Hrs.**

Direct and Reciprocal lattice. Vibration modes of mono and diatomic lattices- upper and lower branches, Born-von Karman cyclic condition, quantization of lattice vibration-phonon momentum. Lattice vibrations and specific heats for three dimensional lattices, Inelastic scattering of neutrons by phonons-neutron diffraction, Density of Phonon modes in 1D and 3D, Lattice heat capacity, Thermal resistivity, Normal and Umklapp process.

UNIT 3 BAND THEORY OF SOLIDS **12 Hrs.**

Origin of energy bands – periodic potential in 1D - Bloch’s theorem, Kronig-Penney 1D model-Limitation - construction of Brillouin zones-extended, reduced and periodic zone schemes-effective mass of an electron-nearly free electron model, Distinction between conductors, semiconductors and insulators, E-k curve, Born cyclic condition and number of electrons per band

UNIT4 ATOMIC MOLECULAR STRUCTURE **12 Hrs.**

Central field approximation-Thomas Fermi model and its application-Hartree and Hartree Fock equations hydrogen molecules-Heiyrt London model-LCAO –Hybridization.

UNIT 5 FERMI SURFACE **12 Hrs.**

Fermi surface and Brilloiun zones-Harrison’s method of constructing Fermi surface in 2Delectron, hole and open orbits-characteristics of Fermi surface-effects of electric field on the Fermi surface-effect of magnetic field on the Fermi surface-quantization of electron orbits-experimental study of Fermi surface (dHVA method)

Max. 60 Hours

Course Outcomes:

After the end of this course, the students will be able to;

CO1: Understand the basic physics behind the various crystal structure.

CO2: Understand the concept of phonons

CO3: Understand the basic concepts to classify the solids based on the electron transport properties.

CO4: Understand in depth concept of atomic structure

CO5: Understand the importance and Fermi surface and classify it.

TEXT /REFERENCEBOOKS

1. C.Kittel, Introduction to solid state Physics 7 thEdn, Wiley Eastern, 1996.
2. A.K.Chandra, Quantum Chemistry, Prentice Hall, 1990.
3. R.E.Hummel, Electronic properties of materials, 2nd Edn, A Narosa, 1993.
4. S.Raimes, The wave mechanics of electrons in metals, 3rd Ed, Amsterdam: North Holland Pub.co, 1967.
5. Michael P. Marder, Condensed Matter Physics, Wiley, 2010.
6. C.P.Smyth, Dielectric behavior and structure, McGraw Hill, New York, 1965
7. M.A.Wahab, Solid State Physics, Structure and properties of materials, second edition, Narosa publishing house,

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SPHA7403	ENERGY MATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide the understanding of various energy sources and energy conversion for current applications.
- It is extended to describe fuel vehicles, hydrogen storage and bio fuel and its applications.
- To motivate the students to do research in energy materials.

UNIT 1 Indian Energy Scenario: **12 Hrs.**

Role of energy in economic development and social transformation, Various types of energy sources: Energy sources and overall energy demand, Availability of energy sources. Non-Renewable Energy sources: Coal, Oil, Natural gas, Nuclear power, Hydroelectricity, Renewable Energy sources: Solar, Wind, Biomass, Tidal, Ocean wave, Ocean thermal, Geothermal and other. Energy consumption and its impact on environmental climatic change. Future Energy Option: Sustainable development, Energy crisis, Transition from carbon free technologies, Parameters of transition, Carbon credits.

UNIT2 Solar Photovoltaics (SPV) Solar Photovoltaics (SPV) Conversion: **12 Hrs.**

Basic principles, Types of solar cell materials, Fabrication of solar photovoltaic cells, solar cell parameters and characteristics, Modules. Block diagram of general SPV conversion system and their characteristics, Different configurations, Application (such as street light, water pumps, Radio/TV, Small capacity power generation) Solar Photovoltaic (SPV) Systems Designing: Load estimation, selection of inverters, battery sizing, array sizing.

