

SRI VENKATESWARA UNIVERSITY:: TIRUPATI

SVU COLLEGE OF SCIENCES

DEPARTMENT OF PHYSICS



Syllabus for M.Sc. PHYSICS

Choice Based Credit System (CBCS)

(w.e.f. the Academic Year 2017-2018)

SRI VENKTESWARA UNIVERSITY:: TIRUPATI

DEPARTMENT OF PHYSICS

TWO YEAR M.Sc. COURSE IN PHYSICS

DEPARTMENT OF PHYSICS
Syllabus _2017-2018

Vision

To impart quality education and appropriate training to produce talented Physicists and to pursue research in thrust areas for the betterment of contemporary society.

Mission

The Department of Physics is one of the founder departments, started in 1954 and has been playing a pivotal role in the University. The mission of the department is to

- develop qualified and competent Physicists/Scientists through effective teaching.
- train students with hands on laboratory training in advanced fields of Physics.
- promote in depth research in thrust areas for societal applications.

Program Objective: The objective of the program is to (i) impart students with better knowledge and understanding of the subject, (ii) train students to take up local and global competitive challenges in Physics, (iii) prepare analytically and technically skilled students to get good employment, (iv) provide an opportunity for students to pursue quality research in thrust areas and (v) create a sense of academic and social ethics among students. (vi) Inspire them in such a way that they can demonstrate and maintain the highest standard on ethical issues in their professional lives.

Program Outcomes

PO No.	Programme Outcomes
PO1	Apply the Scientific knowledge of various field in physics to solve complex problems in Physics.
PO2	Identify, formulate, and analyse scientific problems in reaching conclusions using first principles of mathematics and physics and related other sciences
PO3	Apply the knowledge based on research and related methods, including design of experiments, data collection, analysis and interpretation to provide valid conclusions of Physics concepts.
PO4	Planning, design and develop experiments to measure the experimental data taking the safety and environmental considerations.
PO5	Applying appropriate technique or tool or modern tool for investigating the identified problem with an understanding of its limitations and usage.
PO6	Solving the problems related to societal, health and safety issues using the professional skills learned.
PO7	Evolving methods to demonstrate the knowledge acquired for understanding the environmental issues for their sustainable development.
PO8	Understanding ethical principles, professional ethics and responsibilities, and apply them to solve societal problems.
PO9	Effective functioning in solving different issues as an individual / member of a team / team leader.
PO10	Communicating on various issues particularly with Physics scientific problems in society, writing of reports and design of presentations.
PO11	Demonstrating acquired knowledge and skills and apply them to generate external funding and to manage the projects within the budget limitations.
PO12	Recognize the importance of learning process throughout the life in view of technological changes that occur from time-to-time.

Program Outcomes: At the end of the program, the student will be able to:

- (1) Understanding the basic ideas and concepts in theoretical and applied Physics
- (2) Make students to learn mathematical methods in solving real physical problems.
- (3) Train students to compete national level tests like UGC-CSIR NET, JEST, GATE etc.
- (4) Motivation of students towards higher studies and to pursue research in advanced areas in Physics.
- (5) Develop human values and professional ethics for betterment of the society.

(Choice Based Credit System with effect from Academic Year 2017-2018)
(For S.V. University College of Sciences and for affiliated colleges)
COURSE STRUCTURE AND EXAMINATION SCHEME

Semester	Course code	Title of the Course	Core/ Elective	No. of credits	Internal Assessment	Semester End Exams	Total Marks
I	PHY 101	Classical Mechanics and Statistical Mechanics	Coretheo	04	20	80	100
	PHY 102		Coretheo	04	20	80	100
	PHY 103	Analog and Digital Electronics General Physics lab 1	Corepract	04			100
	PHY 104		Corepract	04			100
	PHY 105	Electronics lab 1	Compulsory foundation	04	20	80	100
	PHY 106	Electro magnetic theory, Atomic and Molecular Physics Human values &Professional Ethics-I	Elective foundation	04	20	80	100
							600
II	PHY 201	Lasers and Modern optics	Coretheo	04	20	80	100
	PHY 202		Coretheo	04	20	80	100
	PHY 203	Mathematical Physics General Physics lab 2	Corepractical				
	PHY 204		Corepractical	04			100
	PHY 205	Electronics lab 2	Compulsory foundation	04			100
	PHY 206	Solid State Physics Human values &Professional Ethics-II	Elective foundation	04	20	80	100
							600
Semester	Course code	Title of the Course	Core/ Elective	No. of credits	Internal Assessment	Semester End Exams	Total Marks

III	PHY 301	Quantum Mechanics – I	Coretheo	04	20	80	100
	PHY 302	Physics of semiconductor devices	Coretheo	04	20	80	100
	PHY 303	Computer lab	Corepract	04			100
	PHY 304	Elective lab 1	Corepract	04			100
	PHY 305	Elective A) Applied Spectroscopy-I B) Condensed Matter Physics-I C) Electronics-embedded systems D) Photonics-I E) Solar energy-thermal physics F) Vacuum and thin film technology	Generic elective	04	20	80	100
	PHY 306	A) Computational methods and Programming B)Energy Harvesting Systems	Open Elective	04	20	80	100
							600
IV	PHY 401	Quantum Mechanics - II	Coretheo	04	20	80	100
	PHY 402	Advances in Physics	Coretheo	04	20	80	100
	PHY 403	Elective lab 2	Corepract	04			100
	PHY 404	Project work	Coreprac	04			100
	PHY 405	Elective A) Applied Spectroscopy-II B) Condensed Matter Physics-II C) Electronics-Wireless communications D) Photonics-II E) Solar energy-Photovoltaic aspects F)Properties and applications of thinfilms	Generic elective	04	20	80	100
	PHY 406	A)Analytical techniques and Nuclear Physics B) Nanomaterials and devices	Open elective	04	20	80	100
				<u>96</u>			600

COURSE STRUCTURE

COURSE CODE	TITLE
PHY 101	Classical Mechanics and Statistical Mechanics
PHY 102	Analog and Digital Electronics
PHY 103	General Physics lab 1
PHY 104	Electronics lab 1
PHY 105	Electromagnetic theory, Atomic and Molecular Physics
PHY 106	Human Values and Professional Ethics-I
PHY 201	Lasers and Modern Optics
PHY 202	Mathematical Physics
PHY 203	General Physics lab 2
PHY 204	Electronics lab 2
PHY 205	Solid State Physics
PHY 206	Human Values and Professional Ethics-II
PHY 301	Quantum Mechanics - I
PHY 302	Physics of Semiconductor Devices
PHY 303	Computer lab
PHY 304	Elective lab 1
PHY 305	Generic Elective
PHY 306	Open Elective
PHY 401	Quantum Mechanics - II
PHY 402	Advances in Physics
PHY 403	Elective lab 2
PHY 404	Project Work
PHY 405	Generic Elective
PHY 406	Open Elective

GENERIC ELECTIVES

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COURSE CODE	TITLE
PHY 305A	Applied Spectroscopy - I
PHY 305B	Condensed Matter Physics - I
PHY 305C	Electronics – Embedded Systems
PHY 305D	Photonics - I
PHY 305E	Solar Energy – Thermal Aspects
PHY 305F	Vacuum and Thin Film Technology
PHY 405A	Applied Spectroscopy - II
PHY 405B	Condensed Matter Physics - II
PHY 405C	Electronics – Wireless Communication Systems
PHY 405D	Photonics - II
PHY 405E	Solar Energy- Photovoltaic Aspects
PHY 405F	Properties and Applications of Thin Films

OF OTHER DEPARTMENTS AND ALSO SAME DEPARTMENT)

COURSE CODE	TITLE
PHY 306A	Computational Methods and Programming
PHY 306B	Energy Harvesting Systems
PHY 406A	Analytical Techniques and Nuclear Physics
PHY 406B	Nanomaterials and Devices

Note: The Department will offer any one or two from Generic Electives. If one is selected from generic elective, the student will select another one from open elective in a semester. The other department students will select one or two from open electives.

SELF STUDY COURSES (FOR THE STUDENTS OF M. Sc., PHYSICS)

COURSE CODE	TITLE
PHY 407	Digital Signal Processing
PHY 408	Applications of Statistics to Physics
PHY 409	Physics – Philosophy and Society

Branch: PHYSICS
Course title: Classical Mechanics and Statistical Mechanics
Semester: I

Course code: PHY 101
Credits: 4
Marks: 80 + 20 (Internal)

Course Objectives

1. To know how to impose constraints on a system in order to simplify the methods to be used in solving physics problems and to interpret the concepts of Lagrange and Hamiltonian Mechanics.
2. To explain canonical transformation, poisson brackets and Hamilton-Jacobi theory.
3. To learn the concepts of ensembles and many partition functions.
4. To understand the use of methods of quantum statistics to obtain properties of systems made of microscopic particles which either obey Fermi-Dirac statistics or Bose-Einstein statistics.

UNIT – I: Lagrangian Mechanics and Hamiltonian Mechanics

Newtonian mechanics of one and many particle systems: Conservation laws, Constraints and their classification, Degrees of freedom: Generalized coordinates: Principle of virtual work, D'Alemberts principle, Lagrange's equations of motion.

Applications: Inclined plane, Linear harmonic oscillator and simple pendulum, Hamiltonian principle, Lagrange's equation from Hamilton's principle, Hamilton's equation of motion, Applications, Simple pendulum, Compound pendulum. (1-4)

UNIT – II: Canonical Transformations and Hamilton - Jacobi Theory

Canonical Transformations, Generating function and their properties, Condition for transformation to be canonical, Illustration of canonical transformation, Poisson – Brackets, Canonical equations in terms of Poisson, Bracket notation. Lagrange-Brackets and their properties.

Hamiltonian - Jacobi equation, one dimensional harmonic oscillator, Small oscillations and normal modes, Action Angle variables, Kepler problem in action angle variables. (4,5)

UNIT- II I: Ensembles and Partition Functions

Phase space – Concept of ensembles – Types of ensembles - Ensemble average - Liouville's Theorem – Microcanonical ensemble: ideal gas – Gibb's paradox Canonical partition function – Molecular partition function – Transnational partition function – Rotational partition function – Vibrational partition function

UNIT – IV: Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac Statistics

Maxwell - Boltzmann distribution - Equipartition energy. Bose – Einstein distribution, Bose – Einstein condensation, Black body radiation and the Planck's radiation law - Fermi - Dirac distribution – One dimensional random walk – Random walk and Brownian motion.

Books for Reference

1. Classical Mechanics, N.C. Rana and P.S. Joag - Tata Mc-Graw Hill, 1991.
2. Classical Mechanics, H. Goldstein - Addison Wesley, 1980.
3. Classical Mechanics, J.C.Upadyaya - Himalaya Publishing House, 2005.
4. Classical Mechanics, Gupta, Kumar and Sharma -Pragathi Prakashan, 2012.
5. Classical Dynamics of Particles, J.B.Marion Academic Press -Saunders College Publications, 4th edition, 1995.
6. Introduction to Classical Mechanics, R.G. Takwale and P.S. Puranic -Tata McGraw-Hill,1989.
7. Statistical Mechanics , B.K. Agarwal, Melvin Eisner,2nd Edition, New Age International (P)Ltd.
8. Statistical Mechanics and properties of Matter by ESR Gopal — Student Edition (Ellis Horwood)
9. Statistical and Thermal Physics , F. Reif 4th Edition,Mc Graw Hill

10. Elementary Statistical Mechanics, C. Kittel, Dover Publications

Course Outcomes: After completion of the course, the student shall be able to

1. Understanding the Lagrangian and Hamiltonian mechanics and solving the related problems.
2. Learn the concepts of Poisson brackets, Hamilton-Jacobi equations and action angle variables.
3. Learn different ensembles and partition functions in statistical mechanics and their applications.
4. Disseminate the applications of Maxwell's distribution of velocities and various applications of systems behaving as ideal Bose gas or Fermi gas.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	1	1	-	-	-	2	3
CO3	3	3	2	3	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Analog and Digital Electronics

Semester: I

Course code: PHY 102

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To prepare students to perform the analysis of any Analog electronics circuits.
2. To understand design and working of BJT/FET/MOSFETs amplifiers, oscillators, operational amplifiers.
3. To acquire knowledge of digital logic levels and to understand digital electronics circuits.
4. To understand the, Delta Modulation, Adaptive Delta modulation CVSD.

SYLLABUS

UNIT – I: Introduction to Electronic Devices

Field Effect Transistor (FET): Structure and working of JFET, Characteristics, and parameters of JFET. Advantages of FET over BJT. FET as switch and Amplifier, Application of FET as voltage variable resistor. Structure of MOSFET, depletion type and enhancement type, MOSFET Characteristics, MOSFET as variable resistor, Concept of CMOS. Structure, working and Characteristics of UJT. Application of UJT as a Relaxation oscillator. (1)

UNIT – II: Operational Amplifiers

Block diagram of a typical Op-Amp, differential Amplifier, Comparator open loop configuration, inverting and non-inverting amplifiers. Op-amp with negative feedback, voltage shunt feedback, effect of feedback on closed loop gain, input resistance, output resistance, CMRR, frequency response slew rate.

Instrumentation- Amplifier, integrator and differentiator. Waveform generators: Square and triangle. Filters: Low pass, High pass and Band pass. (2)

UNIT – III: Digital Electronics

Combinational Logic: Multiplexers, Decoder, Demultiplexer, Data Selector, Multiplexer, Encoder. Sequential Logic: JK Flip – Flop, JK Master Slave Flip–Flops, D Flip-Flop. Shift Registers: Serial in Serial out, Serial in Parallel out, parallel in Serial out, Parallel in Parallel out Registers. Counters: Asynchronous and Synchronous Counters, MOD-3 Counter, MOD-5 Counter. Converters: R-2R Ladder D/A Converter, Successive Approximation A/D Converter. (3,4)

UNIT – IV: Communication Electronics

Introduction to Modulation (AM & FM), Sampling Theorem, Low pass and Band pass signals, PAM, Channel BW for a PAM signal. Natural sampling, Flat-top sampling. Signal recovery through holding. Quantization of signals, PCM transmission, Quantization of noise, Differential

PCM, Delta Modulation, Adaptive Delta modulation CVSD. Signal to noise ratio in PCM and Delta Modulations. (5)

Text Books

1. Micro Electronics, Milliman and Halkias. TMH Publications.
2. OP-Amps & Linear Integrated Circuits, RamakanthA.Gayakwad, PHI, 2nd Edition, 1991.
3. Digital Systems: Principles and Applications, Ronald J. Tocci, Neal Widmer and Gregory L.Moss, 10th Edition, PHI, 2007.
4. Digital Principles and Applications, A.P. Malvino and Donald P.Leach, TataMcGraw-Hill, New Delhi, 1993.
5. Principles of Communication, Taub and Schilling, Mc-Graw Hill Publication.

Reference Books

1. Electronic Devices and Circuit Theory, R. Boylested and L.Nashdsky, PHI, New Delhi, 1991.
2. Micro Electronics, Sedra and Smith.
3. Electronic Principles, Malvino, 6th Ed. TMH.
4. Linear Integrated circuits, Roy Choudhry.
5. Operational amplifiers, Collins.

Course Outcomes: After completion of the course, the students will be able to

1. Utilize the basic knowledge in Electronics and Communication Engineering field.
2. Understand the design and working of BJT/FET/ MOSFETs based electronic circuits and perceive the effect of positive feedback on working of Op-Amps based Oscillators.
3. Develop the skills to design and analyze analog and digital circuits build and test an electronic system.
4. Know the communication types like AM and FM and their fundamental theory along with broadcasting of television.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	2	2	-	-	1	3	3
CO2	3	3	2	2	2	3	1	-	-	-	2	2
CO3	3	3	2	1	3	2	2	-	-	-	3	2
CO4	3	3	3	-	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course code: PHY 103

Course title: Electromagnetic Theory, Atomic and Molecular Physics Credits: 4

Semester: I

Marks: 80 + 20 (Internal)

Course Objectives:

1. To understand principles of Electromagnetic theory, lasers, modern optics and their applications.
2. To explain the spin -orbit interaction, fine structure of spectral lines and the concepts of LS and JJ coupling schemes.
3. To learn about the effect of magnetic and electric fields on spectral lines.
4. To understand the rotational and vibrational spectra of diatomic molecules and their applications.

