MINUTES OF THE BOARD OF STUDIES (BoS)M.Sc. PHYSICS MEETING HELD ON 17th NOVEMBER 2021 AT 10:30 AM IN THE DEPARTMENT OF PHYSICS RAYALASEEMA UNIVERSITY, KURNOOL.

MEMBERS:

1. **Prof. C.V.KRISHNA REDDY, Chairman, Board of Studies.**
2. **Prof.T.SUBBA RAO, SriKishnadevaraya University, Member, Board of Studies.**
3. **Prof.S.VIJAYA BHASKAR RAO, SriVenkateswara University, Member, Board of Studies.**
4. **Prof.K.KRISHNA REDDY, YogiVemana University, Member, Board of Studies.**
5. **Sri. K.DHANUMJAYA, Vice President, Aditi Solar Pvt., Ltd., GKS, Rishita Elite, ECIl, Hyderabad.**
6. **Prof.M.V.LAKSHMAIAH, S.K.University, Anantapuramu, Member, Board of Studies.**

ITEM I

To prepare the structure of two year M.Sc., Physics Course to be offered in the Choice Based Credit System (CBCS) from 2021-2022Academic year onwards.

RESOLUTION

1. It is unanimously resolved to offer two year M.Sc. Physics course on Choice Based Credit System (CBCS) from 2021-2022 Academic year onwards.
2. In I, II and III Semester 04 theory papers and 02 practical lab courses are to be offered in each semester and in the IV semester 04 theory papers and project work to be introduced. Each theory paper to be taught for 4 hours/week is credited with 4 credits and each practical lab course to be credited as 2 credits and project work to be credited as 2 credits.
3. In II and III semester the following open electives are to be introduced of which minimum two are to be opted each of 2 credits.
   a. Renewable Energies.
   b. RADAR and Satellite Communication.
   c. Nanotechnology.
4. In IV semester Project work along with (Massive Open Online Course) MOOC's are to be introduced.
5. For any student the evaluation consists of 20 Marks for Internal Assessment Examination (IAE) (Average of two Internal Assessments) and 80 Marks for Semester EndExamination (SEE).
6. Practical Examinations are to be conducted at the end of each semester (2 Credits for General & 2 Credits for Electronics)and each of practical paper consists of 100 Marks for Semester End Examination (SEE).
7. The Total marks for M.Sc. Physics Course for 2600 marks and 84 Credits.

ITEM II

To Consider and approve the Subjects / Papers to be offered in each Semester.

RESOLUTION

It is unanimously resolved to offer the following papers for the Department of Physics.

SEMESTER-I	PHY 101: CLASSICAL MECHANICS
	PHY 102: ELECTROMAGNETIC THEORY, LASERS AND NONLINEAR OPTICS
	PHY 103: CONDENSED MATTER PHYSICS
	PHY 104: SEMICONDUCTOR DEVICES, ANALOG AND DIGITAL CIRCUITS
	PHY 105: PRACTICAL LABORATORY COURSE-I (GENERAL)
	PHY 106: PRACTICAL LABORATORY COURSE-II (ELECTRONICS)
SEMESTER-II	PHY 201 : STATISTICAL AND RELATIVISTIC MECHANICS
	PHY 202: MATHEMATICAL PHYSICS
	PHY 203 : MATERIAL SCIENCE
	PHY 204: FUNDAMENTALS OF 8085,8086 MICROPROCESSORS AND INTERFACING DEVICES
	PHY 205: RENEWABLE ENERGIES **(OPEN ELECTIVE PAPER)**
	PHY 206: PRACTICAL LABORATORY COURSE-I (GENERAL)
	PHY 207: PRACTICAL LABORATORY COURSE-II (ELECTRONICS)
SEMESTER-III	PHY 301: QUANTUM MECHANICS-1
	PHY 302 : ANALYTICAL TECHNIQUES
	PHY 303: NUMERICAL TECHNIQUES & COMPUTER PROGRAMMING
	PHY 304:ELECTRONICS-I (8051 MICROCONTROLLERS)
	PHY 305: RADAR AND SATELLITE COMMUNICATION / NANOTECHNOLOGY. **(OPEN ELECTIVE PAPER)**
	PHY 306: PRACTICAL LABORATORY COURSE-I (GENERAL)
	PHY 307: PRACTICAL LABORATORY COURSE-II (ELECTRONICS)
SEMESTER-IV	PHY 401: QUANTUM MECHANICS-II
	PHY 402: NUCLEAR AND PARTICLE PHYSICS
	PHY 403: ATMOIC AND MOLECULAR PHYSICS
	PHY 404:ELECTRONICS-II (COMMUNICATION ELECTRONICS ANDDIGITAL SIGNAL PROCESSING)
	PHY 405: PROJECT WORK AND MOOC's