UNIT 3 Hydrogen Energy: **12 Hrs.**

Hydrogen Fuel: Importance of Hydrogen as a future fuel, Sources of Hydrogen, Fuel of vehicles. Hydrogen production: Production of Hydrogen by various methods, Direct electrolysis of water, Direct thermal decomposition of water, Biological and biochemical methods of hydrogen production. Hydrogen storage: Gaseous, Cryogenic and Metal hydride. Utilization of hydrogen: Fuel cell – Principle, construction and applications.

UNIT 4 Wind Energy: **12 Hrs.**

Wind Energy: Introduction, Basic principle of wind energy conversion, Extraction of maximum power from wind and its dependence on various parameters. Wind Mills: Types of wind mills, Vertical axis and Horizontal axis wind mills their performance, Merits and Demerits, Limitations of wind energy conversions.

UNIT 5 Bio Energy: **12 Hrs.**

Biomass, Generation and utilization, Property of biomass, Agriculture crop and Forestry residues used as fields. Physical, Chemical and biological conversion of biomass into useful form of energy. Gasification, Biomass gasifiers and types. Biogas: Introduction, Generation of biogas, Aerobic and anaerobic bioconversion process. Substances used to produce biogas (Cow dung, Human and other agricultural waste, Municipal waste etc.), Digesters and their designs, Pyrolysis and gasification, Fermentation process. Biofuels: Types of biofuels, Production processes, Biofuel applications.

COURSE OUTCOMES:

CO1: Understanding of Indian Energy Scenario. They know about the energy sources in india.

CO2: construct the solar photovoltaics cell

CO3: understanding about the production and applications of hydrogen energy

CO4: Design and implement systems of wind energy and wind mills.

CO5: Understand and utilization of Bio energy and bio fuel applications.

REFERENCE BOOKS:

1. Climatological and Solar data for India, Seshadri. (Sarita Prakashan), 1969.
2. Solar Energy Utilization, G.D. Rai, 9Khanna Publishers), 1995.
3. Energy technology, S. Rao and B.B. Parulekar (Khanna Publishers), 1995
4. Terrestrial Solar Photovoltaics, Tapan Bhattacharya, (Namsa: Publication House, New Delhi)
5. Solar Cells-operating Principles, technology and System Applications, Martin A. Green (Prentice Inc. USA).
6. Solar Thermal Engineering, J.A. Duffie (Academic Press)
7. Renewable Energy Sources and Conversion Technology, N.K. Bansal, M. Kleeman and S.N. Sreinivas Tata Energy Research Institute, New Delhi), 1996.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SCCA9501	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	-	2	2	100

UNIT 1 ADVANCED TECHNOLOGY AND MATERIALS 7 Hrs.
Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nano mechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaics, Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT 7 Hrs.
Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal, public health issues-improving water management in surface and overhead irrigation- Integration of energy, water and environmental systems for a sustainable development.

UNIT 3 SMART MANUFACTURING 8 Hrs.
Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles (UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations –Intellectual Property Rights (IPR): Case Studies.

UNIT 4 SMART WORLD 8 Hrs.
Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Intellectual Property Rights- Case Studies.

UNIT 5 CYBER PHYSICAL SYSTEMS 8 Hrs.
Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : Case Studies.

Course Outcomes:
Upon successful completion of this course, students should be able to:

CO1: Understand the advanced Materials/Technology
CO2: Acquire knowledge about environmental systems for a sustainable development
CO3: Covers many different technologies from Smart Manufacturing
CO4: Effectively learning the smart technology
CO5: Understand various modeling formalisms for CPS, such as hybrid automata, state-space methods, etc

TEXT / REFERENCE BOOKS

1. William D. Callister,"Materials Science and Engineering, An Introduction, John Willey and Sons Inc. Singapore, 2001.
2. V. Raghavan, "Physical Metallurgy: Principle and Practice. Prentice Hall India Pvt Ltd, 2006.
3. FlavioCraveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, pp. 251-267, 2019.
4. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
5. Oliver Grunow, SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies" , Studylab Publications, 2016
6. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 2016

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**
PART A: 5 Questions of 6 mark each - No choice. **30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SALA4001	INTELLECTUAL PROPERTY LAW	L	T	P	Credit	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE:

- This course is intended to introduce the different categories of Intellectual Property, the minimum standard to indentify the items of protection.
- Bundle of rights conferred to the right holder and remedies available in the case of infringement are also examined.