SYLLABUS

UNIT – I: Electromagnetic Theory

Maxwell's equations, The wave equation, Propagation of light in isotropic dielectric medium – Dispersion, Propagation of light in conducting medium-skin depth, Reflection and refraction at the boundary of a dielectric interface – Fresnel's equations, Propagation of light in crystals-Double refraction.

Electromagnetic radiation ; Retarded potentials, Radiation from moving point charge, Radiation from oscillating dipole (electric and magnetic dipoles), Radiation from linear antenna – Radiation resistance, electric quadruple radiation, Lienard – Wiechert potentials.

UNIT II: Atomic Spectra

Introduction: Vector atom model –Spectra of Alkali elements-fine structure- Spectral terms and term symbols, Ground states based on electron configuration - Coupling schemes - LS coupling - JJ coupling- Hund's rule of multiplicity - Equivalent and non-equivalent electronic systems. Spectral terms for equivalent and non-equivalent electrons - Width of spectral lines –Absorption, emission and excitation spectra- Spectrophotometer – Applications of atomic spectra – Photo Electron Spectroscopy-Atomic absorption spectroscopy.

UNIT III: Zeeman and Stark Effects

Introduction: Magnetic moment of the atom and Lande's 'g'-factor - Zeeman effect, Normal and Anomalous Zeeman effects, Experimental details, Zeeman effect of hyperfine structure, Zeeman effect in sodium atom, Lande g-formula for LS and JJ couplings - Paschen-Back effect, Splitting of sodium lines and selection rules, Stark effect, Experimental details, Weak and strong field effects, Width of spectral lines.

UNIT IV: Molecular Spectroscopy – Rotational – Vibrational Spectra

Introduction – Rotational, vibrational and electronic spectra of diatomic molecules – Rotational spectra of a diatomic molecule as rigid rotator and non-rigid rotor – Intensity of rotational lines - Rotational analysis of electronic spectra- Evaluation of rotational constants - Effect of isotopic substitution on rotational levels – Applications of rotational spectroscopy. Vibrational spectra of diatomic molecule – Diatomic molecule as a simple harmonic oscillator and anharmonic oscillator – Energy levels and spectrum – PQR branches – Progressions and sequences – Vibrational analysis of electronic spectra - Deslander's table – Evaluation of vibrational constants – Morse potential energy curve – Frank-Condon principle – Intensity distribution in absorption and emission spectra –IR and FTIR spectrometers - Applications of vibrational spectroscopy.

Books for study

1. Introduction to Atomic Spectra, H.E. White, McGraw-Hill Kogakusha. Ltd., New Delhi.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M.Mc Cash, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 1994.
3. Spectroscopy, Vol. I & III, B.P. Straughan & S. Walker, John Wiley & Sons, Inc., NY,1976.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw - Hill Book Co, 1962.
5. Spectra of Diatomic Molecules, G. Herzberg, D.Van Nostrand Company Inc, New York.
6. Molecular Spectroscopy, J.M. Brown, Oxford Science Pub. Oxford, 1998.
7. Molecular Structure and Spectroscopy, G. Aruldas, Prentice- Hall of India, Pvt., 2005.
8. Elements of Diatomic Molecular Spectra by H. Dunford – Addison-Wisely, 1957.
9. Elements of spectroscopy by S.L.Gupta, V.Kumar and R.C.Sarma- Pragati prakasan

Course Outcomes: After completion of the course, the students will be able to

1. Understand the laws related to electrostatics and magnetostatics and also light propagation.
2. Understand the basics of atomic physics.
3. Understand the Zeeman effect , Paschen-Back effect and Stark effects in detail.
4. Know the importance of Rotational and Vibrational spectra and their applications in structure determination.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	1	-	-	-	2	3
CO4	3	3	3	1	3	2	2	-	1	-	1	3

Branch: PHYSICS
Course title: Human Values and Professional Ethics – I

Course code: PHY 104
Credits: 4

Semester: I

Marks: 80 + 20 (Internal)

Course Objectives:

1. To create an awareness on moral, ethical and social values.
2. To appreciate the good behavior, good character and also conduct of others.
3. To get more knowledge on spirituality and related things.
4. To get knowledge on Bhagava Gita and its importance in real life.

SYLLABUS

Chapter I: Definition and Nature of Ethics – Its relation to Religion, Politics, Business, Law, Medicine and Environment. Need and Importance of Professional Ethics – Goals – Ethical Values in Various Professions.

Chapter II: Nature of Values – Good and Bad, Ends and Means, Actual and Potential Values, Objective and Subjective Values, Analysis of Basic Moral Concepts – Right, Ought, Duty, Obligation, Justice, Responsibility and Freedom, Good Behavior and Respect for Elders, Character and Conduct.

Chapter III: Individual and Society: Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non Possession) and Aparigraha (Non-stealing). Purusharthas (Cardinal virtues) - Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desires), Moksha (Liberation).

Chapter IV: Bhagavd Gita – (a) Niskama Karma, (b) Buddhism – The Four Nobel Truths – Arya astanga marga, (c) Jainism - Mahavratas and Anuvratas. Values Embedded in Various Religions, Religious Tolerance, Gandhian Ethics.

Chapter V: Crime and Theories of Punishment – (a) Reformative, Retributive and Deterrent, (b) Views on Manu and Yajnavalkya.

Books for study:

1. Johns S Mackenjie: A Manual of ethics
2. “The Ethics of Management” by Larue Tone Hosmer, Richard D. Irwin Inc.
3. Management Ethics – Integrity at work by Joseph A. Petrick and John F. Quinn, Response Books, New Delhi.
4. “Ethics in Management” by S.A. Shelekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed) G.C. Haughton.
10. Sasruta Samhita: Tr. KavirajKunjanlal, KunjanlalBrishagratha, Chowkamba Sanskrit Series, Vol I,II and III, Varanasi, Vol I PP, 16-20, 21-32 and 74-77 only.
11. Charaka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series Office. Varanasi I, II, III Vol I PP 183-191.
12. Ethics, Theory and Contemporary Issues. Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed.,) John H. Piet and Ayodya Prasad, Cosmo Publications.

15. Text Book for Intermediate First Year Ethics and Human Values, Board of Intermediate Education – Telugu Academy, Hyderabad.
16. I.C. Sharma Ethical Philosophy of India. Nagin& Co Julundhar.

Course Outcomes: After completion of the course, the student shall be able to

1. Understand the core values that shape the ethical behaviour in various professions.
2. Expose awareness on professional ethics and human values.
3. Get awareness on the importance of spirituality.
4. Know the role of the Bhagavad Gita and its impact on real life.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	3	3	3	-	-	-
CO2	-	-	-	-	-	1	2	3	2	-	-	-
CO3	-	-	-	-	-	2	2	3	2	-	-	-
CO4	-	-	-	-	-	2	2	3	2	-	-	-

Branch: PHYSICS

Course title: General Lab – I

Semester: I

Course code: PHY 105

Credits: 4

Marks: 100

Course Objectives:

1. Students able to learn experiments in basic as well as certain advanced areas of physics such as semiconductor physics and optics.
2. To analyze the data and design new devices.
3. Able to understand and improve skill towards operating different optical measurements.
4. To provide hands on experience in measurements to motivate towards research.

List of Experiments

01. Plank's constant determination
02. Thermo EMF of bulk samples
03. Resistivity measurement – Four probe Method
04. Lasers – Determination of wavelength with (a) Grating (b) Metal Scale
05. Hartmann's Dispersion formula.
06. Thermistor – Characteristics
07. X-Ray diffraction – Determination of lattice constant, grain size.

Course Outcomes: After completion of the course, the students shall be able to

1. Determining the value of Planck's constant and Seebeck coefficient of a thermocouple, and also determination of wavelength.
2. Learn structural determination using X-ray diffraction method.
3. Improve demonstration of skills related to the said experiments in Physics.
4. Improve the presentation skill and suitable knowledge on optical related experiments.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	-	-	-	-	1	3	2

CO2	3	3	2	-	2	-	-	-	-	2	3	2
CO3	3	2	2	2	2	-	-	-	-	1	3	3
Co4	3	2	1	-	2	-	-	-	-	-	3	2

Branch: PHYSICS

Course title: Electronics Lab – I

Semester: I

Course code: PHY 106

Credits: 4

Marks: 100

Course Objectives

1. To explain the students about different electronic circuits and their application in practice.
2. To impart knowledge on assessing the performance of electronic circuits through monitoring of sensitive parameters.
3. To evaluate the use of computer-based analysis tools to review the performance of semiconductor device circuits.
4. To get knowledge and improve skills to work on different electronic circuits and instruments.

List of Experiments

01. UJT Characteristics
02. 555 – Timer Astable Multivibrator
03. Wien Bridge Oscillator using Op-Amp
04. Op Amp Parameters (a) Input offset voltage, (b) Input bias current, (c) CMMR and (d) Slew rate
05. Op-Amp offset null adjustment Inverting Amplifiers
06. Op-Amp Integration, Differentiation & Summation

Course Outcomes: After completion of the course, the students are able to

1. Identify relevant information to supplement the Analog Electronic Circuits.
2. Set up testing strategies and select proper instruments to evaluate the performance characteristics of the electronic circuit.
3. Choose testing and experimental procedures on different types of electronic circuits and analyze their operation at different operating conditions.
4. Get knowledge and improve skills to work on different electronic circuits and instruments.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	-	2	-	1	1	3	3
CO2	3	3	-	2	2	-	-	-	2	1	3	3
CO3	3	3	2	-	2	-	1	-	1	1	3	3
CO4	3	3	2	1	2	-	-	-	1	2	2	2

Branch: PHYSICS
Course title: LASERS AND MODERN OPTICS
Semester: II

Course code: PHY 201
Credits: 4
Marks: 80 + 20 (Internal)

Course Objectives

1. To understand the properties of laser beam and applications of different lasers.
2. To know the basic concepts of non linearity in optics and their applications.
3. To study the importance of holography in different fields and also the applications of Fourier analysis in optics.
4. To understand the propagation of light in optical fibres and various applications of optical fibers.

SYLLABUS:

UNIT – I: Lasers

Basic principles of lasers – Spontaneous and stimulated emission – Coherence - Population inversion- Einstein coefficients– Pumping schemes – Threshold condition for laser oscillation – Losses and Q-factor –Principles and working mechanisms of Ruby, Nd:YAG, Ar ion, CO₂ and semiconducting lasers – Applications.

UNIT II : Non-linear Optics

Basic Principles – Origin of optical nonlinearity - Harmonic generation – Second harmonic generation – Phase matching condition – Third harmonic generation – Optical mixing – Parametric generation of light – Parametric light oscillator – Frequency upconversion – Self focusing of light – Phase conjugate optics-Guided wave optics - Non linear optical materials.

UNIT – III: Holography and Fourier Optics

Introduction to Holography – Basic theory of Holography – Recording and reconstruction of Hologram – Diffuse object illumination – Speckle pattern – Fourier transform Holography – Applications of Holography.

Introduction to Fourier optics– Two dimensional Fourier transforms – Transforms of Dirac-Delta function – Optical applications – linear systems- The convolution integral – convolution theorem- Spectra and correlation – Parseval's formula – Auto correlation and cross-correlation – Apodization – Array theorem – Fourier methods in diffraction - Fraunhouffer diffraction of single slit, double slit and transmission grating using Fourier method.

UNIT – IV: Fiber Optics

Total internal reflection - Optical fiber modes and configuration – Single mode fibers – Graded index fiber structure – Fiber materials and fabrication – Mechanical properties of fibers – Fiber optic cables – Attenuation – Signal distortion on optical wave guides- Erbium doped fiber amplifiers – Solitons in optical fibers - Block diagram of fiber optic communication system - Applications of optical fibers in communication and medicine.

Text and Reference Books

1. Introduction to Electrodynamics, D.J. Griffiths, 4th Edition, Prentice-Hall of India, ND,2013.
2. Electromagnetics, B.B. Laud, 3rd Edition, New Age International Publishers Ltd, ND, 2011.
3. Fundamentals of Electromagnetic theory, 2nd Edition, S.K. Dash and S.R. Khuntia, ND,2011.
4. Modern Optics by G.R. Fowels, 1989.
5. Laser and their Applications, M.J. Beesly, Taylor and Francis, 1976
6. Lasers and Non-Linear Optics, B.B. Laud, 3rd Edition, New Age International Publishers Ltd, New Delhi, 2011.
7. Optics, E. Hecht, Addison Wiley,1974.
8. Optical Fiber Communications, Gerel Keiser, McGraw Hill Book, 2000.

- Course Outcomes:** After completion of the course, the students should be able to
1. Understand the properties of lasers and various applications in different fields.
 2. Know the importance of non linearity in physics problems and solutions.
 3. Understand the principles and different types of holography; and its applications.
 4. Know the properties of optical fibers and their importance in communication and medicine.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	2
CO2	3	3	2	2	1	1	1	-	-	-	2	3
CO3	3	2	2	1	3	2	2	-	-	-	2	2
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course code: PHY 202

Course title: MATHEMATICAL PHYSICS

Credits: 4

Semester: II

Marks: 80 + 20 (Internal)

Course Objectives

1. To learn the use of different special functions in solving physical problems.
2. To understand Laplace and Fourier transforms and their applications to electrical circuits
3. To give the basic knowledge and understanding of Laplace equations and Tensors.
4. To understand the problems related to complex variables.

SYLLABUS

UNIT - I: Special Functions

Beta and Gamma Functions – Definitions and properties – Evaluation of integrals, Legendre, Bessel and Hermite differential equations – Solutions – Generating functions – Orthogonal properties of Legendre, Bessel and Hermite Functions (Proof not necessary) – Recurrence relations – (Proof for Legendre polynomials only)

UNIT - II: Integral Transforms

Fouriers Transforms: Properties of Fourier transforms – Fourier sine and cosine transforms- Power in Fourier series – Modulation theorem, Fourier transform of impulse function, Constants, Unit step function and Periodic (square wave, triangular wave & sawtooth wave) functions.

Laplace Transforms: Definition and notation – Properties of Laplace transforms – Laplace transforms of Dirac delta function and periodic functions (Square wave, sawtooth wave and triangular wave) – Inverse Laplace transforms – properties – Solution of linear differential equations with constant coefficients - Applications to LCR circuits, Operational amplifiers and resonance of simple pendulum.

UNIT - III: Partial Differentiations and Tensors

Partial Differentiations: Laplace equation – Method of separation of variables – Application of Laplace equation to two dimensional steady state of heat flow in a thin rectangular plate and a long cylinder. Wave equation in two dimensions – Application to the vibration of a rectangular membrane and circular membrane.

Tensors: Definition – Contravariant, Covariant and Mixed tensors – Dummy suffix notation- Addition, subtraction, contraction, inner product, outer product, symmetric and anti-symmetric tensors - Application of Tensor theory to strain, thermal expansion and piezoelectricity.

UNIT – IV: Complex Variables

Functions – Complex differentiation - Analytic function - Cauchy – Reimann equations – Derivatives of elementary functions – Singular points and classification. Complex integration - Cauchy's theorem – Integrals of special functions – Cauchy's integral formula – Taylor's and Lorentz theorem (statements only) – Residues, calculations of residues - Residue theorem – evaluation of definite integrals.

Reference Books

1. Functions for Scientists and Engineers, W.W. Bell, Van Nostrand Co., London (1968).
2. Fourier Analysis, Hsu P. Jewi, Unitech Division.
3. Laplace Transforms, Murray Spiegle, Schaum's outline series, McGraw Hill, New York.
4. Applied Mathematics for Engineers, Pipes and Harval, III Edition, McGraw Hill Books Co.
5. Vector Analysis & Introduction to Tensor Analysis, M. R. Spiegel, Schaum's Series 1959.
6. Physical Properties of Crystals, J.F. Nye, Schaum's Series, Oxford Univ. Press, 1957.
7. Theory and Properties of Complex Variables, S. Lipschutz, Schaum's Series, Mc Graw Hill.
8. Mathematical Physics, H.K. Das and Ramaverma, S. Chand & Co. Ltd., New Delhi (2011).
9. Mathematical Physics, B. Bhattacharyya, New Central Book Agency Pvt. Ltd., (2010).