S.NO	NAME		SIGNATURE
1.	**Prof. C.V.KRISHNA REDDY**	CHAIRMAN	
2.	**Prof. T.SUBBA RAO**	MEMBER	
3.	**Prof.S.VIJAYA BHASKAR RAO**	MEMBER	
4.	**Prof. K.KRISHNA REDDY**	MEMBER	
5.	**Sri. K.DHANUMJAYA**	MEMBER	
6.	**Prof.M.V.LAKSHMAIAH**	MEMBER	

MINUTES OF THE BOARD OF STUDIES (BoS) M.Sc. PHYSICS MEETING HELD ON 27th AUGUST 2022 AT 10:30 AM IN THE DEPARTMENT OF PHYSICS RAYALASEEMA UNIVERSITY, KURNOOL.
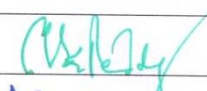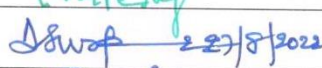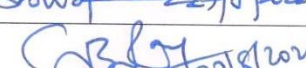
MEMBERS:

1. Prof. C.V.KRISHNA REDDY, Chairman, Board of Studies.
2. Prof. D.S.V.V.D. PRASAD, Andhra University, Visakhapatnam, Member, Board of Studies.
3. Prof.S.VIJAYA BHASKAR RAO, Sri Venkateswara University, Member, Board of Studies.
4. Prof.K.KRISHNA REDDY, YogiVemana University, Member, Board of Studies.
5. Prof.T.SUBBA RAO, Sri Kishnadevaraya University, Member, Board of Studies.
6. Sri. K.DHANUMJAYA, Vice President, Aditi Solar Pvt., Ltd., GKS, Rishita Elite, ECIL, Hyderabad, Member, Board of Studies.

ITEM I

To prepare the curriculum of two year M.Sc., Physics Course to be offered in the Choice Based Credit System (CBCS) from 2021-2022 academic year onwards in accordance with NEP -2020.

RESOLUTION

1. It is unanimously resolved to offer two year M.Sc. Physics course on Choice Based Credit System (CBCS) from 2021-2022 Academic year onwards.
2. All core papers are Mandatory.
3. All Compulsory Foundation papers are Mandatory.
4. Elective Foundation, Generic Elective and Open Elective courses are being offered.
5. Skill Oriented course practical is mandatory.
6. Interested students may register for SWAYAM /MOOCs/ NPTEL with the approval of the concerned HoD for the award of the grade as 'open elective'.
7. Multi-disciplinary Course is mandatory.
8. The total marks for M.Sc. Physics Course is 2400 marks with 96 Credits.

S.NO	NAME		SIGNATURE
1.	Prof. C. V. KRISHNA REDDY	CHAIRMAN	
2.	Prof. D. S.V.V.D. PRASAD	MEMBER	27/8/2022
3.	Prof. S. VIJAYA BHASKAR RAO	MEMBER	27/8/2022
4.	Prof. K. KRISHNA REDDY	MEMBER	27/8/22
5.	Prof. T. SUBBA RAO	MEMBER	27/8/22
6.	Sri. K. DHANUMJAYA,	MEMBER	— Not attended.