UNIT 1 INTRODUCTION 8Hrs

Meaning and concept of intellectual Property and the need for protection - The world Intellectual property Organization (WIPO) Convention - Origin and functions of World Trade Organisation (WTO) - Trade Related Intellectual property Rights (TRIPS) Agreement of WTO and its effects on Intellectual Property law in India; Dispute Settlement Mechanism.

UNIT 2 COPYRIGHT ACT 12Hrs

The Copyright Act (1957) and recent amendments-works in which copyright subsist-Authorship And Ownership-Different Rights-Registration of copyright-Term of copyright-Administration of copyright law-Performer's rights-Broadcaster's rights-Collective administration of copyrights-Moral rights-Copyright infringements-Remedies-Composition of Copyright Board.

UNIT 3 TRADEMARK & DESIGNS ACT 12Hrs

The Trade Mark Act (1999), object, definitions, salient features- Distinctiveness, deceptive similarity- Assignment and transmission -Registration: Procedure-Term-Effects-Grounds for refusal- Powers and functions of Registrar- collective marks-certification marks-Trade mark agents - Appellate board - Infringement action, passing off action –Well known marks- The designs Act 2000; definitions, registration of designs, copyright in registered designs, piracy of registered designs, remedies, powers and duties of Controller - Semi conductor integrated circuit layout-Trade secrets.

UNIT 4 LAW OF PATENTS 12Hrs

The Patents Act (1970): object definitions, salient features-Invention: patentable and non- patentable inventions-product and process patents- -Rights of patentees-assignment and transmission-term of patent–Registration-opposition to grant of patent, anticipation- Revocation of patents- Compulsory licences- Exclusive marketing rights-Infringement- exclusive marketing rights- Patent office and power of Controller, patents of addition-Patenting of biotechnology-Nanotechnology.

UNIT 5 FARMERS AND BREEDERS RIGHT & GEOGRAPHICAL INDICATION 12Hrs

The Protection of Plant Varieties And Farmers' Rights Act, 2001: object definitions, salient features The Geographical Indications Of Goods (Registration And Protection) Act, 1999- object definitions, salient features

COURSE OUTCOME:

CO1: The course is designed to introduce fundamental aspects of Intellectual property Rights.

CO2: The course introduces all aspects of the IPR Acts.

CO3: The course is intended to explain the basic principles of patents, trademarks, geographical designs, industrial designs, and copyright.

CO4: The course follows an international perspective and examines the international IP legal regime rather than focusing solely or predominantly on the national framework.

CO5: This course revolves around the protection of plant varieties and farmers right act and This Course will equip the students with the required Professional Skills.

TEXT BOOKS

1. V.K. Ahuja, Law Relating to Intellectual Property Law, Lexis Nexis, 2nd ed., 2013.
2. N.S. Gopalakrishnan& T.G. Ajitha, Principles of Intellectual Property, Eastern Book Company, 2nd ed., 2014

REFERENCE BOOKS

1. B.L. Wadhera, Law Relating to Intellectual Property, Universal Law Publishing, 5th ed., 2014.
2. S. Narayan, Intellectual Property Law in India, Gogia Law Agency, Hyderabad, 3rd ed., 2005.
3. Holyoak&Torreman, Intellectual Property Law, Oxford University Press, New York, 2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A :5 Questions of 6 marks each-No choice **30 Marks**

PART B :2 Questions from each unit with internal choice, each carrying 14 marks **70 Marks**

SPHA7405	INTRODUCTION TO COMPUTATIONAL MATERIAL SCIENCE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide depth of knowledge and to improve the understanding capability about crystal structure.
- It is intended to describe the bonding nature, optical and dielectric properties of solids.
- Also to motivate the students to pursue research in the field of condensed matter physics.

UNIT 1 CRYSTALBINDING 12 Hrs.