Course Outcomes: After completion of the course, the students should be able to

1. Understand and apply the mathematical skills to solve quantitative problems in physics.
2. Apply Laplace and Fourier transforms in solving different problems of mechanics, electronics etc.
3. Solve different physical problems related to partial differential equations and tensors.
4. Know the solving of problems related to complex variables.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	-	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	2	1	3

Branch: PHYSICS

Course title: SOLID STATE PHYSICS

Semester: II

Course code: PHY 203

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To impart knowledge on different types of interactions, forces and temperature effect on solids.
2. To learn the behavior of electrons in solids based on classical and quantum theories.
3. To become familiar with classification of solids using band theory.
4. To provide basic ideas in superconductivity and the related theories and parameters.

SYLLABUS

UNIT – I: Lattice Energies and Lattice Vibrations

Origin of chemical binding in ionic and van der Waals crystals – Elastic properties – Stress and strain – Elastic moduli - Lattice energy calculations for ionic and van der Waals crystals – Lattice vibrations: Mono and diatomic one dimensional infinitely long lattices – Vibrational spectra – Infrared absorption in ionic crystals – Vibrational spectra of finite lattice – Quantization of lattice vibrations – Phonons – Properties – Experimental measurement of dispersion relation.

UNIT – II: Transport Phenomena and Band Theory

Concept of electrical and thermal resistivity – Expression for thermal and electrical conductivities for metals – Lorenz number - Different scattering mechanisms – Matheissens rule- Formulation of Boltzmann transport equation – Relaxation time approximation – Distribution function.

Sommerfeld model – its consequences – electron-lattice interaction (Quantitative only) – Motion of electron in periodic potential – Bloch function - Kronig-Penny model – Formation of energy bands in solids – Brillouin zones – Different schemes of representation of E versus K curves -Concept of effective mass – Distinction between metals, insulators and semiconductors.

UNIT – III: Semiconductor Physics

Intrinsic and extrinsic semiconductors – Expression for position of Fermi levels and carrier concentrations – Variation of Fermi level with temperature – np product – Carrier mobility, conductivity and their variation with temperature – Direct and indirect band gap semiconductors – Differences and examples – Hall effect - Continuity equation – Drift and Diffusion – Einstein relation – Generation, Recombination and life time of non-equilibrium carriers – Heyness-Schockley experiment – Determination of life time, diffusion length of minority charge carriers.

UNIT – IV: Superconductivity

Concept of zero resistance – Magnetic behavior – Distinction between a perfect conductor and superconductor – Meissner effect – Isotope effect – Specific heat behavior – Two-fluid model – Expression for entropy difference between normal and superconducting states – London's equations – Penetration depth – BCS theory – Josephson junctions – SQUIDS and its applications - Applications of superconductors – High T_C superconductors – Preparation – Properties.

Books for Study

1. Solid State Physics, C. Kittel, John Wiley & Sons.
2. Solid State Physics, A.J. Dekkar, Macmillan India Ltd.
3. Elementary Solid State Physics, M. Ali Omar, Addison-Wesley.
4. Solid State Physics, M.A. Wahab, Narosa Publishing House.
5. Solid State Electronic Devices, B.G. Streetman.
6. High T_C Superconductivity, C.N.R. Rao and S.V. Subramanyam.
7. Solid State Physics, S.O. Pillai.
8. Solid State Physics, S.L. Kakani and C. Hemarajan.
9. Electrons in Solids, Richard H. Bube.

Course Outcomes: After completion of the course, the students shall be able to

1. Understand different bonds in solids, importance of lattice vibrations, their models and elastic properties.
2. Explain electronic properties of solids in classical, quantum and the nearly free electron model.
3. Able to classify materials as metals, insulators and semiconductors and sketch the band diagram for each Hall effect.
4. Understand the Heyness-Schockley experiment, properties, theories and applications of superconductors.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	2	1	2	3

CO2	3	3	2	2	3	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	2	2
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course code: PHY 204

Course title: : HUMAN VALUES & PROFESSIONAL ETHICS – II

Credits: 4

Semester: II

Marks: 80 + 20 (Internal)

Course Objectives

1. To know more about on family ethics and their values.
2. To instil moral and social values.
3. To get knowledge on business ethics.
4. To create awareness on environmental ethics.

SYLLABUS

Chapter I: Value Education – Definition – Relevance to present day – Concept of human values - Self introspection – Self esteem. Family values-Components, Structure and responsibilities of family Neutralization of anger – Adjustability – Threats of family life – Status of women in family and society – Caring for needy and elderly – Time allotment for sharing ideas and concerns.

Chapter II: Medical ethics – Views of Charaka, Sushruta and Hippocrates on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia, Ethical obligation to animals, Ethical issues in relation to health care professionals and patients. Social justice in health care, human cloning, problem of abortion. Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge.

Chapter III: Business ethics – Ethical standards of business – Immoral and illegal practices and their solutions. Characteristics of ethical problems in management, ethical theories, causes of unethical behavior, Ethical abuses and work ethics.

Chapter IV: Environmental ethics – Ethical theory, man and nature - Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and pollution, Justice and environmental health.

Chapter V: Social ethics – Organ trade, Human trafficking, Human rights violation and social disparities, Feminist ethics, Surrogacy/pregnancy. Ethics of media – Impact of Newspapers, Television, Movies and Internet.

Books for study:

1. Johns S Mackenjie: A Manual of ethics
2. “The Ethics of Management” by Larue Tone Hosmer, Richard D. Irwin Inc.
3. Management Ethics – Integrity at work by Joseph A. Petrick and John F. Quinn, Response Books, New Delhi.
4. “Ethics in Management” by S.A. Shelekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed) G.C. Haughton.
10. Sasruta Samhita: Tr. KavirajKunjanlal, KunjanlalBrishagratha, Chowkamba Sanskrit Series, Vol I,II and III, Varanasi, Vol I PP, 16-20, 21-32 and 74-77 only.
11. Charaka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series Office. Varanasi I, II, III Vol I PP 183-191.
12. Ethics, Theory and Contemporary Issues. Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed.,) John H. Piet and Ayodya Prasad, Cosmo Publications.
15. Text Book for Intermediate First Year Ethics and Human Values, Board of Intermediate Education – Telugu Academy, Hyderabad.

16. I.C. Sharma Ethical Philosophy of India. Nagin & Co Julundhar.

Course Outcomes: After completing the course, the students will be able to

1. Understand the issues which will help to sensitize students to be broader towards the social, cultural, economic and human issues, involved in social changes
2. Know the nature of the individual and the relationship between the self and the community
3. Understanding major ideas, values, beliefs, and experiences that have shaped human history and cultures.
4. Aware of the environmental ethics and values.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	3	3	3	-	-	-
CO2	-	-	-	-	-	1	2	3	2	-	-	-
CO3	-	-	-	-	-	2	2	3	2	-	-	-
CO4	-	-	-	-	-	2	2	3	2	-	-	-

Branch: PHYSICS

Course title: General Lab – II

Semester: I

Course code: PHY 205

Credits: 4

Marks: 100

Course Objectives

1. To provide experimental knowledge from theoretical concepts and important areas of research.
2. To provide practical knowledge on Physics using different experiments and their importance in understanding the Physics.
3. To understand and improve skill towards operating different optical measurements.
4. To provide hands on experience in measurements to motivate towards research.

List of Experiments:

1. Laser –Determination of (a) Slit width and (b) Diameter of Wire
2. Young’s Modulus-Interference Method
3. Stefan’s Constant
4. Verification of Malus Law
5. Refractive index of liquids
6. Phototransistor characteristics
7. G M Counter

Course Outcomes: Students will have hands on experience on

1. Lasers and its slit width calculation and refractive index measurement, Young’s modulus finding through interference and Stefan’s constant calculation
2. Intensity variation of light, photo transistor working, absorption and decay of nuclear radiation
3. Analyze the results and able to design the instruments.
4. Improve the presentation skill and suitable knowledge on optical related experiments.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3

CO2	3	3	2	2	3	1	1	-	-	-	2	3
CO3	3	3	2	-	1	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Electronics Lab – II

Semester: I

Course code: PHY 206

Credits: 4

Marks: 100

Course Objectives

1. To explain the students about different electronic circuits and their application in practice.
2. To impart knowledge on assessing the performance of electronic circuits through monitoring of sensitive parameters.
3. To evaluate the use of computer-based analysis tools to review the performance of semiconductor device circuits.
4. To get knowledge and improve skills to work on different electronic circuits and instruments.

List of Experiments

1. First order filters using –Op-Amp : Low Pass, High Pass and Band Reject – Frequency Response
2. Digital Trainer Kit a) Flip-Flop (R-S, R-S-T, J-K)
3. Microprocessor 8085 Programming
4. Amplitude Modulation (AM) and Demodulation
5. Frequency Modulation (FM) and Demodulation
6. DAC-using Op-Amp & R-2R Ladder Network.

Course Outcomes: After completion of the course, the students are able to

- 1 Identify relevant information to supplement the Analog Electronic Circuits.
2. Set up testing strategies and select proper instruments to evaluate the performance characteristics of the electronic circuit.
3. Choose testing and experimental procedures on different types of electronic circuits and analyze their operation at different operating conditions.
4. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	2	1	-	3	3	3	2
CO2	3	3	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	3	2	2	-	-	-	1	3	3
CO4	3	2	1	-	2	-	-	-	3	-	3	2

Branch: PHYSICS

Course title: Quantum Mechanics - I

Semester: III

Course code: PHY 301

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives:

1. To provide an understanding of the formalism and language of quantum mechanics.
2. To gain knowledge of Quantum Dynamics and to understand the concepts of perturbation theory and their applications to physical situations.
3. To solve the harmonic oscillator and hydrogen-like atom problems using perturbation methods.
4. To illustrate scattering theory and to determine the scattering parameters.

SYLLABUS:

UNIT - I: Formulation and Simple Problems

Wave particle duality – Wave functions in coordinate and momentum representation- Postulates of quantum mechanics -Linear vector space: Hilbert space - Dirac's Bra and Ket notations- Hermitian operators and their properties- Matrix representation of an operator- Unitary operators- Unitary transformation - The Kronicker Delta and Dirac delta functions

Eigen values and Eigen functions for finite potential well and step barrier – Quantum mechanical tunneling

UNIT - II: Quantum Dynamics and Simple Problems

Equations of motion - Schrodinger Picture- Heisenberg Picture- Interaction Picture- Equivalence of various Pictures- . Poisson and Commutation brackets- Their Properties

Eigen values and Eigen functions for Simple harmonic oscillator- Polynomial method and abstract operator method in one dimension- Eigen values and Eigen functions for a free particle and particle in a box in three dimensions.

UNIT - III: Approximate Methods

Time independent perturbation theory for non-degenerate levels: Perturbed harmonic oscillator, Normal Helium atom, Stark effect of the plane rotator. First order perturbation theory for degenerate levels: First order Stark effecting in hydrogen atom; Time dependent perturbation theory: Transition to continuum (Fermi Golden rule).

WKB approximation – Turning points and connecting formulae: Application to potential barrier. Variational methods.

UNIT - IV: Scattering Theory

Introduction: classical theory of scattering - Quantum theory of scattering - Method of partial wave analysis - Scattering by a perfectly rigid sphere - Greens function in scattering theory - Born approximation - Validity of Born approximation - optical theorem.

Reference Books

1. QuantumMechanics: S.L.Kakani and H.M.Chandalia.SultanChandandSonsFirst Edition
2. Advanced Quantum Mechanics : B.S. Rajput, Pragatiprakashan.
3. Quantum Mechanics: V.K. Thankappan, Wiley Eastern Limited
4. A Textbook of Quantum Mechanics : P.M. Mathews and K. Venkatesan, Tata Mc GrawHill Publishing Company.
5. Quantum Mechanics: S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma Jai Prakash Nath and Company.
6. An introduction to QuantumMechanics, P.T. Mathews c Graw Hill Publishing Company.

Course Outcomes: After completing the course, the students will be able to

1. Solve the problems in quantum mechanics using Schrodinger's equation and Dirac representation.
2. Grasp the importance of quantum dynamics in solving the problems.
3. Know with approximation methods applied to atomic, nuclear and solid-state physics.
4. Understand the method of partial wave analysis.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS
Course title: Physics of Semiconductor Devices
Semester: III

Course code: PHY 302
Credits: 4
Marks: 80 + 20 (Internal)

Course Objectives

1. To introduce the concept of junctions, calculation of junction parameters, different diodes and applications.
2. To understand principle and operation of diodes.
3. To learn the differences between BJT and FET, their applications and working of MOSFET.
4. To learn different types of power devices and their technological applications.

SYLLABUS

UNIT - I: Junctions and Interfaces

p-n Junctions: Description of p-n Junction action – Junction in equilibrium- application of bias – energy band diagrams. Abrupt junction – calculation of the built-in voltage - electric field and potential distributions – Expression for Depletion layer capacitance, Static I-V characteristics of p-n junction diodes: Ideal diode model- Derivation of ideal diode equation. Real diodes – Carrier generation – recombination in the junction depletion region, I-V characteristics of Real Diodes. Electrical breakdown in p-n junctions: Zener and Avalanche breakdown in p-n junctions, Distinction between the Zener and Avalanche breakdown, Applications of breakdown diodes. Metal-Semiconductor interfaces, Ohmic and Schottky contacts.

UNIT- II: Junction Diodes

Tunnel diode- I-V characteristics, Schottky barrier diode - operation and applications. Varactor diode, Gunn diode, IMPATT diode, TRAPATT diode, BARITT diode - basic principle, operation and its applications. Solar cell – Structure - Principle of operation – Solar cell parameters – Light Emitting Diodes (LEDs), Semiconductor lasers – principle of operation and applications.

UNIT - III: Junction Transistors

Bipolar junction transistors: Principle of operation- Analysis of the ideal diffusion transistor – Calculation of terminal currents, DC parameters. Ebers-Moll Equations – Four regions of operation of a bipolar transistor. Real transistors - carrier recombination in the Emitter-Base junction depletion region – Effect of collector bias variation, avalanche multiplication in the collector – base junction and base resistance.

Junction field-effect transistors: JFET Principle of operation, Static I-V Characteristics of the idealized model.

MOS transistors and charge-coupled devices: MOS capacitor – Surface field effect – Energy band diagrams of an MOS capacitor for different bias conditions. C-V characteristics of the MOS capacitors. Basic Structures and the operating principle of MOSFET, I-V characteristics of an ideal MOSFET, Charge Coupled Devices (CCD)- principle of operation.

UNIT – IV: Power Devices and Semiconductor Technology

Technology of Semiconductor Devices: Crystal growth and Wafer preparation, Methods of p-n junction formation, Growth and deposition of dielectric layers, Planar technology, Masking and lithography, Pattern definition, Metal deposition techniques.

Power rectifiers and Thyristors: Power rectifiers, Thyristors, Some special thyristor structures, Bidirectional thyristors, Field-controlled thyristor.

Books for Study

1. Introduction to Semiconductor Materials and Devices, M.S. Tyagi, John Wiley & Sons (Asia) Pvt. Ltd., Singapore, 2000.
2. Microwave Devices and Circuits, Samuel and Y. Lao, Prentice-Hall of India, 1999.
3. Microwave and Radar Engineering, M. Kulkarni, UMESH Publications, New Delhi, 1999.

Reference Books

1. Physics of Semiconductor Devices , S.M. Sze, 3rd Edition , Oct.2006, John Wiley.

2. Solid State Electronic Devices, B.G. Streetman, PHI, New Delhi.

Course Outcomes: After completion of course students able to

1. Classify different diodes and its importance in different applications.
2. Understand the basic principles of diodes .
3. Gain theoretical knowledge on devices formation and able to fabricate devices.
4. Learn applications of MOSFET power devices

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	1	2	-	-	1	2	3
CO2	3	3	2	2	-	1	3	-	2	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	3	3
CO4	3	3	3	2	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Specialization – A: Applied Spectroscopy– I

Semester: III

Course code: PHY 303

Credits: 4

Marks: 80 + 20 (Internal)

Course objectives:

1. To understand about rotational and vibrational effects on diatomic and polyatomic molecular spectra.
2. To know details and analysis of rotational, vibrational and Raman spectra using various techniques.
3. To know the instrumentation involved in different spectrophotometers like UV-Vis –IR, NIR and FTIR.
4. To become familiar with the concepts of different types of luminescence and their applications.