RAYALASEEMA UNIVERSITY::KURNOOL
Pasupula-518 007, A.P., INDIA
(A State University, Accredited with "B" Grade by NAAC)
M.Sc. Physics Syllabus
(Course structure and curriculum for the academic year 2021-2022)

Semester	Components of Study	Course Code	Title of the Course	No. of credits	(Theory) No. of hours per week	Practical/ Project (HRS)	Internal Assessment	Semester End Exams	Total
SEMESTER-I	Mandatory Core	PHY21101	**Classical Mechanics**	04	04		20	80	100
		PHY21102	**Electromagnetic Theory, Lasers & Nonlinear Optics**	04	04		20	80	100
	Compulsory Foundation	PHY21103	**Semiconductor Devices, Analog and Digital Circuits**	04	04	--	20	80	100
	Elective Foundation	PHY21104	**(A) Condensed Matter Physics** (B) Integrated Circuit Fabrication Technique (C) Principles of Ultrasonics	04	04		20	80	100
	Practical-I	PHY21105	**General Lab**	04	--	08	--	100	100
	Practical-II	PHY21106	**Electronics Lab**	04	--	08	--	100	100
			Sub-total	**24**	**16**	**16**	**80**	**520**	**600**
SEMESTER-II	Mandatory Core	PHY22101	**Statistical and Relativistic Mechanics**	04	04		20	80	100
		PHY21202	**Materials Science**	04	04		20	80	100
	Generic Elective	PHY21203	**Mathematical Physics**	04	04	--	20	80	100
	Open Elective	PHY21204	**(A) Fundamentals of 8085,8086 Microprocessors and Interfacing Devices** (B) Sensors and Transducers (C) Nanomaterials and Devices	04	04		20	80	100
	Practical-I	PHY21205	**General Lab**	04	--	08	--	100	100
	Practical-II	PHY21206	**Electronics Lab**	04	--	08	--	100	100
			Sub-total	**24**	**16**	**16**	**80**	**520**	**600**
SEMESTER-III	Mandatory Core	PHY21301	**Introductory Quantum Mechanics**	04	04		20	80	100
		PHY21302	**Analytical Techniques**	04	04		20	80	100
	Generic Elective	PHY21303	**(A) Electronics-I (8051 Microcontrollers)** (B) Physics of Advanced Materials (C) Applied Spectroscopy	04	04	--	20	80	100
	Open Elective	PHY21304	(A) **Numerical Techniques & Computer Programming** (B) Renewable Energy Sources (C) SWAYAM / MOOCs / NPTEL	04	04		20	80	100
	Skill Oriented Course	PHY21305	**General Lab**	04	--	08	--	100	100
	Practical-I	PHY21306	**Electronics Lab**	04	--	08	--	100	100
			Sub-total	**24**	**16**	**16**	**80**	**520**	**600**
SEMESTER-IV	Mandatory Core	PHY21401	**Advanced Quantum Mechanics**	04	04		20	80	100
		PHY21402	**Atomic and Molecular Physics**	04	04		20	80	100
	Generic Elective	PHY21403	**(A) Electronics-II (Communication Electronics and Digital Signal Processing)** (B) Properties & Characterization of Materials (C) Communication Systems	04	04	--	20	80	100
	Elective Foundation	PHY21404	**(A) Nuclear And Particle Physics** (B) Vacuum and Thin Film Physics (C) Frontiers Of Physics	04	04		20	80	100
	Multi-Disciplinary Course / Project/Lab	PHY21405	**General Lab**	04	--	08	--	100	100
		PHY21406	**Electronics Lab**	04	--	08	--	100	100
			Sub-total	**24**	**16**	**16**	**80**	**520**	**600**
			Grand Total	**96**	**128**		**320**	**2080**	**2400**