Force between atoms-cohesive energy-calculation of cohesive energy bonding in solids-ionic, covalent, metallic, and molecular –hydrogen bonded crystals-binding energy of ionic crystals-Madelung Constant-Born Heber cycle.

UNIT 2 LATTICE DYNAMICS 12 Hrs.

Reciprocal space: Brolliouin Zones-vibration modes of mono and diatomic lattices-quantization of lattice vibration-phonon momentum-scattering of neutrons by phonons-neutron diffraction.

UNIT 3 DIELECTRICS 12 Hrs.

Different types of polarization-internal field and its calculation-Clausius-Mossotti equation-dielectric in a.c. field-dielectric loss-ferroelectric materials and their behavior.

UNIT 4 OPTICALPROPERTIES 12 Hrs.

Index of refraction-damping constant –characteristic penetration depth-absorbance-reflectivity and transmissivity-point defect-color centers-luminescence-exciton-polaron-interband-intra band transitions-dispersion relation.

UNIT 5 ATOMIC MOLECULAR STRUCTURE 12 Hrs.

Central field approximation-Thomas Fermi model and its application-Hartree and Hartree Fock equations hydrogen molecules-HeiyrtLondon model-LCAO –Hybridization.

Max. 60 Hours

Course Outcomes:
At the course end, the students will be able to

CO1: Understand the structural properties of the solid and to calculate the cohesive energy bonding in solid
CO2: Understand the crystal lattice and lattice vibration
CO3: Explain the dielectricproperties of solids
CO4: Describe the luminescence of solid and other opticalproperties of solids
CO5: Learn about atomic molecular structure and especially, could explain the fine structure in the spectra of hydrogen

TEXT / REFERENCEBOOKS

1. C.Kittel, Introduction to solid state Physics 7 thEdn, Wiley Eastern, 1996.
2. A.K.Chandra, Quantum Chemistry, Prentice Hall, 1990.
3. R.E.Hummel, Electronic properties of materials, 2nd Edn, A Narosa, 1993.
4. S.Raimes, The wave mechanics of electrons in metals, 3rd Ed, Amsterdam: North Holland Pub.co, 1967.
5. Michael P. Marder, Condensed Matter Physics, Wiley, 2010.
6. C.P.Smyth, Dielectric behavior and structure, McGraw Hill, New York, 1965

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**
PART A :5 Questions of 6 marks each-No choice **30 Marks**
PART B :2 Questions from each unit with internal choice, each carrying 14 marks **70 Marks**

SPHA7406	THIN FILM TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide depth of knowledge and to improve the understanding capability about various thin film technology.
- It is intended to describe the methods of thin film deposition, growth, characterization and thickness measurements.
- Also to motivate the students to pursue research in the field of thin film coating technology.

UNIT 1 VACUUM TECHNOLOGY **12 Hrs.**

Fundamentals of vacuum, basic definition and pressure regions of vacuum, kinetic theory of gases mean free path, types of flow, conductance, vacuum pumps and systems, rotary mechanical pump, roots pump, diffusion pump, turbo molecular pump, sputter ion pump, measurement of vacuum, concept of different gauges, capacitance gauges, Pirani gauge, ionization gauge and penning gauge, vacuum system components and operation.

UNIT 2 PHYSICAL METHODS OF THIN FILM DEPOSITION **12 Hrs.**

Thermal evaporation, resistive heating, flash evaporation, laser evaporation, rf-heating, co evaporation, electron bombardment heating, sputtering plasma, discharges and arc, sputtering variants, sputtering yield low pressure sputtering, rf-sputtering, reactive sputtering, magnetron sputtering, magnetron configurations, bias sputtering, evaporation versus sputtering.

UNIT 3 CHEMICAL METHODS OF THIN FILM DEPOSITION **12 Hrs.**

Electrodeposition, electrolytic deposition, electro less deposition, anodic oxidation, spray pyrolysis, spin and dip coating, chemical vapor deposition (CVD), homogenous and heterogeneous process, CVD reactions, pyrolysis, hydrogen reduction, halide disproportionation, transfer reactions, CVD processes and systems, low pressure CVD, laser enhanced CVD, metalorganic CVD (MOCVD).