SYLLABUS

UNIT I: Molecular Spectroscopy

Introduction – Rotational structure of electronic bands of diatomic molecules – Fortrat diagram – General relations – Combination relations for $^1\Sigma - ^1\Sigma$ and $^1\Sigma - ^1\pi$ bands– Evaluation of rotational constants with reference to above transition. Isotope effect in electronic spectra of diatomic molecules – Vibrational effect and rotational effect. Potential energy curves and dissociation energy, and pre-dissociation energy. Vibrations of polyatomic molecules: CO₂ and H₂O).

UNIT- II: Raman Spectroscopy

Introduction – Theory of Raman Scattering – Rotational Raman Spectra – Vibrational Raman Spectra – Mutual Exclusion Principle – Laser Raman Spectroscopy – Sample Handling Techniques – Polarization of Raman Scattered Light – Single Crystal Raman Spectra – Raman Investigation of Phase Transitions – Resonance Raman Scattering – Structure Determination using FTIR and Raman Spectroscopy. Fourier Transform (FT) Raman Spectroscopy and its additional advantages over the conventional Raman Spectroscopy, Significance of confocal Raman spectrometer, Surface enhanced Raman Scattering-Coherent Anti-Stokes Raman Spectroscopy.

UNIT – III: Spectrophotometry

Introduction – Beer's law – Absorptivity – UV and visible absorption – Instrumentation – Essential parts of spectrophotometer – Gratings and prisms – Radiant energy sources – Filters – Photosensitive detectors – Barrier layer cells – Photo emissive cells – Photomultiplier tubes – Relationship between absorption in the visible and UV region and molecular structure – IR Spectrophotometry – Fourier Transform Infrared (FTIR) Spectrometer – Molecular structure – Qualitative and Quantitative analysis –Importance of photography in the spectrochemical analysis.

UNIT - IV: Fluorescence and Phosphorescence Spectroscopy

Introduction – Normal and Resonance Fluorescence – Intensities of Transitions – Non-radiative decay of fluorescent molecules – Phosphorescence and the nature of the triplet state – Population of the triplet state – Delayed Fluorescence – Excitation spectra – Experimental methods – Emission lifetime measurements – Time resolved emission spectroscopy – Applications of Fluorescence and Phosphorescence.

Books for Study

1. Molecular spectra and Molecular structure Vol. I, G. Herzberg, 2nd Ed, Van. Nostrand.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata Mc Graw-Hill, 1983.

3. Spectroscopy Straughan and Walker (vol. 2 & 3, John Wiley & Sons, 1976.
4. Molecular Structure and Spectroscopy BY G. Aruldas, Printice-Hall Pvt. Ltd. 2001.
5. Instrumental Methods of Analysis Willard, Merritt, Dean & Settle, CBS Pub, 2001.
6. Spectrochemical Analysis, L.H. Ahrens and S.R. Taylor, Addison – Wesley, London.

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

1. Understand the molecular structure.
2. Know the importance of various molecular transitions and also about rotational, vibrational and Raman spectra of molecules.
3. Understand the instrumentation techniques that are used in different regions of spectra.
4. Familiar with fluorescence and phosphorescence spectroscopy and their applications.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	1	2	-	-	1	3	3
CO2	3	3	3	2	2	1	1	-	-	-	3	2
CO3	3	3	2	1	3	2	2	-	-	2	2	3
CO4	3	3	3	1	3	2	-	-	1	-	3	3

Branch: PHYSICS

Course title: Specialization – B: Condensed Matter Physics - I

Semester: III

Course code: PHY 303

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives:

1. To familiar with the different crystal growth techniques and various crystal imperfections.
2. To understand the dielectric properties and ordering of dipoles in dielectrics and ferroelectrics.
3. To learn the different types of magnetism and magnetism-based phenomenon.
4. To know photoconductivity, luminescence, type of excitations in solids and their importance.

SYLLABUS:

UNIT - I: Crystal Growth and Imperfections in Crystals

Crystal growth: Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystal growth techniques – Melt growth: Bridgman, Czochralski techniques. Imperfections: Classification– Point defects – Schottky and Frenkel defects - Expressions for equilibrium defect density – Colourcentres – its production – Line defects – Edge and Screw dislocations – Burger vector – Estimation of dislocation densities – Mechanism of creep – Determination of creep activation energy.

UNIT- II: Dielectrics and Ferroelectrics

Dielectrics: Introduction – Dipole moment – various types of polarization – Electronic, ionic and orientational polarization – Langevin's theory – Lorentz field – Clausius-Mosotti equation – Measurement of dielectric constant – Applications of dielectrics. Ferroelectrics: Piezo-, Pyro- and ferroelectric crystals– Spontaneous polarization – Classification and properties of ferroelectrics - Ferroelectric domains – Oxygen ion displacement theory – Applications of ferroelectrics.

UNIT- III: Ferromagnetism and Anti-ferromagnetism

Ferromagnetism: Introduction – Weiss molecular field theory – Temperature dependence of spontaneous magnetization – Heisenberg model – Exchange interaction – Ferromagnetic domains – Magnetic bubbles – Bloch wall – Thickness and energy – Ferromagnetic spin waves – Magnons – Dispersion relations.

Anti-ferromagnetism: Introduction – Two sub lattice model of anti-ferromagnetism – Ferri magnetism - Ferrites – Structure – Applications – Multiferroics.

UNIT-IV: Photoconductivity and Luminescence

Excitons: Weakly bound and tightly bound – Photoconductivity – Simple model – Influence of traps – Space charge effects – Determination of photoconductivity. Luminescence – Various types– Thermoluminescence, Electroluminescence, Photoluminescence, Cathodoluminescence and Chemiluminescence - Excitation and emission – Decay mechanisms – Applications.

Reference Books

1. Introduction to Solid State Physics, Charles Kittel VII edition, John Wiley & Sons.
2. Solid State Physics, A.J. Dekker, McMillan Publications.

3. Material Science and Engineering, V. Raghavan, PHI, New Delhi.
4. Crystal Growth, B.R. Pamplin, Pergamon Press.
5. Crystal Growth from High Temperature Solutions, D. Elwell and H.J. Scheel, Academic Press.
6. Solid State Physics, M.A. Wahab, Narosa Publishing House.

Course Outcomes: The students are able to

1. Learn the various crystal growth techniques and their importance, and also to analyze the defects
2. Know the different dielectric properties and methods to study dielectrics behavior.
3. Differentiate between ferroelectric, anti-ferroelectric, piezoelectric and pyroelectric materials.
4. Understand excitons, photoconductivity, types of luminescence and decay mechanisms

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	2	2	2	1	-	1	-	-	-	2	3
CO3	3	2	2	1	3	2	2	-	-	-	2	2
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course code: PHY 303

Course title: Specialization – C: Electronics- Embedded Systems

Credits: 4

Semester: III

Marks: 80 + 20 (Internal)

Course Objectives

1. To know the basics of PIC microcontroller system and its programming in assembly language.
2. To program PIC microcontroller for data acquisition and processing applications.
3. To know Interface sensors, transducers, motors, relays, and various input/output devices with PIC microcontroller.
4. To provide experience to integrate hardware and software for PIC microcontroller application systems

SYLLABUS

Unit - I: Introduction to Embedded Systems

Embedded systems in today's world – examples of Embedded systems – Microprocessors and Microcontrollers – Microchip and PIC microcontroller – Introduction to PIC microcontrollers using the 12 series. Architecture of 16F84A – Memory organization – in 16F84A – Timing generation – Power-up and Reset functions in 16F84A.

Unit - II: Hardware Details of 16F84A

Parallel ports : Basic idea – Technical challenge – connecting to the parallel port – Parallel ports of PIC16F84A -Clock oscillator -Power supply- Interrupts -Timers and counters -watch dog timer -Sleep mode.

Unit - III: Assembler and Assembler Programs

Basic idea – PIC 16 series instruction set and ALU – Assemblers and Assembler format – creating simple programs – Adopting a development environment – Building structured programs – Flow control: Branching and Subroutines – Generating time delays and intervals – Logical instruction – Arithmetic instructions.

Unit - IV: PIC Microcontroller PIC 16F873A

Block diagram and CPU – Memory and memory maps – Interrupts – Oscillator, Reset and Power supply – Parallel ports.

PIC 16F87XA Timer 0 and Timer 1 – 16F87XA Timer 2, Comparator and PR2 register – capture/Compare/PWM (CCP) Module – Pulse width modulation – ADC module.

Interface: LED displays – Liquid crystal displays –Sensors –Actuators.

Books for Study

1. Designing Embedded Systems with PIC Microcontrollers: Principles and applications, Tim Wilmshurst, First Edition, 2007, Newnes – Elsevier – Publishers.
2. Microcontrollers: Theory and Applications, Ajay V. Deshmukh, , Tata McGraw Hill, New Delhi, 2005
3. Designing with PIC Microcontrollers, John B. Peatman, Pearson Education, Inc.,1998.
4. The 8051 Microcontroller and Embedded systems, M.A. Mazidi and J.G. Mazidi, PEA, Pvt. Ltd., 2000.

Course Outcomes: After completion of the course, the students are able to

1. Acquire knowledge about PIC microcontroller and embedded processors and their applications.

2. Understand the internal architecture/functional block diagram of PIC microcontrollers.
3. Develop program for PIC microcontroller timers, serial port and Interrupts using “C”.
4. Interface LCD, keyboard, ADC, DAC, sensors, relays, DC and stepper motor with PIC microcontroller.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	1	2	-	-	1	3	3
CO2	3	3	2	2	1	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	2	2
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Elective – A: Photonics – I

Semester: III

Course code: PHY 304

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To inspire the student to learn about basics to applications of Photonic devices
2. To develop the ability to formulate problems related to photonic structures/processes and analyze.
3. To understand processes that help to manipulate the fundamental properties of light.
4. To develop the creativity to understand and formulate problems related to photonic structure and potential applications.

SYLLABUS

UNIT - I: Laser systems

General description, Laser structure, Single mode laser theory, Excitation mechanism and working of: CO₂, Nitrogen, Argon ion, Excimer, X-ray, Free-electron, Dye, Nd:YAG, Alexanderite and Ti:sapphire lasers, Diode pumped solid state laser, Optical parametric oscillator (OPO) lasers. Optical amplifiers- Semiconductor optical amplifiers, Erbium doped waveguide optical amplifiers, Raman amplifiers, Fiber Lasers. Laser applications-Lasers in Isotope separation, Laser interferometry and speckle metrology, Velocity measurements.

UNIT - II: Properties of laser Radiation

Introduction, Laser linewidth, Laser frequency stabilization, Beam divergence, Beam coherence, Brightness, Focusing properties of laser radiation, Q-switching, Methods of Q-switching: Rotating-mirror method, Electro-optic Q-switching, Acoustic-optic Q-switching and Passive Q-switching, Modelocking, Methods of mode locking: Active and passive mode locking techniques, Frequency doubling and Phase conjugation

UNIT - III: Opto-electronic Devices

Introduction, P-N junction diode, Carrier recombination and diffusion in P-N junction, Injection efficiency, Internal quantum efficiency, Hetero-junction, Double hetero-junction, Quantum well, Quantum dot and Super lattices; LED materials, Device configuration and efficiency, Light extraction from LEDs, LED structures-single heterostructures, double heterostructures, Device performances and applications, Quantum well lasers; Photodiode and Avalanche photodiodes (APDs), Laser diodes-Amplification, Feed back and oscillation, Power and efficiency, Spectral and spatial characteristics.

UNIT – IV: Modulation of Light

Introduction, Birefringence, Electro-optic effect, Pockels and Kerr effects, Electro-optic phasemodulation, Electro-optic amplitude modulation, Electro-optic modulators: scanning and

switching, Acousto-optic effect, Acousto-optic modulation, Raman-Nath and Bragg modulators : deflectors and spectrum analyzer, Magneto-optic effect, Faraday rotator as an optical isolator. Advantages of optical modulation.

Text and reference books

1. Lasers: Principles and applications by J.Wilson And J.F.B.Hawkes, Prentice, Hall of India, New Delhi, 1996.
2. Laser fundamentals, W.T.Silfvast, Foundation books, New Delhi, 1999.
3. Semi conductor opto electronics devices, P. Bhattacharya, Prentice – Hall of India, New Delhi, 1995.
4. Optical fiber communications, John M. Senior, Prentice-Hall of India, New Delhi, 2001
5. Optoelectronics: An Introduction, J.Wilson And J.F.B.Hawkes, Prentice-Hall of India, New Delhi, 1996.
6. Electro-Optical devices, M.A. Karim, Boston, Pws-Kent Publishers, 1990

Course Outcomes: After completion of the course, the students shall able to

- 1 Learn the concept of lasers and their applications...
2. Understand the fundamental properties of lasers and laser systems
3. Know about the different optoelectronic devices and their behavior.
4. Aware of wide variety of applications of opto-electronic components.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	3	1	2	3
CO2	3	3	3	2	2	1	1	-	-	-	2	3
CO3	3	3	2	-	3	2	2	-	-	2	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Elective – B: Solar Energy- Thermal Aspects

Semester: III

Course code: PHY 304

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To provide information on thermal component of solar energy, measurement of radiation
2. To learn about theoretical aspects of solar collectors, performance evaluation and procedures.
3. To understand various types of solar thermal applications in the day-to-day life.
4. To get knowledge on solar energy and their applications.

SYLLABUS

UNIT - I: Solar and Thermal Radiation- Basics

Spectral distribution of Extra-terrestrial radiation – Solar Constant-Concept of Zenith Angle and Air-Mass. Standard Time, Local Apparent Time, Equation of Time. Definitions of Declination, Hour Angle, Solar and Surface Azimuth Angles. Direct, Diffuse and Total Solar Radiations - Intensity Measurements- Thermoelectric Pyranometer, Thermoelectric Pyrheliometer and Angstrom Pyrheliometer.

Reflection, Absorption and Transmission of solar radiation through single and multiple covers- Transmittance-Absorptance product. Kirchoff's law-Relationship among absorptance, emittance and reflectance. Spectrally Selective Surfaces-Methods of obtaining selectivity -Direct measurement of solar absorptance and thermal emittance of a selective surface.

UNIT - II: Flat-Plate Collectors

General description of a flat-plate collector- Liquid heating type flat-plate collector-Energy balance equation and efficiency. Temperature distribution in the flat-plate collectors-Collector over-all heat-loss coefficient- Definitions of fin efficiency - Collector efficiency factor, Collector heat-

removal factor and Collector flow-factor. Standard method of testing the thermal performance of liquid heating type flat-plate collector. Evacuated tubular collectors.

UNIT - III: Concentrating Collectors and Thermal Energy Storage

Types of Concentrating Collectors - Non-imaging and imaging concentrators-single axis and two-axis tracking – Definitions of Aperture, Rim-angle, Concentration ratio and Acceptance angle. Thermal performance of Linear Parabolic Trough Concentrator with an uncovered receiver. Thermal Energy Storage - Sensible heat storage- liquid and pebble-bed storage, Latent Heat storage and Thermochemical storage.

UNIT - IV: Solar Thermal Energy Applications

Principles of Solar Water Heating System- Natural and Forced Circulation types-sizing of domestic water system. Solar space heating systems-active heating system-liquid heating type - Passive space heating and cooling concepts. Solar vapour absorption type and vapour compression type cooling systems. Solar Cookers, Solar Desalinators. Solar Air Heaters - Different configurations-Solar Driers - Principle of working – Solar thermal power generation.

Books for study

1. Solar Thermal Energy Engineering, J.A. Duffie and W.A. Beckman, John Wiley & Sons, 1990.
2. Solar Energy Utilization, G.D. Rai, Khanna Publishers.
3. Solar Energy-Fundamentals and Applications, J.P.Garg & J Prakash, Tata McGrawHill Pub 2000.
4. Solar Energy-Fundamentals, Design, Modelling&Applications, GN Tiwari, Narosa Pub. 2005.
5. Solar Energy- Principles of Thermal Collection and Storage, S.P. Sukhatme, Tata McGraw Hill Pub., 1999.