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SEMESTER-I	Mandatory Core	PHY21101	**Classical Mechanics**	04	04		20	80	100
		PHY21102	Electromagnetic Theory, Lasers & Nonlinear Optics	04	04		20	80	100
	Compulsory Foundation	PHY21103	**Semiconductor Devices, Analog and Digital Circuits**	04	04	--	20	80	100
	Elective Foundation	PHY21104	**(A) Condensed Matter Physics** (B) Integrated Circuit Fabrication Technique (C) Principles of Ultrasonics	04	04		20	80	100
	Practical-I	PHY21105	**General Lab**	04	--	08	--	100	100
	Practical-II	PHY21106	**Electronics Lab**	04	--	08	--	100	100
			Sub-total	24	16	16	80	520	600

MANDATORY CORE
PHY21101: CLASSICAL MECHANICS

OBJECTIVES:
- To develop familiarity with the physical concepts of mechanics
- To Facility Hamiltonian Formulation
- Understand the concepts on Canonical Transformations
- To understand the concept of central force and dynamics.

OUTCOMES:
- Understanding the basic laws of mechanics
- Explain Linear Harmonic Oscillator applications
- Explain various types of transformations
- Understanding rotational kinetic energy of a rigid body and Euler equation of motion.

UNIT – I: LAGRANGIAN MECHANICS
Mechanics of a particle and system of particles, Conservation laws, Constraints and their classifications, Generalized coordinates, Principle of virtual work, D'Alembert's principle. Lagrange's equations: Lagrange's equations from D'Alembert's principle,Simple applications of Lagrange's equation: Linear Harmonic Oscillatory, Simple pendulum. Hamilton's principle, Lagrange's equation from Hamilton's Principle, Extension of Hamilton's principle of non-conservative and non-holonomic system.

UNIT – II: HAMILTONIAN MECHANICS
Legendre transformations, Generalized momentum and cyclic coordinates, Conservation theorems, Hamiltonian function, Hamiltonian equations of motion, Physical significance of Hamiltonian, Routh's procedure. Application of Hamiltonian Formulation: Linear Harmonic Oscillator, Simple pendulum. Principle of least action.

UNIT – III: CANONICAL TRANSFORMATIONS AND HAMILTON-JACOBI THEORY
Equation of Canonical Transformations, Generating functions, Examples of canonical transformations. Poisson and Lagrange brackets, Equations of motion in terms of Lagrange and Poisson brackets, Angular momentum and Poisson brackets. Hamilton-Jacobi equation, One dimensional harmonic oscillator, Physical significance of the Hamilton's characteristic function.

UNIT – IV: CENTRAL FORCE FIELD AND RIGID BODY DYNAMICS
Reduction to the equivalent one-body problem, motion in a central force field, Inverse square law of force, Kepler's law of motion and its deduction, Rutherford Scattering Cross-Section. General coordinates of Rigid Body, Euler angles, Angular Velocity of a rigid body, Angular momentum and products of inertia, Rotational Kinetic energy of a rigid body and Euler equation of motion.

BOOKS FOR STUDY
1. Classical Mechanics by H. Goldstein (Addi Wesely)
2. Classical Mechanics,G. Aruldhas, PHI Learning Pvt. Ltd.

BOOKS FOR REFERENCES
1. Classical Mechanics, J. C. Upadhyaya, Himalaya Publication house.
2. Classical Mechanics, SathyaPrakash, PragathiPrakashan Publications, Meerut.
3. Classical Mechancis, N. C. Rana& P. S. Joag, Tata-McGraw Hill Publications, New Delhi.
4. Introduction to Classical Mechanics, R. G. Takwale and P. S. Puranic.
5. Classical Mechanics, Gupta, Kumar and Sharma, PragathiPrakashan Publication, Meerut.

MANDATORY CORE
PHY21102: ELECTROMAGNETIC THEORY, LASERS AND NONLINEAR OPTICS

OBJECTIVES:
- To understand the basic ideas of electromagnetic theory
- To understand the Lasing action and Parametric generation of light
- Introduction to holography, Fourier optics and Basic optical laws
- To understand the ray optics in optical communication system.