UNIT 4 GROWTH OF THIN FILMS AND THICKNESS MEASUREMENTS **12 Hrs.**

Introduction: nucleation and early stages of film growth, thermodynamic aspects of nucleation, capillary theory, thin film growth modes Volmert, Weber (VW) growth, Frank-van der Merwe (FM) growth, Stranski-Krastanov growth, thickness measurement, electrical methods, microbalance monitors, quartz crystal monitor, mechanical method (stylus), optical interference methods, ellipsometry, interference fringes.

UNIT 5 CHARACTERIZATION METHODS OF THINFILMS **12 Hrs.**

X-ray diffraction (XRD), scanning electron microscopy, transmission electron microscopy, energy dispersive analysis, Auger electron spectroscopy, X-ray photoelectron spectroscopy, Rutherford backscattering spectroscopy, secondary ion mass spectrometry.

Max. 60 Hours

Course Outcomes:

At the course end, the students will be able to

CO1: Understand the Vaccum process and they can know how to create

CO2: Identify the physical synthesis of thin film methods

CO3: identify the chemicall synthesis of thin film methods

CO4: analyse the Basic sciences behind the thin film growth and the thickness factor

CO5: Characterize the thinfilm in various methods.

TEXT /REFERENCE BOOKS:

1. Maissel and Glang, Hand Book of Thin Film Technology
2. K.L. Choppra, Thin Film Phenomena
3. Dupy and Kachard, Physics of Non-Metallic Thin Films –
4. S. Dushman and J.M. Lafferty, Scientific Foundations of Vacuum Technology
5. M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Ed., Academic Press, 2002.
6. S. Campbell, The Science and Engineering of Microelectronic Fabrication, 2nd Ed., OUP, 1996. 3. Kaufmann, Characterization of Materials, 2 nd Ed., Wiley, 2003.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SPHA7408	PHYSICS OF DIELECTRICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

To acquire knowledge concerning the electrical behaviour of dielectric materials (polar and non polar).
To Learn the different theories of static and complex permitivities
To familiarize with the experimental investigation methods of dielectrics.
To study applications of dielectric spectroscopy.

UNIT 1 INTRODUCTION TO PHYSICS OF DIELECTRICS **12 Hrs**

Permanent dipole moment. Induced dipole moment. Polarization and dielectric constant. Types of polarization, Electron polarization, Atomic polarization, Orientation polarization. Ionic polarization. Dipole moments and electrostatic problems. Polarizability. Polarization and energy. Internal field Langeven function. Non-polar dielectrics. Lorentz's field. Clausius-Massotti formula.

UNIT 2 THEORIES OF DIELECTRICS **12 Hrs**

Reaction field. Debye's Theories, Polar molecules in nonpolar solvent. Onsager's theory. The dielectric properties of polar non-associative liquids. Kirkwood-Frolich's theory, the dipole-dipole interaction, the correlation factor of Kirkwood. The static dielectric permittivity of strong polar associative liquids. The modern theories of the static dielectric permittivity (Böttcher, Nienhuis and Deutch, Ramshaw, Wertheim etc).

UNIT3 THEORIES OF DIELECTRIC RELAXATION **12 Hrs**

The theory of linear response. The time dependent fields. The dielectric response function. The dielectric relaxation theory. Frequency and Time Domain. The complex dielectric permittivity. Dielectric losses and dispersion. The distribution functions of the relaxation times. Cole-Cole distribution. Cole-Davidson distribution. Havriliak-Nehamy and Johnsher distributions The dipole correlation function. The relationship between the complex dielectric permittivity and the dipole correlation function. Short-range and long range correlation functions. Fulton's Theory. The memory function. Kohlrausch-Williams-Watts (KWW) non-exponential behavior in complex systems.