Reference Books

1. Principles of Solar Energy Engineering, Kreith and Kreider.
2. Handbook of Solar Energy Technology, Part A & Part B, Chemisnoff and Dickinson.
3. Treatise on Solar Energy, Vol. 1, H.P. Garg, John Wiley.
4. Applied Solar Energy, Meinel and Meinel.

Course Outcomes: After successful completion of the course, the student will be able to:

1. Understand the fundamentals of solar energy, particularly the thermal energy component.
2. Acquire knowledge on solar radiation measurement techniques and procedures.
3. Demonstrate skills related collector performance analysis through hands on experience.
4. Understand the importance of solar thermal energy and their applications.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	2	-	-	1	2	3
CO2	3	3	2	2	2	1	1	-	-	-	3	3
CO3	3	3	2	-	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Elective – C: Vacuum and Thin film Physics

Semester: III

Course code: PHY 304

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To know about vacuum, creation and measurement of vacuum using vacuum pumps and gauges.
2. To design and construct the system for required vacuum level.
3. To learn various techniques used for thin film formation.
4. To understand the various mechanisms of thin film formation and thickness measurement techniques.

SYLLABUS

UNIT - I: Production and Measurement of Vacuum

Vacuum pumps: Fundamentals of kinetic theory applicable to vacuum technology- Mechanical Pumps: Rotary pump, Roots pump: Dry Pumps- Turbo molecular pump –Diffusion pump – Sorption pump – Cryogenic pump. (1,2)

Vacuum Gauges: Thermal conductivity (Pirani) gauge- Ionization gauges: Penning gauge, Hot cathode ionization gauge – Bayard –Alpert gauge –Quadruple mass spectrometer

UNIT - II: Construction and Operation of Vacuum Systems

Valves for medium and high vacuum – Devices for transmitting motion – Working vessel – Pump combinations – Design of vacuum systems - Leaks and leak detection.

Vacuum application: Vacuum metallurgy, Space simulators, Freeze drying – Vacuum in electrical applications (Drying, Impregnation, circuit breakers). (1,2,3)

UNIT - III: Preparation of Thin Films

Physical Methods: Vacuum evaporation:– Thickness distribution of evaporated films (Point and Ring sources) - Resistive heating, Electron beam evaporation, Co-evaporation Pulsed laser ablation –Epitaxial thin deposition: Close-space vapour transport (CSVT) and molecular beam epitaxy.Sputtering: Glow discharge, DC and RF sputtering, Reactive sputtering and magnetron sputtering.

Chemical methods: Electroplating – Spray pyrolysis – Chemical vapour deposition (CVD), Sol-gel – spin coating. (3,4,5)

UNIT - IV: Growth and Thickness Measurements of Thin Films

Growth of thin films: Condensation, Nucleation and growth of thin films – Langmuir Frenkel theory of condensation – Theories of thin film nucleation – Capillarity theory – Statistical or Atomistic theory – Comparison of the nucleation theories – The four stages film growth – Incorporation of defects during growth.

Thickness measurement: Multiple beam interferometer (MBI) methods – Quartz crystal thickness monitor, Stylus profiler. (3,4,6)

Books for Study

1. Vacuum Technology, A.Roth, North-Holland, 1986.
2. Vacuum Science and Technology, V.Vasudeva Rao, T.B.Ghosh and K.L.Chopra, Allied Publications, 1998.
3. Handbook of Thin Film Technology, L.I.Maissel and R.L.Glang, Mc Graw HillBook Co., 1970.
4. Thin Film Phenomena,K.L.Chopra, Mc Graw Hill Book Co., New York, 1969.
5. Vacuum Deposition onto Webs, Films and Foils, Charles A. Bishop, Elsevier, London, 2011.
6. The Materials Science of Thin Films, M. Ohring, Academic Press, New York, 1992.
7. The User's Guide to Vacuum Technology, J.F .O'Henlon, John Wiley & Sons, 2003.

Course Outcomes: After the completion of this course, students shall be able to

1. Demonstrate various pumps and gauges.
2. Design a vacuum system and inspect leak in system.
3. Prepare thin films, outlining the conditions for deposition of amorphous, crystalline and epitaxial films.
4. Understand the thin film growth mechanism and measure the thickness of a given film.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO1	3	3	2	3	2	3	2	-	-	1	2	3
CO2	3	3	2	2	2	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	3	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Specialization Lab – A. Applied Spectroscopy - I

Semester: III

Course code: PHY 305

Credits: 4

Marks: 100

Course Objectives:

1. To introduce of various experiments techniques for analysis.
2. To translate certain theoretical concepts learnt earlier into experimental knowledge by providing hands on experience of basic laboratory techniques.
3. To get knowledge on instrumentation involved in different spectrophotometers like UV-VIS and IR.
4. To translate certain theoretical concepts learnt earlier into experimental knowledge by providing hands on experience.

List of Experiments

1. Measurement of Refractive indices of various liquids, using Abbe's Refractometer with sodium lamp.
2. To determine the Cauchy's constant of given prism by using dispersion phenomenon.
3. To study the nature of polarization with the aid of quarter wave plate and photo cell.
4. To determine the specific charge of an electron using gauss metre with neon discharge lamp as source by the Zeeman Effect.
5. Dispersive nature of Iron atomic spectra - a) To verify the dispersion relation in the wavelength region between 2660Å to 4880Å based on a prism spectrograph/ Littrow spectrograph; b) To verify the dispersion relation in the wavelength region between 2660Å to 4800Å based on a prism spectrograph/ Jarell ash spectrograph.
6. Qualitative analysis-To identify the elements that are present in the given powder by the method of qualitative analysis. Corresponding spectral lines recorded on the given film for the powder mixer.

Course Outcome: After completion of the course, the students shall be able to

1. Gain experience with some statistics to analyse data in laboratory.
2. Handle the spectrophotometers and could analyse the data.
3. Identify the compounds based on qualitative analysis.
4. Improve the presentation skill and suitable knowledge on spectroscopic instruments.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	1	-	-	-	1	3	2
CO2	3	3	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	2	-	2	-	1	3	3	3
CO4	3	2	1	-	2	-	-	-	-	-	3	2

Branch: PHYSICS

Course title: Specialization Lab – B. Condensed Matter Physics - I

Semester: III

Course code: PHY 305

Credits: 4

Marks: 100

Course I Objectives

1. To provide experimental knowledge in properties of solids and its behavior
2. To understand the hysteresis behaviour of magnetic materials
3. To understand the ferroelectric behaviour of dielectric materials.
4. To provide knowledge in analysis of experimental results to drive students towards research

List of Experiments

1. Energy gap-Reverse saturation current
2. B-H Loop
3. Creep - activation energy determination
4. BaTiO₃ -Dielectric behavior
5. Mono and Diatomic lattice- Saturation frequency

Course Outcomes: Students will have hands on experience of

1. Minority charge carrier current in calculation of band gap
2. Analysis of magnetic materials in terms of coercivity and saturation magnetization,
3. Creep importance in materials characteristics analysis
4. Transition temperature determination by finding dielectric constant, calculation of dispersion frequency of mono and diatomic lattices through electrical analog.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	1	2	-	-	3	-	3	2
CO2	3	3	2	-	1	1	1	-	-	-	3	2
CO3	3	2	2	1	1	-	-	-	-	1	3	3
CO4	3	2	1	-	1	2	1	-	-	-	3	2

Branch: PHYSICS

Course title: Specialization Lab – C. Electronics – Embedded Systems

Semester: III

Course code: PHY 305

Credits: 4

Marks: 100

Course Objectives

1. Demonstrate the different physical parameters of PIC 16F877A.
2. Explain the calibration of parameters measured and displayed.
3. Demonstrate PIC 16F877A on simulation module.
4. Evaluate the data transfer

List of Experiments

Software Experiments

1. To add two 8- bit Numbers using PIC Microcontroller 16F877.
2. To subtract two 8- bit Numbers using PIC Microcontroller 16F877.
3. To convert Uppercase letter to lowercase letter using PIC Microcontroller 16F877 A.
4. To find maximum of two 8- bit numbers using PIC Microcontroller 16F877.

Hardware Experiments

5. Interface LED to PIC Microcontroller 16F877 A.
6. Interface Switch to PIC Microcontroller 16F877 A.
7. Interface Buzzer to PIC Microcontroller 16F877 A.
8. Interface Relay to PIC Microcontroller 16F877 A.

Course Outcomes: After completion of the course, the students are able to

1. Define the arithmetical and logical assembly language for microcontroller PIC 16F877A

2. Know the downloading procedure on hardware into flash ROM of PIC 16F877A
3. Show the testing data on a defined port wish board.
4. Competent to evaluate the data transfer response of PIC 16F877A.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	2	-	-	-	-	-	3	2
CO2	3	3	2	-	2	-	-	-	-	1	3	2
CO3	3	2	2	1	2	-	-	-	-	-	3	3
CO4	3	2	1	-	2	-	-	-	-	-	3	2

Branch: PHYSICS

Course title: Elective Lab – A. Photonics

Semester: III

Course code: PHY 306

Credits: 4

Marks: 100

Course Objectives

1. To demonstrate the various experiments based on Photonics
2. To analyze the bending losses of optical fibres and its importance
3. To learn the concept of electro optic effect
4. To train the students to study various characteristics of Photonic materials through modulation of light.

List of Experiments

- 1) Optical rotation by Sugar solution
- 2) Determination of bending losses in optical fibre
- 3) Determination of the pitch of the wire mesh using laser diode
- 4) Determination of refractive index of the transparent solids
- 5) Study of Electro optic effect in LiNbO_3
- 6) Determination of numerical aperture of a fibre
- 7) Determination of numerical aperture of a fibre optic material
- 8) Construction of diffraction grating using holographic technique
- 9) Study of Laser beam divergence and measurement of spot size
- 10) Construction of Refraction Hologram of an object by using Holographic technique

Course Outcomes: At the end of the courser, the students shall able to

1. Demonstrate both the theory and experiments related to propagation and modulation of light
2. Learn the optical fibre working
3. Design the Hologram
4. Propose and design new experiments based on the verification of theory with available optical components

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	2	-	-	-	1	-	3	2
CO2	3	3	2	-	2	2	-	-	-	-	3	2
CO3	3	2	2	-	2	-	-	-	-	2	3	3
CO4	3	2	1	-	2	-	-	-	-	-	3	2

Branch: PHYSICS

Course title: Elective Lab – B. Solar Energy Physics

Semester: III

Course code: PHY 306

Credits: 4

Marks: 100

Course Objectives

1. To train the students to in studying the characteristics of solar thermal and photovoltaic experiments.
2. To train the students in working of solar cells
3. To learn the students on influence of various parameters on the efficiency of solar cell
4. To demonstrate the skills related to effect of various parameters on the behavior of solar cells

List of Experiments

1. To measure direct radiation using thermoelectric pyrheliometer
2. To measure global and diffuse radiation using thermoelectric pyranometer
3. To prepare CuO coating by chemical conversion method and study quality of the coatings
4. To prepare black chrome selective surface using electroplating method
5. To study of I-V characteristics of solar cell at a constant light intensity
6. To study of I-V characteristics of a solar module at a constant light intensity.
7. To study of I-V characteristics of cells when connected in series.
8. To study of I-V characteristics of cells when connected in parallel.
9. To study of spectral response of a solar cell

Course Outcomes: At the end of the courser, the students shall able to

1. Demonstrate the skills related to measurement of direct, diffuse and global solar radiation.
2. Understand the working of a solar cell and its efficiency measurement
3. Verify the influence of different parameters on the solar cell efficiency
4. Design a solar module for a specific output current and voltage ratings.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	1	1	-	1	-	3	2
CO2	3	3	2	1	2	-	-	-	-	2	3	2
CO3	3	2	2	-	2	1	2	-	-	-	3	3
CO4	3	2	1	2	2	-	-	-	-	2	3	2

Branch: PHYSICS

Course title: Elective Lab – C. Thin Films Physics

Semester: III

Course code: PHY 306

Credits: 4

Marks: 100

Course Objectives

1. To train the students understanding the working of pumps
2. To train the students on different properties of thin films.
3. To train the students on growth of films
4. To learn the skills related to thin film characterization for optical and electrical properties.

List of Experiments

1. Study of rotary pump characteristics and determination of its speed.
2. Study of diffusion pump characteristics and determination of its speed.
3. Determination of optical energy band gap of a semiconductor using transmission measurements.
4. Determination of optical constants of thin films using transmittance data (Swanepoel method).
5. Hall effect – determination of carrier mobility and concentration in a semiconductor film.
6. Study the temperature dependence of thermo emf of a semiconductor thin film.
7. Study the current-voltage characteristics of a solar cell.

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

1. Understand the working of rotary and diffusion pumps.
2. Determine the thermoelectric emf of any semiconductors.
3. Study the characteristics of any solar cells.
4. Demonstrate the skill acquired in connection with thin film and device characterization

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	-	-	-	-	2	3	2
CO2	3	3	2	-	2	2	1	-	-	-	3	2
CO3	3	2	2	2	2	-	-	-	2	1	3	3
CO4	3	2	1	-	2	1	1	-	-	-	3	2

Branch: PHYSICS

Course title: Computational Methods and Programming

Semester: III

Course code: PHY 307

Credits: 4

Marks: 80+20(Internal)

Course Objectives

1. Understand the working of rotary and diffusion pumps.
2. Band gap determination of semiconductor thin film.
3. Working of solar cell.
4. Demonstrate the skill acquired in connection with thin film and device characterization.

UNIT – I: (a) Fundamentals of C language

C character set – Identifiers and keywords – Constants – Variables – Data types – Declarations of variables – Declaration of storage class – Defining symbolic constants – Assignment statement. Operators : Arithmetic operators – Relational operators – Logic operators – Assignment operators – Increment and decrement operators – Conditional operators.

(b) Expressions and I/O statements: Arithmetic expressions – Precedence of arithmetic operators – Type converters in expressions – Mathematical (library) functions – Data input and output - Getchar and putchar functions – Scanf – Printf – Simple programs.

(c) Control statements: If-Else statement – Switch statement – The ?operator – GO TO – While , Do-while, FOR statements – BREAK and CONTINUE statements.

UNIT – II: (a) Arrays

One dimensional and two dimensional arrays – Initialization – Type declaration – Inputting and outputting of data for arrays – Programs of matrices addition, subtraction and multiplication.

(b) User Define functions: The form of C functions – Return values and their types – Calling a function – Category of functions. Nesting of functions. Recursion. ANSI C functions – Function declaration. Scope and life time of variables in functions.

(c) Pointers: Accessing the address of variable. Declaration and Initialization of pointer variables. Accessing the value of variable through its pointer. Pointer Expressions- Pointers and arrays – Pointers and structures.

UNIT – III: Linear, non-linear equations and curve fitting

(a) Solution of Algebraic and transcendental equations – Bisection, Falsi position and Newton-Raphson methods – Basic principles – Formulae – Algorithms.

(b) Simultaneous equations: Solutions of simultaneous linear equations – Gauss elimination and Gauss-Seidel iterative methods - Basic principles – Formulae – Algorithms

(c) Curve fitting – Least square fitting – Linear and quadratic equations.

UNIT – IV: (a) Interpolations: Concept of linear interpolation – Finite differences – Newton’s and Lagrange’s interpolation formulae – Principles and Algorithms

(b) Numerical differentiation and integration: Numerical differentiation – algorithm for evaluation of first order derivatives using formulae based on Taylor’s series – Numerical integration – Trapezoidal and Simpson’s 1/3 rule – Formulae – Algorithms.

(c) Numerical solution of ordinary differential equations: Euler, method, fourth order Runge-Kutta Method.

Books for reference

1. Programming with ‘C’, Byron Gottfried, Tata McGraw Hill.
2. Programming in ‘C’, Balaguruswamy.
3. Numerical Methods, E. Balaguruswamy, Tata McGraw Hill.
4. Computer oriented numerical methods, Rajaraman.
5. Let Us C, Yeswanth Kanetkar.