OUTCOMES:
- Able to apply Maxwell's equations in homogenous medium
- To study different types of Laser Systems
- Understanding the advantages of Fourier transforms and Holography
- To Differentiate step index fibre and graded index fibre structuresand know the applications of fibre optics

UNIT-I: ELECTROMAGNETIC THEORY
Maxwell's equations, Poyinting theorem. Vector and scalar potentials. Maxwell's equations in homogenous medium. Reflection and refraction at a plane boundary of the dielectric medium. Polarization by reflection and total internal reflection. Propagation of electromagnetic waves in conducting medium. Propagation in isotropic dielectric medium. Electromagnetic radiation – Retarded potentials, Radiation from moving point charge and oscillating dipoles.

UNIT-II: LASERS AND NONLINEAR OPTICS
Einstein coefficients. Amplification in a medium and population inversion. Spatial and temporal coherence. The ruby laser, Helium-Neon laser, four level solid state laser. CO_2 laser, Dye laser, semiconductor laser.
Non Linear Optics: Basic Principles, Harmonic generation, Second harmonic generation, Phase matching condition, Third harmonic generation, Optical mixing, Parametric generation of light , Parametric light oscillator, Frequency up conversion, Self focusing of light.

UNIT-III: HOLOGRAPHY AND FOURIER OPTICS
Introduction to Holography: Basic theory of Holography, Recording and reconstruction of Hologram, Fourier transform Holography, Acoustic and Holographic Microscopy, Pattern recognition and Applications of Holography. Fringe contrast variation. FourierTransformation spectroscopy. Michelson interferometer. Advantages of Fourier transforms. Optical data processing. Diffraction.

UNIT-IV: FIBRE OPTICS
Optical fibres. Basic optical laws. Optical fibre modes, fibre types, rays and modes. Distinction between step index fibre and graded index fibre structures. Ray optics and wave representation. Attenuation in fibres. Absorption & scattering losses, radiation losses. Material dispersion. Fibre materials. Applications of fibre optics.

BOOKS FOR STUDY:
1. Introduction to Electrodynamics, D.J. Griffiths, 4 th Edition, Prentice-Hall of India.
2. Lasers and Non Linear Optics.B. B. Laud, New Age International Publishers.
3. Electromagnetic wave and Radiating systems, EC Jordan & K.G.Balmen.

REFERENCE BOOKS:
1. Optical Fiber Communication (SIE) | 5th Edition, Gerd Keiser, McGraw-Hill Education
2. Introduction to Classical and Modern Optics. J. R. Meyer.
3. Contemporary Optics. Ghatak and Thyagarajan, McMillan, India.
4. Introduction to Modern Optics. Grant R. Fowles,Holt,Rinehart and Winston,Inc New York
5. Laser and their Applications, M.J. Beesly, Taylor and Francis.

COMPULSORY FOUNDATION
PHY21103: CONDENSED MATTER PHYSICS

OBJECTIVES:
- To understand the crystal structures by diffraction methods.
- To discuss the concept of quantization of Lattice vibration energy.
- To find the Direct and indirect band gap semiconductors, concept of Hall Effect.
- Understand the Imperfections in Crystals

OUTCOMES:
- Explain the types in crystals structures
- Explain the applications to Lattice Vibrations
- Understand the formation of energy bands in solids
- Abe to explain the defects in crystals

UNIT – I: STRUCTURE OF CRYSTALS

Crystal systems, Bravias lattices, Miller indices. Relation between inter-planar spacing and lattice spacing, Reciprocal lattice and structural factor. X- ray diffraction - Laue diffraction, Bragg's law. Powder diffraction - Experimental determination of structure of cubic crystals by powder diffraction technique.Bonding in crystals- Ionic, Covalent and metallic Binding energy of Ionic crystals.

UNIT – II: LATTICE VIBRATIONS

Mono and diatomic one dimensional infinitely long lattice, vibrational spectra, infrared absorption in ionic crystals, vibrational spectra of finite lattice, quantization of lattice vibrations, phonons, properties, experimental measurement of dispersion relation. elastic properties, stress and strain, elastic moduli.