UNIT 4 EXPERIMENTAL METHODS OF DIELECTRIC SPECTROSCOPY **12 Hrs**

Dielectric Spectroscopy. Classification of the experimental methods. Frequency methods: Bridges, Resonance methods, Coaxial lines, Waveguides, Transient methods, Strip lines, Slot lines, etc. Broad Band Dielectric Spectroscopy. A frequency response analyzer (10^{-5} Hz - 10^{6} Hz), automatic radio - frequency bridge (10 Hz - 10^{7} Hz) coaxial line reflectometer (10^{6} Hz - 10^{9} Hz) and coaxial vector network analyzer (10^{7} Hz - 10^{11} Hz). Time Domain Dielectric Spectroscopy. The single reflection and transition methods. Multiple reflection, transition, lumped capacitance methods. Non uniform sampling. Fourier transform and the time domain treatment

UNIT 5 APPLICATIONS OF DIELECTRIC SPECTROSCOPY **12 Hrs**

Application of DS to Pure liquids and Solutions. Glass forming liquids. Dielectric relaxation of water. Dielectric relaxation of ice. The dielectric properties of heterogeneous substances. Emulsions and Micro emulsions. Polarization of Maxwell Wagner. Dielectrics with conductive paths. Percolation Phenomena. Dielectric properties of biological materials.

Course Outcomes:

At the course end, the students will be able to know
CO1: Different polarization mechanisms
CO2: Various theories of static and complex permitivities
CO3: Various theories on dielectric mechanisms
CO4: Experimental methods of dielectric spectroscopy
CO5: Applications of dielectric spectroscopy to pure liquids and solutions, emulsions and biological molecules

TEXT / REFERENCE BOOKS

Boetcher. C. J. F, Theory of Electric Polarization 2nd Edition, Elsevier Scientific Publication Company, 1973.
H. Fröehlich, Theory of Dielectrics, Oxford University/Clarendon Press, 1950 reprinted 1992.
Mansel Davies, Dielectric and Related Molecular Processes volume 3, Royal Society of Chemistry, 1972.
J.B. Hasted, Aqueous Dielectrics, Chapman and Hall, 1973.
N.E. Hill, Dielectric properties and Molecular Behaviour, Van Nostrand Reinhold; 1st edition, 1969.
C.H. L. Goodman, Physics of Dielectrics Solids, Institute of Physics, 1980.
S. Takashima, Electrical Properties of Biopolymers and Membranes 1st edition, CRC Press,1989.
E.H.Grant, R.J.Sheppard and G.P.South, Dielectric Behaviour of Biological Molecules in Solutions, Oxford Univ. Press, 1978.
S.Bone and B.Zaba, Bioelectronics, John Wiley and Sons Ltd, 1992.
V. Raicu and Yu. Feldman, Dielectric Relaxation in Biological Systems: Physical Principles, Methods, and Applications, Oxford University Press, 2015.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**
PART A: 5 Questions of 6 mark each - No choice. **30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SPHA7411	RADIATION PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

Course Objectives:

- The aim and objective of the course on Radiation Physics is to expose the students of M.Sc. class to the relatively advanced topics Radiation Physics and nuclear reactions.
- They understand the details of the underlying aspects and can use the techniques if they decide to be radiation or nuclear physicists in their career.

UNIT 1 INTERACTION OF ELECTROMAGNETIC RADIATIONS WITH MATTER12 Hrs.

Different photon interaction processes viz. photoelectric effect, Compton scattering and pair production. Minor interaction processes, Energy and Z dependence of partial photon interaction processes. Attenuation coefficients, Broad and narrow beam geometries.Multiple scattering.

UNIT 2 INTERACTION OF CHARGED PARTICLES WITH MATTER12 Hrs.

Elastic and inelastic collisions with electrons and atomic nucleus.Energy loss of heavy charged particles. Range-energy relationships, Straggling. Radiative collisions of electrons with atomic nucleus.

UNIT 3 NUCLEAR DETECTORS AND SPECTROSCOPY12 Hrs.

General characteristics of detectors, Gas filled detectors, Organic and inorganic scintillation detectors, Semi-conductor detectors [Si(Li), Ge(Li) HPGe]. Room temperature detectors, Gamma ray spectrometers. Gamma ray spectrometry with NaI(Tl) scintillation and semiconductor detectors.