Course Outcomes: After completing the course, the students shall be able to

1. Write a C programme for analytical problems, algorithms for numerical problems and execute them.
2. Solve many problems including algebraic/transcendental equations, simultaneous equations, boundary value problems, data analysis, numerical differentiation and integration and also differential equations.
3. Get knowledge on programme.
4. Improve the skills to write different programme.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	1	1	-	2	-	2	3
CO1	3	3	2	1	3	2	2	-	-	-	2	3
CO2	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: ENERGY HARVESTING SYSTEMS

Semester: III

Course code: PHY 307(a)

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives:

1. To gain the knowledge on energy sources and their role in economic development.
2. To understand the various types of solar cells and applications.
3. To learn the energy from biomass and types of bio energies.
4. To gain knowledge on electrochemical double layer capacitor -in energy storage systems.

UNIT-I

Introduction to Energy: Definition and units of energy, power, Forms of energy, Conservation of energy, second law of thermodynamics, Energy flow diagram to the earth. Origin and time scale of fossil fuels, Conventional energy sources, Role of energy in economic development and social transformation.

Environmental Effects: Environmental degradation due to energy production and utilization, depletion of ozone layer, global warming, biological damage due to environmental degradation.

UNIT-II

Solar energy: Solar energy, Spectral distribution of radiation, Flat plate collector, solar water heating system, Applications, Solar cell: fabrication and working principle, Types of solar cells, Solar module and array, Components of PV system, Applications.

Wind Energy: Introduction, Principle of wind energy conversion, Components of wind turbines, Operation and characteristics of a wind turbine, Advantages and disadvantages of wind mills, Applications of wind energy.

UNIT-III

Bio-Energy

Energy from biomass – Sources of biomass – Different species – Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification and combustion – Aerobic and anaerobic bio-conversion – Properties of biomass – Biogas plants – Types of plants – Design and operation – Properties and characteristics of biogas.

UNIT-IV

Electrochemical Energy Storage Systems:Batteries: Primary, Secondary, Lithium, Solid-state and molten solvent batteries; Leadacid batteries; Nickel - Cadmium Batteries; Advanced Batteries.

Capacitors: Super capacitor: Pseudo capacitors, Electrochemical Double Layer Capacitor(EDLC), principle of working, structure, performance and application.

Fuel Cell: Fuel cell definition, Fuel cell components, principle and working of fuel cell, performance characteristics,efficiency, Advantages and disadvantages.

References:

1. Solar Energy Principles, Thermal Collection &Storage, S.P.Sukhatme: Tata McGraw Hill Pub., New Delhi.
2. Non-Conventional Energy Sources, G.D.Rai, New Delhi.
3. Renewable Energy, power for a sustainable future, Godfrey Boyle, 2004,
5. Hydrogen and Fuel Cells: A comprehensive guide, Rebecca Busby, Pennwell corporation (2005)
6. Hydrogen and Fuel Cells: Emerging Technologies and Applications, B.Sorensen, Academic Press (2012).
7. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub., 2009.
8. J. Jensen and B. Squirensen, Fundamentals of Energy Storage, John Wiley, NY, 1984.
9. M. Barak, Electrochemical Power Sources: Primary and Secondary Batteries by, P. Peregrinus,IEE,1980.

Course Outcomes: After completing the course, the students shall be able to

1. Gain knowledge on energy sources and economic development.
2. Understand the energy flow diagram and environmental diagram.
3. Learn about the importance of energy in various applications.
4. Learn more on electrochemical storage systems.

COPO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	3	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	2	3	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Quantum Mechanics – II

Semester: IV

Course code: PHY 401

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives:

1. To gain the knowledge of identical particles and spin.
2. To understand about the orbital angular momentum and spin angular momentum
3. To learn the basics of relativistic quantum Mechanics.
4. To gain knowledge of fields and quantization methods.

SYLLABUS:**UNIT- I: Identical Particles and Molecules**

Identical particles- Indistinguishability of Identical particles- Construction of Symmetric and Anti-symmetric wave functions for two and three particle systems - Pauli's Exclusion Principle-Hydrogen molecule- Spin-orbit interaction- Ortho and Para hydrogen- Spin statistics connection.

UNIT - II: Angular Momentum

Introduction: Motion in Central Potential, Orbital Angular momentum L_x, L_y, L_z, L^2, L_+ and L_- Operators - Commutation rules for angular momentum - Eigen values and Eigen functions of L_z and L^2 - Angular momentum in general - Allowed values of angular momentum J - Eigen values of J_+ and J_- angular momentum matrices - Addition of angular momenta and Clebsch - Gordan coefficients: Clebsch-Gordan coefficient for $J_1=J_2=1/2$ and $J_1=1, J_2=1/2$ - spin angular momentum and Pauli's spin matrices.

UNIT - III: Relativistic Quantum Theory

Klein - Gordon Equation - KG equation in Co-variant form- Probability Density and Probability Current Density - Inadequacies of K.G. Equation - Dirac's Relativistic Equation for a Free Particle - Dirac's Matrices - Dirac's Equation in Co-variant form - Plane wave solution - Negative Energy States - Spin Angular Momentum - Existence.

UNIT - IV: Quantization of Wave Fields

Concept of Field - Method of Canonical Quantization: Lagrangian Formulation of Field, Hamilton Formulation of Field - Second Quantization - Field equation - Quantization of Non-relativistic Schrodinger equation - Commutation and Anti-commutation Relations, The N-representation - System of Fermions and Bosons - Creation and Annihilation.

Books for Study

1. Quantum Mechanics: S.L. Kakani and, H.M. Chandalia Sultan, Chand & Sons Company.
2. Advanced Quantum Mechanics : B.S. Rajput, Pragati Prakashan
3. Quantum Mechanics : V.K. Thankappan, Wiley Eastern Limited
4. A Textbook of Quantum Mechanics : P.M. Mathews and K. Venkatesan,
5. Quantum Mechanics: S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma,
6. An Introduction to Quantum Mechanics, P.T. Mathews, Mc Graw Hill Publishing Company

Course Outcomes: After completing the course, the students shall be able to

1. Learn distinguishability and indistinguishability of identical particles, construct symmetric and anti symmetric wave functions.
2. Grasp the concepts of spin and angular momentum as well as their quantization and addition rules.
3. Understand the principles of relativistic quantum mechanics and importance of Klein Gordon equation.
4. Learn different quantization of fields and its importance.

CO - PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	2	1	2	3
CO2	3	3	2	2	2	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	1	2	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Advances in Physics

Semester: IV

Course code: PHY 402

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To make the students acquire in understanding in broad outline of Nanomaterials and Nanotechnology.
2. To know the recent developments in science and technology of micro- and nano-systems.
3. To introduce the concepts of Remote sensing and Geographic Information System (GIS) to students.
4. To train students in processing and interpretation of image patterns for various applications.

SYLLABUS

UNIT – I: Nano Technology

Introduction to Nanomaterials – Zero, One and Two Dimensional Nanostructures - Quantum confinement - Density of states and Dependence of dimensionality – Properties of Nanomaterials – Carbon Nanotubes, Fullerenes, Graphene. Synthesis of Nanomaterials – Physical Techniques: Ball Milling – Plasma Arc Deposition – Inert Gas Condensation – Pulsed Laser Deposition – Molecular Beam Epitaxy. Chemical Techniques: Hydrothermal synthesis– Sol-Gel Process – Chemical Vapour Deposition. Applications: Single Electron Transistor – Solar Cells – Light Emitting Diodes.

UNIT – II: Micro and Nano devices

Microelectromechanical systems (MEMS): Introduction to MEMS, Basic MEM structure. Applications of MEMS: Pressure sensors, Accelerometers, Mass flow sensors.

Nanodevices: Quantum well and quantum dot devices: Infrared Detectors-Quantum Dot Lasers. Carbon nanotube emitters - Photoelectrical cells - Plasmons propagation in wave guides.

UNIT - III: Remote Sensing

Definition of remote sensing; introduction to concepts and systems; Electromagnetic radiation; electromagnetic spectrum; image characteristics; remote sensing systems; remote sensing platform; Sources of remote sensing information; Advantages of remote sensing. Application of Remote sensing in Environmental Management, Natural resource management – forest resources, water resources, land resources and mineral resources.

UNIT IV : Geographic Information System

Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems (DBMS).

Books for Study

1. Nanostructures and Nanomaterials: Synthesis, properties & application, G. Cao, Imperial College Press
2. Introduction to Nanotechnology, Charles P. Poole, Jr & Frank J. Owens, Wiley India, 2006.
3. An Introduction to Microelectromechanical Systems Engineering, Nadim Maluf.
4. The 8051 Microcontroller and Embedded systems, M.A. Mazidi and J.G. Mazidi, PEA, Pvt. Ltd., 2000.
5. Remote Sensing Principles and interpretation, F.F. Sabins Jr., W.H. Freeman and Company, New York.
6. Remote Sensing and Image Interpretation, T.Lillesand& R Kiefer, John Wiley & Sons, New York,1994
7. An Introduction to GIS by Ian Heywood et al., Addison Wesley, Longmont Limited, England.
8. Rachael A. McDonnell, ” Principles of GIS”, Oxford University Press, 2000

Course Outcomes: After completion of the course, the students shall be able to

1. Understand the synthesis of nanomaterials, their application and impact on the environment.
2. Acquire the knowledge about MEMS and their applications.
3. Learn the basics of remote sensing, different payloads, sensors and satellite platforms.
4. Get the concept of image processing& interpretation and digital data transmission and storage.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	2	1	-	2	-	2	3
CO3	3	3	2	-	3	2	2	-	-	3	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Specialization – A: Applied Spectroscopy - II

Semester: IV

Course code: PHY 403

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives:

1. To acquire thorough knowledge on ligand field theory and crystal field theory in spectroscopy.

2. To know about rare earth ions doped hosts, the concept of Judd-Ofelt theory and its application in lasers.
3. To develop and to understand different types of detectors and its uses.
4. To get knowledge on two photon spectroscopy and its advantages over single photon spectroscopy.

SYLLABUS

UNIT - I: Solid State Spectroscopy I – Transition Metal Ions

Introduction – Crystal fields and ligand fields-Concept of ligand field – Scope of ligand field theory – ‘d’ and other orbitals (s,p,f) – Quantitative basis of crystal fields – Crystal field theory – Octahedral crystal field potential on the d-wave functions – The evaluation of $10 Dq$ - Effect of weak field on S, P, D and F terms. Term energy level diagrams – Correlation diagram for d^2 configuration in octahedral coordination – Tanabe-Sugano diagrams for d^2 configuration in octahedral field.

UNIT - II: Solid State Spectroscopy II – Rare Earth Ions

Introduction – Intensity of absorption and emission bands – Oscillator strengths – Intra-configurational f-f transitions – Selection rules – Electric and Magnetic dipole transitions – Judd-Ofelt theory and evaluation of Judd-Ofelt parameters – Radiative transition probabilities of excited states of rare earth ions – branching ratios, stimulated emission cross-sections – Non-radiative process – Energy transfer – Possible mechanisms of energy transfer – Resonance energy transfer – Process of IR to visible up-conversion – Applications of rare earth doped luminescent materials.

UNIT – III: High Resolution Spectroscopy

Introduction – Light detectors – Single photon counting technique – Phase sensitive detectors – Laser optogalvanic spectroscopy – Matrix isolation spectroscopy – Laser cooling and its applications.

UNIT- IV: Two Photon Spectroscopy

Introduction – Two photon absorption spectroscopy – Selection rules – Expression for the two photon absorption cross section – Photo acoustic spectroscopy – Experimental methodology and applications to Physics, Chemistry, Biology and Medicine.

Books for Study

1. Introduction to ligand fields, B. N. Figgis (Intersci. Pub. New York, 1966).
2. Laser Crystals, A.A. Kaminskii, Springer-Verlag, New York, 1981.
3. Laser and Excited states of Rare Earths, R. Reisfeld and C.K. Jorgnesen, Springer, New York, 1977.
4. Optical Properties of Transparent Rare Earth compounds, S. Hufner, Acad. Press, 1978.
5. High Resolution Spectroscopy, J.M. Hollas.
6. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata Mc Graw-Hill Pub. 1983.
7. Instrumental Methods of Analysis, Willard, Merritt, Dean and Settle, CBS Pub. 2001.
8. Opto Acoustic Spectroscopy and Detection, Yoh-Han Pao, Academic Press, 1977.

Course Outcomes: After completion of the course, the student shall able to

1. Have the knowledge on crystal field theory and the effect of weak crystal field on S, P, D and F terms.
2. Understand the importance of rare earth doped materials and able to evaluate various laser parameters.
3. Know the instrumentation techniques used in various spectrophotometers and uses of various detectors.
4. Acquire the knowledge on two photon spectroscopy.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	3	2	2	-	1	-	2	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	1	1	3

Branch: PHYSICS

Course title: Specialization – B: Condensed Matter Physics - II

Semester: IV

Course code: PHY 403

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives:

1. To introduce the concepts and theories of elastic and thermal properties of solids.

2. To impart the knowledge about energy bands and Fermi surface.
3. To get knowledge and know the importance of Fermi surface.
4. To give the information about advanced functional materials

SYLLABUS

UNIT - I: Elastic Properties of Solids

Lattice as a homogeneous and continuous medium - Analysis of stress and strain tensors – Hooke's law - Elastic compliances and stiffness constants – Elastic energy density – Reduction in the number independent elastic constants in cubic crystals – Cauchy's relations – Bulk modulus and compressibility – Elastic waves in cubic crystals – Formulation and solution of wave equations along [100], [110] and [111] directions – Experimental determination of elastic constants – Pulse-echo technique.

UNIT - II: Thermal Properties of Solids

Quantum theory of lattice vibrations – Properties of phonons – Lattice specific heat at low temperatures – Einstein and Debye models – Born cut-off procedure – Inelastic scattering of neutrons by phonons – Experimental study of dispersion curves – Inadequacy of harmonic model– Anharmonicity – Thermal expansion – Gruneisen parameter- Lattice thermal conductivity – Elementary kinetic theory – Role of U and N processes.

UNIT - III: Energy bands and Fermi Surfaces

Energy band calculations: Plane Wave method and Augmented Plane Wave (APW) method. Importance of Fermi surface – Characteristics of Fermi surface – Construction of Fermi surface -Quantization of electron orbits - Experimental study of Fermi surface: Anomalous skin effect – Cyclotron resonance – de Haas van Alphen effect.

UNIT - IV: Functional materials

Amorphous semiconductors: Band structure – Electronic conduction – Optical absorption – Applications. Liquid crystals: Classification – Orientational order and intermolecular forces – Magnetic effect– Optical properties – Applications. Polymers: Classification – Structural property correlation – Molecular weight – Crystallinity in polymers – Applications.

Reference Books

1. Introduction to Solid State Physics, Charles Kittel 7th Edition, John Wiley & Sons.
2. Solid State Physics, A.J. Dekker, Mac Millan.
3. Solid State Physics, H.C. Gupta, Vikas Publishing House.
4. Elementary Solid State Physics, M. Ali Omar, Addison Wesley.
5. Solid State Physics, M.A. Wahab, Narosa Publishing House.
6. Science of Engineering Materials, C.M. Srivastava and C. Srinivasan, New Age Inter.

Course Outcomes: After completion of the course, the students shall be able to

1. Learn the relation between stress and strain and gain knowledge on elastic constants and velocity of elastic waves.
2. Understand the classical and quantum theories of specific heat and also about Gruneisen parameter and lattice thermal conductivity.
3. Know the theories of different bands and experimental determination of Fermi surface.
4. Classify and to know properties and applications of amorphous semiconductors, liquid crystals and polymers.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	2	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	3	1	3

Branch: PHYSICS

Course title: Specialization – C: Electronics-Wireless

Semester: IV

Communication Systems

Course code: PHY 403

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To instruct students and provide hands on experience in the subject areas of digital Communication
2. To learn the concepts related to optical communication
3. To understand the concepts of satellite communication
4. Practical demonstration of the theoretical pedagogy

SYLLABUS

Unit – I: Base band data transmission

Digital Modulation techniques: BPSK, QPSK, DPSK, QASK, BFSK, MSK, M-ary techniques. Base band binary data transmission system – Inter symbol interference – Nyquist pulse shaping criteria – line coding, pulse shaping, and scrambling techniques, Detection of error probability.