UNIT 4 NUCLEAR SPECTROMETRY AND APPLICATIONS12 Hrs.

Analysis of nuclear spectrometric data, Measurements of nuclear energy levels, spins, parities, moments, internal conversion coefficients, Angular correlation, Perturbed angular correlation, Measurement of g-factors and hyperfine fields.

UNIT 5 ANALYTICAL TECHNIQUES12 Hrs.

Principle, instrumentation and spectrum analysis of XRF, PIXE and neutron activation analysis (NAA) techniques. Theory, instrumentation and applications of electron spin resonance spectroscopy (ESR). Experimental techniques and applications of Mossbauer Effect, Rutherford backscattering.Applications of elemental analysis, Diagnostic nuclear medicine, Therapeutic nuclear medicine. Max. 60 Hours

COURSE OUTCOMES:

CO1: Understand various modes of interaction of electromagnetic radiations and charged particles with matter.
CO2: Distinguish various types of radiations based on their interaction with matter.
CO3: Learn and understand about different detectors and their use for spectroscopy.
CO4: Use different analytical technique such as XRF, PIXE, neutron activation analysis and electron spin resonance spectroscopy.
CO5: Understand various analysis techniques and way to apply the materials in suitable manner

TEXT/REFERENCE BOOKS:

1. The Atomic Nucleus: R.D. Evans, Tata McGraw Hill, New Delhi.
2. Nuclear Radiation Detectors: S. S. Kapoor and V. S. Ramamurthy, New Age, International, New Delhi.
3. Radiation Detection and Measurements: G. F. Knoll, Wiley & Sons, New Delhi.
4. Introductory Nuclear Physics: K. S. Krane, Wiley & Sons, New Delhi.
5. An Introduction to X-ray Spectrometry: Ron Jenkin, Wiley.
6. Techniques for Nuclear and Particle Physics Experiments: W. R. Leo, Narosa Publishing House, New Delhi.
7. Introduction to experimental Nuclear Physics: R.M. Singru, Wiley & Sons, New Delhi

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

	MICROPROCESSOR, MICROCONTROLLER AND EMBEDDED SYSTEM	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSEOBJECTIVES

- To illuminate the knowledge of microprocessor (8085, 8086, 80386, 80486) and its instruction set to develop the assembly language programs.
- Also to focus on the operations of peripheral interfacing microprocessor (Traffic Light control, stepper motor).

UNIT1 8086 MICROPROCESSORS (16-BIT) 12Hrs.

Introduction to 8086 microprocessor - Internal architecture, signals-addressing modes-instruction formats-instruction set, simple programs using 8086, Interfacing- traffic light controller, stepper motorcontrol

UNIT2 ADVANCED MICROPROCESSORS 12Hrs.

Review of processor and its types-80286-80386-80486-Introduction to Pentium family-MMX architecture and instruction set- Multi core processor architecture.

UNIT3 ARM MICROCONTROLLER 12Hrs.

Introduction to ARM Cortex M Series-Introduction to various versions of ARM Cortex-Comparison of Various Versions-Machine Cycle-Harvard Architecture vs. Von-Numen Architecture -Debugging Features-Thumb Instruction Set- Memory Management-Raspberry pi 3 development board.

UNIT4 PYTHON PROGRAMMING AND IoT 12Hrs.

Introduction to Python, Introduction to different IoT Tools, Developing Applications through IoT Tools, Developing Sensor based Application through Embedded System Platform, Implementing IoT concepts with Python.

UNIT5 EMBEDDED SYSTEM DESIGN AND DEVELOPMENT 12Hrs.

Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In-circuit emulator, Target Hardware Debugging, Case studies on Smart card-Adaptive Cruise control in a Car-Robotics-Home automation-Industrial applications.

Max. 60 Hours

Course Outcomes:

Having successfully completed this course, students will be able to
CO1: Describe the architecture and instruction set of 8086 microprocessor.
CO2: Develop algorithms and programs for 8086 microprocessor-based systems.
CO3: Design and implement microcontroller-based systems.
CO4: Design basic concepts of interfacing memory and peripheral devices to a microcontroller.
CO5: Design and develop real time applications using microcontrollers.

TEXT / REFERENCEBOOKS

1. A.K Ray and K M Bhurchandi, Advanced Microprocessors and Periperals,3RD edition, TMH,2017.
2. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3,2nd Edition, Newnes,2015.
3. Dr.MarkFisher, ARM Cortex M4 Cookbook, Packt, 2016.
4. David Hanes, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco press, 2017
5. Olivier Hersent , David Boswarthick , Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Wiley, 2012.
6. Rajkamal, “Embedded system-Architecture, Programming, Design”, TMH, 2011.
7. JonathanW.Valvano, “Embedded Microcomputer Systems,Real Time Interfacing”,Cengage Learning,3rdedition,2012

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**
PART A: 5 Questions of 6 mark each - No choice. **30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SPHA6101	GENERALPHYSICS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

GENERAL PHYSICS LABORATORY

Objective:

- To introduce the basic concepts of physics through hands on experience and impart experimental skill to students.

List of Experiments

1. Meyer disc- Viscosity of a liquid
2. Hall Effect in Semiconductor-carrier concentration and mobility
3. Ultrasonic interferometer- velocity of ultrasound in liquid at different temperatures
4. Acoustic Diffraction
5. Michelson Interferometer-determination of wavelength
6. Cornu's Method – Determination of Elastic Constants of Transparent Materials(Elliptical fringes)
7. Dielectric constant and Curie temperature of ferroelectric ceramics
8. Fresnel biprism-determine the wavelength of given light source
9. Fabry-Perot etalon interferometer
10. Arc spectra
11. He-Ne laser- diffraction at straight wire and circular aperure
12. Stefan's constant

Course Outcomes:

- Having successfully completed this course, students will be able to demonstrate knowledge and understanding of broad range of techniques in conducting scientific experiments

TEXT BOOKS

1. General Physics Laboratory Manual, Department of Physics, NITT.

REFERENCE BOOKS

1. R.A. Dunlap, Experimental Physics: Modern Methods, Oxford University Press, New Delhi (1988).
2. E.V. Smith, Manual for Experiments in Applied Physics, Butterworths (1970).
3. D. Malacara (ed.), Methods of Experimental Physics, Series of Volumes, Academic Press Inc. (1988).

SPHA6201	ADVANCEDPHYSICS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

ADVANCED PHYSICS LABORATORY

Objective:

- To introduce the basic concepts of various advanced experimental techniques used in research through hands on experience.

List of Experiments

1. UV-Vis Spectrophotometer – Determination of absorption coefficient and band gap
2. Fluorescence spectrometer – Emission spectra of a fluorophore
3. FTIR Spectrometer – Determination of vibration levels in a compound
4. Thin Film Deposition and Measurement of Electrical Conductivity – Four Probe Method
5. Impedance Spectroscopy – measurement of impedance of capacitor
6. Band structure study of Si at ambient and under pressure
7. Bridgmann technique – method of growing single crystal
8. Thermo gravimetric analysis and Differential Scanning calorimeter
9. Measurement of thickness of thin film
10. Experiment with microwaves – measurement of dielectric constant of solid
11. Non-Destructive Testing
12. IR Pyrometer

Course Outcomes:

By the end of this course students will be able to

CO1: Calculated the absorption co efficient and bank gap by spectrophotometer
CO2: Determine the vibrational levels in a compound by FTIR spectrometer
CO3: Measurement of electrical conductivity of a thin film by four probe method
CO4: Identifying structural problems by NDT method
CO5: The student will be able to understand the fundamental physics behind modern scientific equipment used in research through hands on experience.

Reference Books

1. L.A. Leventhal, Micro Computer Experimentation with the Intel SDK-85 (1980).
2. Learning MATLAB – The MathWorks, Inc (1999).
3. Kenneth L. Ashley, Analog Electronics with LabVIEW, Pearson Education (2003).