Unit – II: Codes for error detection and correction

Linear block codes, Convolutional codes. Encoding, Decoding of convolutional codes, State, Tree and Trellis diagrams. Maximum likelihood – Viterby algorithm, Burst error correction - Interleaving techniques – Block and convolutional interleaving, Types of ARQ.

Unit – III: Introduction to wireless communication systems

Global system for mobile (GSM): cellular concept, system design. Transmission system, Receiving system; frequency re-use; Spread spectrum modulation; Multiple access techniques as applied to wireless communications; 1G, 2G, 3G wireless networks.

Unit – IV: Satellite and Optical communications

Introduction Satellite systems: Orbiting satellites, satellite frequency bands, communication satellite system-modulation and multiple access format-satellite systems in India, Satellite receiving systems, G/T ratio, satellite uplink and down link analysis. Applications to communications and remote sensing. Introduction to Optical communications systems: Optical fibers, sources and detectors, analog and digital systems.

Books for Study

1. Modern Digital and Analog communication system, B.P. Lathi: Oxford 3rd Edition.
2. Digital Communications Fundamentals and Applications, Bernard Sklar, Sklar Pearson Education.
3. Principles of Communication, R.E. Ziemer, WH Tranter 5th Edition John Wiley (Fifth module).
4. Modern Electronic Communication Systems, Wayne Tomoasi, Person Education/PHI.
5. Digital Communication, John G Proakis, MGH.
6. Digital Communication Techniques Simon, Hindley Lindsey PHI.
7. Principles of Communication Systems, Taub and Schilling, Tata McGraw-Hill.
8. Digital and Analog Communication System, K. Sam Shanmugam. John Wiley.
9. Digital and Analog Communication System, Leon W Couch, Pearson Education/PHI.
10. Introduction to statistical signal processing with applications, M.D. Srinath, et. al., PHI.
11. Analog and Digital Communication, M.S. Roden PHI.
12. Digital Modulation and Coding. Wilson, Pearson Education.
13. Applied Coding and Information Theory for Engineers, Wells, Pearson Education.

Course Outcomes: After the completion of the course, the students are able to

1. Understand and visualize the digital and optical modulation techniques.
2. Demonstrate the theoretical concepts in the laboratory.
3. Gain hands on experience and envisage the concepts more clearly.
4. Fetch details in handling the fabrication, concepts of instrumentation and circuit design.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	-	1	-	3	-	2	3
CO3	3	3	2	2	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	2	1	3

Branch: PHYSICS
Course title: Elective – A: Photonics – II
Semester: IV

Course code: PHY 404
Credits: 4
Marks: 80 + 20 (Internal)

Course Objectives

1. To understand the concepts of optical fibres and related applications in communication and sensors.
2. To provide knowledge on the enhanced optical properties via planar wave guides and photonic crystals.
3. Learn the concepts of optical signal processing
4. Learn the working of photonic crystals

SYLLABUS

UNIT - I: Fibre Optic Components and Sensors

Connector principles, Fibre end preparation, Splices, Connectors, Source coupling, Distribution networks, Directional couplers, Star couplers, Switches, Fiber optical isolator, Wavelength division multiplexing, Time division multiplexing, Fiber Bragg gratings. Advantage of fiber optic sensors, Intensity modulated sensors, Mach-Zehnder interferometer sensors, Current sensors, Chemical sensors –Fiber optic rotation sensors. Optical biosensors: Fluorescence and energy transfer sensing, molecular beacons and optical geometries of bio-sensing, Bio-imaging, Biosensing.

UNIT - II: Integrated Optics

Introduction – Planar wave guide – Channel wave guide – Y-junction beam splitters and couplers - FTIR beam splitters – Prism and grating couplers – Lens wave guide – Fabrication of integrated optical devices - Integrated photodiodes – Edge and surface emitting laser – Distributed Bragg reflection and Distributed feed back lasers - Wave guide array laser.

UNIT - III: Optical Signal Processing

Introduction, Effect of lens on a wavefront, Fourier transform properties of a single lens, Optical transfer function, Vanderlugt filter, Image spatial filtering, Phase-contrast microscopy, Pattern recognition, Image de-blurring, Photonic switches, Optical transistor, Optical Gates- Bistable systems, Principle of optical Bistability, Bistable optical devices, Self electro-optic effect device.

UNIT - IV: Photonic Crystals

Basics concepts, Theoretical modeling of photonic crystals, Features of photonic crystals, Methods of fabrication, Photonic crystal optical circuitry, Nonlinear photonic crystals, Photonic crystal fibers, Photonic crystals and optical communications, Photonic crystal sensors.

Books for Study

1. Fibre Optic Communication, Joseph C. Palais, Pearson Education Asia, India, 2001
2. Introduction to fibre optics, A. Ghatak & K. Thyagarajan, Cambridge University Press, New Delhi, 1999
3. Optical Guided Wave Signal Devices, R.Syms And J.Cozens. Mcgraw Hill, 1993.
4. Optical Electronics, A Ghatak and K. Thyagarajan, Cambridge University Press, New Delhi, 1991
5. Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, John Willy and Sons,1991
6. Introduction to Fourier Optics, Joseph W. Goodman, McGraw-Hill, 1996.
7. Nanophotonics, P.N.Prasad, Wiley Interscience, 2003.
8. Biophotonics, P.N.Prasad, Wiley Publications, 2004.

Course Outcomes: After completion of the course, the students shall able to

1. Learn the basics of fibre optic components, sensors and their applications.
2. Select appropriate fiber optic components for communication.
3. Understand the different components involved in optical signal processing.
4. Demonstrate their skills related to lasers, fiber optics, photonic and opto-electronic devices.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	3	-	2	1	1	-	-	1	2	3
CO3	3	3	2	1	3	3	2	-	-	-	2	3
CO4	3	3	3	3	3	2	-	-	1	2	1	3

Branch: PHYSICS

Course title: Elective – B: Solar Energy- Photovoltaic Aspects

Semester: IV

Course code: PHY 404

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To understand the concept of solar cell, their types, fabrication procedures and applications.
2. To learn the efficiency measurement procedures and fault analysis of modules.
3. To know various societal applications of solar photovoltaic energy.
4. To understand the different photovoltaic systems and their applications.

SYLLABUS

UNIT - I: Fundamentals

Photovoltaic effect, Types of interfaces, homojunction, heterojunction and Schottky barrier - Choice of semiconductor materials for fabrication of homojunction solar cells. Equivalent circuit of a solar cell. Solar cell output parameters - Fill-factor, conversion efficiency, quantum efficiency. Effect of series and shunt resistance on the efficiency of solar cells. Variation of Open-circuit voltage and short circuit current with intensity of incident light. Effect of temperature on I-V characteristics. p-n heterojunction solar cells- criteria for choosing absorber and window layers in heterojunction solar cell.

UNIT – II: Silicon Photovoltaics

Preparation of metallurgical grade and solar grade silicon - Single crystal silicon ingot growth – Float Zone and Czochralski methods – silicon wafer fabrication – wafer to cell formation - I-V characteristics and spectral response of single crystal silicon solar cells. Factors limiting the efficiency of silicon solar cells - Poly-silicon wafer fabrication methods – EFG, Web, Heat Exchange methods

UNIT – III: Thin Film Solar Cells

Amorphous Silicon – differences in properties between crystalline silicon and amorphous (a-Si) silicon. a-Si deposition by glow discharge method – Electrical and optical properties of a-Si. Amorphous silicon solar cell configurations. Outline of a-Si Solar module processing steps. CdTe/CdS, CuInGaSe/CdS (CIGS) and GaAs thin film solar cells - Cell configuration – techniques used for the deposition of each layer- cell characteristics. Outline of CuInGaSe₂ (CIGS) solar module processing steps.

UNIT - IV: Solar Photovoltaic (PV) Systems

Photovoltaic Module Assembly: Description of steps involved in the fabrication of Silicon Photovoltaic Module - Performance of Photovoltaic Module - Module Protection - Modules in series and in parallel - Use of Bypass and Blocking Diodes, Solar photovoltaic system - components – PV Array, battery, inverter and load. Applications of solar PV systems. Stand alone, Hybrid and Grid connected PV systems.

Books for Study

1. Solar Cells- Charles E.Backus, IEEE Press
2. Fundamentals of Solar Cells, Farenbruch and Bube
3. Solar Electric Systems - G. Warfield(Ed), Hemisphere Pub(1983)
4. Terrestrial Solar Photovoltaics by Bhattacharya.
5. Amorphous Silicon solar cells K.Takahashi& M.Konagai, North Oxford Acad. Press (1986)
6. Solar Cells - Martin A Green
7. Thin Film Solar Cells by K.L.Chopra and Das, Plenum

Course Outcomes: At the end of the course, the student shall be able to:

1. Understand the fundamental concepts of solar cells, manufacturing processes and limitations.
2. Acquire knowledge on cell efficiency study techniques and procedures for fault analysis.
3. Demonstrate skills related cell performance and fault analysis through hands on experience.
4. Comprehend the applications of solar photovoltaic energy in day-to-day applications

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	3	3
CO2	3	3	3	2	2	1	1	-	-	-	2	3

CO3	3	3	2	-	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Elective – C: Properties and Applications of Thin Films

Semester: IV

Course code: PHY 404

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To understand the principle, working, advantages and limitations of composition analysis techniques.
2. To know the electrical properties of metal and dielectric films and the associated mechanisms.
3. To learn the importance of optical properties and measurement of various parameters.
4. To disseminate the different applications of thin films.

SYLLABUS

UNIT - I: Chemical and Physical Characterization of Thin Films

Surface Analytical Techniques: Auger Electron Spectroscopy (AES), Secondary Ion Mass Spectroscopy (SIMS), Secondary Neutral Mass Spectroscopy (SNMS) and Rutherford Back Scattering Spectroscopy (RBS); Spectroscopic techniques: UV-Vis-NIR and IR spectrophotometers, Fourier Transform Infrared Spectroscopy (FTIR) and Raman spectroscopy.

UNIT - II: Transport Properties of Thin Films

Metallic Films: Sources of resistivity in metallic conductors – sheet resistance and temperature coefficient of resistance of thin films – Influence of thickness on the resistivity of structurally perfect thin films – Fuchs-Sondheimer theory – Hall effect – Annealing, agglomeration and oxidation; Dielectric films: Electrical conduction in insulator films – Schottky emission – Tunneling, Poole-Frenkel emission.

UNIT - III: Optical Properties of Thin Films

Reflection and transmission at an interface – Reflection and transmission by single film – Reflection from an absorbing film - Multilayer films – Optical absorption – Determination of optical constants by Ellipsometry; Optical devices: Beam splitters – Reflection and antireflection coatings- Optical filters: Neutral filters, Broad band filters, Narrow band filters – Thin film polarizers.

UNIT - IV: Applications of Thin Films

Photolithography: Photoresists, Mask and pattern generation. Thin film resistors – Thin film capacitors – Thin film diodes and transistors – Thin film solar cells, Thin film microbatteries – Thin film sensors: Gas sensors, Bolometers – Transparent conducting oxide coatings - Metallurgical coatings. Hard coatings and Tribological coatings.

Books for Study

1. Thin Film Fundamentals, A. Goswami, New Age International. Publications, 1996.
2. Preparation of Thin Films, J. Goetz, Marcel Dekker, New York, 1992.
3. Hand Book of Thin Film Technology, L.I. Maissel and R.L. Glang, Mc Graw Hill Book Co., 1970.
4. Thin Film Phenomena, K.L. Chopra by Mc Graw Hill book Co., New York, 1969.
5. Introduction to Semiconductor Materials and Devices, M.S. Tyagi, John Wiley & Sons Pvt. Ltd. 2000.
6. Thin Film Solar Cells, K.L. Chopra and S.R. Das, Plenum Press, New York, 1983.
7. The Materials Science of Thin Films, M. Ohring, Academic Press, New York, 1992.

Course Outcomes: After completion of the course, the students shall be able to

1. Measure and analyze the chemical composition and microstructure of thin films.
2. Understand the electrical transport mechanism and optical behavior of thin films.
3. Acquire knowledge on importance of thinfilm and their Optical properties.
4. Learn the various general and technical applications of thin films in day-to-day life.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	-	1	1	-	-	-	3	3
CO3	3	3	2	3	3	2	2	-	-	3	2	3

CO4	3	3	3	-	3	2	-	-	1	-	1	3
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Branch: PHYSICS

Course title: Specialization Lab – A. Applied Spectroscopy - II

Semester: IV

Course code: PHY 405

Credits: 4:

Marks: 100

Course Objectives:

1. To translate certain theoretical concepts learnt earlier into experimental knowledge by providing hands on experience of basic laboratory techniques required.
2. To develop skill in the recognition of characteristic absorption bands.
3. To learn data analysis, to gain knowledge, handling and interpretation of spectra.
4. To improve knowledge on spectroscopic experimental techniques.

List of Experiments

1. To verify the Beer's law from the measurement of absorption spectra (400 nm-900 nm) of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ aqueous solution and a) To find the band maximum and b) To find out the unknown concentration of the given solution.
2. Optical Fibre -attenuation and bending losses
3. Groove spacing in audio CD's
4. Measurement of Optical band gap of Cr^{3+} ion from the absorption spectrum.
5. Determination of Oscillator strength for Neodymium (Nd^{3+}) ions.
6. To determine the g-factor by the ESR Spectrometer.

Course Outcome: After completion of the course, the students shall be able to

1. Use standardized material to determine an unknown concentration.
2. Handle the spectrophotometers and could analyse the data.
3. Acquire basic knowledge in the field of research.
4. Understand theoretical and experiments analysis of absorption spectra.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	-	-	-	3	-	3	2
CO2	3	3	2	-	2	1	-	-	-	2	3	2
CO3	3	2	2	1	2	1	-	-	-	-	3	3
CO4	3	2	1	-	2	-	1	-	-	-	3	2

Branch: PHYSICS

Course title: Specialization Lab – B. Condensed Matter Physics - II

Semester: IV

Course code: PHY 405

Credits: 4

Marks: 100

Course Objectives

1. To provide experimental knowledge in advanced functional materials.
2. To investigate the properties of new materials for future applications.
3. To study the properties of semiconductors
4. To investigate the properties of new materials for future applications

List of Experiments

1. Magnetic anisotropy – Calcite crystal
2. Liquid crystals – phase transition
3. Seebeck coefficient - Semiconductors
4. Heat capacity of solids
5. Energy gap – conductivity

Course Outcomes: Students will have hands on experience of

1. Magnetic susceptibility determination, liquid crystal phases with temperature.
2. working of temperature sensor, heat capacity calculation.
3. Resistance variation and measurement in semiconductor
4. Able to analyze the materials and its behavior.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	2	-	1	-	-	2	3	2
CO2	3	3	2	-	2	1	-	-	1	-	3	2
CO3	3	2	2	2	2		2	-	-	-	3	3
CO4	3	2	1	-	2	1	-	-	2	-	3	2

Branch: PHYSICS

Course title: Specialization Lab – C. Electronics – Wireless
Semester: IV Communication Systems

Course code: PHY 405

Credits: 4

Marks: 100

Course Objectives

1. To instruct students and provide hands on experience in the subject area of digital communication
2. To learn the working of optical communication experiments/techniques.
3. To analyze the data related to different experiments to draw conclusions
4. Practical demonstration of the theoretical pedagogy

List of Experiments

01. TIME DIVISION MULTIPLEXING (TDM)
02. DELTA MODULATION (DM)
03. PULSE CODE MODULATION (PCM)
04. DIFFERENTIAL PULSE CODE MODULATION (DPCM)
05. PHASE SHIFT KEYING (PSK)
06. DIFFERENTIAL PHASE SHIFT KEYING (DPSK)
07. AMPLITUDE SHIFT KEYING
08. FREQUENCY SHIFT KEYING (FSK)
09. PHASE LOCKED LOOP (LM565)
10. FIBRE OPTIC ANALOG TRANSMISSION KIT
11. FIBRE OPTIC DIGITAL TRANSMISSION KIT

Course Outcomes: Upon completing the course, students shall be able to

1. Understand and visualize the digital and optical modulation techniques.
2. Demonstrate the theoretical concepts in the laboratory.
3. Gain hands on experience and will be able to envisage the concepts more clearly.
4. Know the fabrication process, concepts of instrumentation and circuit design.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	-	2	-	-	-	3	2
CO2	3	3	2	-	2	1	-	-	1	-	3	2
CO3	3	2	2	1	2	-	1	-	-	-	3	3
CO4	3	2	1	-	2	2	-	-	-	1	3	2

Branch: PHYSICS

Course title: Project work

Semester: IV

Course code: PHY 406

Credits: 4

Marks: 100

Course Objectives

1. To train the students in literature survey
2. To train the students for independent thinking, planning and execution of any selected problem.
3. To take-up a simple problem with an aim, plan and the experiment,
4. To discuss the results and give the conclusion.

List of projects

The student is given choice to select his any problem in Physics, preferably in the following branches.

1. Applied spectroscopy
2. Condensed matter Physics
3. Electronics and digital communications
4. Photonics
5. Solar energy
6. Vacuum and Thin films.
7. Atmospheric
8. Semiconductor devices

Course Outcomes: After completion of the project, the student shall be able to

1. Get the experience on literature collection
2. Get the experience on selection of a problem independently related to recent work
3. Able to plan and execute the problem
4. Develop skills related to presentation of data, analysis discussion of the results and draw conclusions.

CO – PO Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	-	-	-	-	3	3	3
CO2	3	3	2	2	2	-	1	-	2	3	3	3
CO3	3	2	2	-	2	1	-	-	-	3	3	3
CO4	3	2	1	-	2	2	-	-	-	3	3	3

Self-Study Courses

Branch: PHYSICS

Course title: Analytical Techniques and Nuclear Physics

Semester: IV

Course code: PHY 406A

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To provide scientific understanding of analytical techniques and detail interpretation of results.
2. To understand the different spectroscopic techniques.
3. To impart knowledge about basic nuclear reactions and nuclear reactors
4. To gain knowledge on elementary particles in nuclear physics.

UNIT I : ESR, NMR and NQR Techniques

Introduction to ESR: Magnetic moment of an electron, ESR theory- spin-spin interaction - Hyperfine interaction-g factor, Relaxation effects, Experimental methods and applications.

Introduction to NMR: Nuclear spin and magnetic moment, Quantum description of NMR, theory of NMR, chemical shift, Spin-lattice (T_1), spin-spin (T_2) couplings, Bloch equations, Carbon-13 NMR and NMR applications.

Basic concepts of NQR spectra: Half integral and integral spins, Instrumentation, Super regenerative oscillator, applications of NQR.

Mossbauer spectroscopy: Introduction-Mossbauer effect, Recoilless emission and absorption, Mossbauer spectrum, Experimental methods and applications.

UNIT – II: Advanced Spectroscopic and Microscopic Techniques

Spectroscopic Techniques : Energy dispersive spectroscopy, X-ray photo electron spectroscopy, X ray fluorescence spectroscopy, Photoemission spectroscopy and Auger Electron Spectroscopy.

Imaging Techniques : Scanning electron microscopy, Transmission electron microscopy, Atomic force microscopy,

Diffraction Techniques : X-Ray diffraction – Laue method – Powder method.

UNIT – III: Nuclear Reactions

Classification of nuclear reactions – Reaction mechanisms – Compound nuclei – Direct reactions

Nuclear fission reactions – Types of fission - Distribution of fission products – Neutron emission on fission – Spontaneous fission – Nuclear fission and thermonuclear reactions – Hydrogen bomb.

Nuclear fusion reactions - Nuclear chain reactions – Four factor formula – The critical size of a reactor – General aspects of reactor design – Classification of reactors – Research reactors and Power reactors.

UNIT – IV:Elementary particles

Discovery and classification of elementary particles – Types of interactions – Conservation laws – Iso-spin, parity, charge conjugation – Time reversal – CPT theorem – Properties of leptons, mesons and baryons – Elementary particle symmetries (SU_2 and SU_3 symmetries) – Quark model – Search for Higg's particle – Elementary ideas.

Reference Books

1. Elements of X-ray Diffraction, B.D. Cullity.
2. Methods of Surface Analysis, Techniques and Applications, J.M. Walls Cambridge University Press, 1990.
3. X-ray Structure Determination, H. Stout and L.H. Jenson, Macmillan, London, 1968.
4. Instrumental Methods of Analysis, Willard Merritt, Dean Settle, CBS publishers, New Delhi, 1986
5. Spectroscopy, B.P. Straughan and S. Walker, John Wiley & Sons Inc., New York, 1976.
6. Spectroscopy, G. Chatwal and S. Anand, Himalaya Pub., 2002.
7. Spectroscopy, B.K. Sharma, Goel Publishers House, Meerut, 1975.
8. NMR Spectroscopy, R.K. Harris, Longman Sci. Tech, 1983.
9. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
10. Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int. 1997.
11. Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co. (1994).
12. Nuclear Physics, D.C. Tayal, Himalaya Pub. (1997).
13. Atomic and Nuclear Physics, R.C. Sharma, K. Nath & Co., Meerut.

Course Outcomes: After completion of the course, the students shall able to

1. Learn the basics and applications of analytical techniques.

2. Gain knowledge related to various spectroscopic techniques.
3. Get advanced knowledge in nuclear interactions in nuclear physics
4. Know more about on elementary particles.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	-	2	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Nano Materials and Devices

Semester: IV

Course code: PHY 406B

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives:

1. To provide knowledge on classification of nano materials classification.
2. To learn different synthesis methods to grow nano structures.
3. To provide knowledge of carbon nano tubes and its properties.
4. To understand Nanoelectronic devices and their applications.

UNIT – I : Introduction to Nanomaterials

Introduction to Nanomaterials – Zero, One and Two dimensional Nanomaterials Quantum confinement, Density of states, Dependence of dimensionality - Physical and chemical properties.

Unit - II : Synthesis of Nanomaterials

Introduction to Bottom-up and Top-down approaches

Ball milling – Inert Gas condensation - Physical vapour deposition -, Molecular Beam Epitaxy – Sputtering – Pulsed laser Deposition - Chemical vapour deposition – Sol-Gel – Hydrothermal Synthesis

UNIT - III : Nano-Carbon

Carbon molecules: Nature of the carbon bond – New Carbon structure – carbon clusters – Small carbon clusters – Discovery of C₆₀ – Structure of C₆₀ and its properties –Synthesis of buckyballs and Applications.

Carbon Nanotubes: Fabrication – Structure – Electrical Properties – Mechanical properties – Applications of carbon Nanotubes

Graphene : Fabrication – Structure – Electrical Properties – Mechanical properties – Applications.

UNIT - IV :Nano Devices

Introduction – Nanofabrication – Photo-Lithography – Pattern transfer –Introduction to MEMS - Single Electron Transistor – Solar Cells – Light Emitting diodes – Gas Sensors – Microbatteries- Field emission display devices – Fuel Cells.

References:

1. Nanomaterials: Synthesis, Properties and Applications – Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, 2002.
2. Introduction to Nanotechnology – Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
3. Nanoparticles from Theory to Applications edited by Gunter Schmid, Wiley VCH, 2004.
4. Nanoelectronics and Nanosystems by K. Gosser, P. Glosekotter and J. Dienstuhl. (Springer).

Course Outcomes: After completing the course, the students shall be able to

1. Understand the classification of nano materials.
2. Know different synthesis methods to grow variety of nanostructures.
3. Describe allotropic forms of carbon and to understand mechanical and electrical properties of carbon structures.
4. Gain knowledge on nano devices and their applications.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Digital Signal Processing

Semester: IV

Course code: PHY 407

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To know the information about digital filters and processing.
2. To understand the details of different Z transformations.
3. To learn the design digital filters and their usages.
4. To learn about Fourier transformations.

UNIT - I: Introduction

Signal Processing Example – Structure of Special Digital Signal Processors – Other Realizations of Digital Filters – Implementation of Digital Filters – Advantages of Digital Filters and Processing. Fundamentals of Discrete-Time systems: Introduction – Basic Definitions – Important Discrete-Time Signals – Discrete-Time systems – Fourier Transform of sequences – Sampling of Continuous-Time Signals – Digital filter with A/D and D/A.

UNIT - II: Z Transform

Definition of the Z Transform – Inverse Z Transform – Relationships Between System Representations – Computation of Frequency Response – Solution of Linear Constant Coefficient Difference Equations.

UNIT - III: Analog Filter Design

Introduction – Butterworth Filters – Chebyshev Filters – General Filter Forums. Digital Filter Design: Discrete-Time Filters – Design by Using Numerical Solutions of Differential Equations – Analog Design Using Digital Filters – Design of Digital Filters Using Digital-to-Digital Transformations – Impulse Invariant Design – FIR Filter Design.

UNIT - IV: Discrete Fourier Transform

Introduction – Continuous-Time Fourier Series – Discrete-Time Fourier Series – The Discrete Fourier Transform – Computation of the Discrete Fourier Transform – Fast Fourier Transform – Interpretation of DFT Results – DFT-Fourier Transform Relationships – Discrete Fourier Transforms of Sinusoidal Sequences.

Book for Study

1. Fundamentals of Digital Signal Processing, L.C. Ludeman, John Wiley & Sons (Asia) Pvt. Ltd., 2003.

Reference books

1. Elements of Digital Signal Processing, N. Sarkar, 2nd Edn. Khanna Publishers, 2000.
2. Digital Signal Processing, Steve White, 1st Edn. Vikas Publishing House, 2002.
3. Digital Signal Processing, O. P. Verma, 1stEdn, Dhanpat Rai & Co.

Course Outcomes: After completion of the course, the students shall able to

1. Learn the basics of Digital Filters – Advantages of Digital Filters and Processing.
2. Gain the knowledge on Z Transform
3. Understand the analog designs using the digital filters.
4. Understand the applications of Fourier transforms in electronics.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	3	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	-	1	2	3
CO4	3	3	3	1	3	2	-	-	1	-	1	3

Branch: PHYSICS

Course title: Applications of Statistics to Physics

Semester: IV

Course code: PHY 408

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To understand the statistical measurements.
2. To understand the details of different probabilities and distribution.
3. To learn about the Multiple linear regression
4. To know more on error of measurement and tests.

UNIT – I: Statistical Measures

Statistical Diagrams and Graphs; Measures of Central Tendency : Arithmetic Mean, Median, Mode, Weighted Mean; Measures of variation: Range, Quantile Deviation, Mean (average), Deviation, standard Deviation, Co-efficient of Variation, Measures of Skewness.

UNIT – II: Probability and Distributions

Basic concepts in probability; Laws of Probability; Random Variable, Mathematical expectation; Probability Distributions: Binomial, Poisson, Normal and Exponential distributions and their applications.

UNIT – III: Correlation and Regression Analysis

Co-efficients of correlation; curve Fitting: Least squares: Fitting of Straightline, parabola, Exponential and power curves; Linear Regression analysis: Simple and Multiple Linear Regression Equations; Partial and Multiple correlation coefficients.

UNIT – IV: Errors of Measurement and Tests of Significance

Types of errors, Gaussian Law of errors; Precision and probable error; Error analysis of experiments: Determination of 'g' and Elastic constants; Basic concepts in Tests of significance; Large sample tests for single sample mean, difference between two sample means; single sample proportion difference between two sample proportions; small sample tests; student's t-test, chi-square test – confidence Intervals and F-test.

Reference books

1. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapur, Sultan Chand and Sons, New Delhi, 1998.
2. Experimental Errors and their Treatment, M.G. Gadad and H.R. Hiregondar, Orient Longman, New Delhi, 1975.
3. Statistical Analysis of Measurement Errors, J.L. Jaech, John Wiley & Sons, NY, 1985.
4. Statistical Physics, A.F. Brown, Edinburgh University Press, 1968.
5. Statistical Theory and Methodology in Science and Engineering by K.A. Brownlee, John Wiley, New York, 1960.

Course Outcomes: After completion of the course, the students shall be able to

1. Gain the statistical measurements.
2. Understand the details of different probabilities and distribution.
3. Learn the Multiple linear regression
4. Gain know more on error of measurement and tests.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	-	1	2	3
CO2	3	3	2	2	2	3	1	-	-	-	2	3
CO3	3	3	3	1	3	2	2	-	-	-	2	3
CO4	3	3	3	1	3	2	-	-	1	2	1	3

Branch: PHYSICS

Course title: Physics-Philosophy and Society

Semester: IV

Course code: PHY 409

Credits: 4

Marks: 80 + 20 (Internal)

Course Objectives

1. To Get knowledge on nature and scope of philosophy of science.
2. To develop theoretical knowledge of concepts of classical physics and concepts of substance in quantum theory.
3. To understand the dynamic theory of matter.
4. To Gain knowledge on philosophical problems.

Chapter I: Nature and Scope of Philosophy and Philosophy of Science

Nature of philosophy - Origin of philosophy-Physics of philosophy - Method of philosophy epistemology and ontology or Metaphysics Philosophy and religion - Epistemology and logic-Metaphysics and logic.

Religion and society- Philosophies of Plato, Aristotle, Descartes, Leibniz, Spinoza, Plank, Schrodinger, De-Broglie, Feynman, Heractitus, Woolf, Haschurt - Need of coordination and integration of the thought processes. Philosophy and commonsense - Science and commonsense - Philosophy and science-Methods of science and philosophy- Logical positivists Denial of metaphysics- Semantics- History of Science; Aristotelian views of Physics- The Enlistment of the Copernicus Revolution - Birth of Newton Physics.

Chapter II: Space, Time, Substance and Causality

Categories of Knowledge- Nature of space-Origin of the idea of space- Nature of time-Origin of ideas of time- Nature of substance of thing - origin of the idea of substance- Relation- Change- Aristotle's view of causation- Nature of causality- Origin of the idea of causality- Substances and causality- Concept of substance in classical physics- Concept of substance in Quantum theory- Objectifiability.

Chapter III: Philosophy of Nature: Matter and life

Naturalism- Mechanism- Matter- Space- Time- Primary and secondary qualities of Matter- Nature of Mass and Motion- Theories of matter-: (a) Atomic theory (b) Dynamic theory of Matter- Origin of life. Philosophical implications of Quantum mechanics- Cosmology and the universe- Big Bang, Dark Matter and Dark Energy.

Chapter IV: Philosophical Problems of Modern Physics

Einstein's theory of Relativity- General relativity-Special theory of relativity- Einstein's view of Zionist and Pacifist programs- Newtonian metaphor of a universal machine- Classical logic- Logic of commensurable and incommensurable properties- Probability and quantum logic- Factors driving the interaction between science and society; Positivist perspective- Social constructivist perspective- Personal responsibility and conscience ethical dilemmas.

TextBooks

1. The Philosophical Impact of Contemporary Physics, D. Van, Nostrand Co., Inc Princeton, New Jersey. 1961.
2. Studies in Arts and Science, A. Felicitation, Volume 2, Prof. N. Subba Reddian, Ram Brothers, Madras, 1978.
3. Introduction to Philosophy, J. N. Sinha, J. N. Sen and B. N. Das Books and Allied (P) Ltd, Calcutta, 1995.
4. Holism in Philosophy of Mind and Philosophy of Physics, M. Esfald, Synthese Library, Vol. 298, Kluwer Academic Publishers, Netherlands, 2001.
5. The Poetry of Physics and the Physics of Poetry, World Scientific Publicity Co., Pvt. Ltd., Singapore, 2010.
6. Science and Society, Scientific thought and education for the 21st century, T. Jones and Bartlett Learning Books, Burligton, 2014.

Course Outcomes: After the completion of this course, students shall be able to:

1. Get knowledge on nature and scope of philosophy of science.
2. Develop theoretical knowledge of substance in Quantum theory.
3. Know the philosophical implications of Quantum mechanics
4. Gain knowledge on philosophical problems.

CO – PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	2	-	2	1	2	3
CO2	3	3	3	2	2	1	1	-	-	-	2	3
CO3	3	3	2	1	3	2	2	-	3	-	2	3

CO4	3	3	3	-	3	2	-	-	1	-	1	3
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