UNIT–III: TRANSPORT PHENOMENA AND BAND THEORY

Classical free electron theory, Expression for thermal and electrical conductivities for metals, (Drude's Model), Lorentz number, Hall Effect, Formulation of Boltzmann transport equation, Relaxation time approximation. Sommerfield model - its consequences. Electron-lattice interaction (Quantitative only),Motion of electron in periodic potential, Bloch function, Kroning-Penny model, Formation of energy bands in solids, Concept of effective mass, Brillouin zones, Different schemes of representation of E Vs K curves.

UNIT-IV: IMPERFECTIONS IN CRYSTALS

Classification of imperfections – Point defects -Schottky and Frenkel defects -Expressions for equilibrium defect concentrations - Diffusion - Ionic conductivity in alkali halides -Kirkendall effect - Line defects - Dislocations - Edge and Screw dislocations - Burger vector - Stress field around dislocations and expression for strain energy of dislocation - Estimation of dislocation densities - Role of dislocations in crystal growth – Frank Reed mechanism of dislocation multiplication - Mechanism of creep - Experimental determination of creep activation energy.

BOOKS FOR STUDY:

1. Solid State Physics, M.A.Wahab, Narosa Publishing House.
2. Introduction to Solid State Physics – C. Kittel, Wiley,8thedition,London.

REFERENCE BOOKS:

1. Solid State Physics –S. O. Pillai, New Age international.
2. Solid State Physics: Theory, applications& problems- S. L. Kakani and C. Hemarajan, S chand and sons, 4thedition
3. Solid State Physics – A. J. Dekkar, pan Macmillan, London.
4. Elementary Solid State Physics: Principles and applications – M. Ali Omar,Addison Wesley series, University of Michigan.
5. X-ray Diffraction – B E Warren, Dover publications, INC, Newyork.

ELECTIVE FOUNDATION
PHY21104: SEMICONDUCTOR DEVICES, ANALOG AND DIGITAL CIRCUITS

OBJECTIVES:
- Characteristics, parameters of JFET and Concept of CMOS
- Understanding the Op-Amp configurations
- To study the Waveform generators
- To identify the differences between Combinational and Sequential Logic

OUTCOMES:
- Application of UJT as a Relaxation oscillator.
- Basic ideals on Filters (Low pass, high pass and Band pass).
- Applying the PCM transmission techniques.
- Identify the fundamentals of digital electronics circuits.

UNIT-I: SEMICONDUCTOR DEVICES
Introduction to P-N junction diode, diffusion capacitance and reverse recovery time. Zener diode, temperature sensing diode and Applications. Special diodes: Schottky diode, Varicap diode and Tunnel diodes. FET- Characteristics of n-channel, p-channel JFETs. MOSFET-Characteristics of enhancement and depletion mode MOSFETs. Characteristics of CMOS and CMOS inverter. Construction, operation and applications of SCR, TRIAC, UJT. Introduction to optoelectronic devices: LED, Laser diode.

UNIT-II: BASICS OF OPERATIONAL AMPLIFIER
Introduction to operational amplifier (Op-Amp), Block diagram of Op-Amp 741. Characteristics of Op Amp: dc offset voltage, offset current, CMMR and Slew rate. Experimental techniques to measure Op-Amp Characteristics. Open and closed loop configurations. Op-Amp configurations: Inverting and non-inverting amplifiers, voltage and current followers, differential amplifier.

UNIT-III: APPPLICATIONS OF OPERATIONAL AMPLIFIER
Mathematical Operations: Addition, subtraction & multiplication. Log and Antilog amplifiers, Sample and hold circuit, precision half and full-wave rectifier circuits, integrator, differentiator and comparator circuits. Waveform generators: Wien-bridge, Phase shift, Colpitts and Hartley oscillators, Instrumentation amplifier.

UNIT-IV: FUNDAMENTALS OF DIGITAL ELECTRONICS
Basic logic gates, Boolean and De morgan's laws, logic simplification using karnaugh map, Multiplexer and De-multiplexer. Decoders: BCD- to- Decimal, BCD-to- 7 segment, Half- and Full adders, Half and Full Substractors. Flip-flops: RS- flip flop, D- flip flop, JK- flip flop and JK- Master Slave flip flop. Counters: 4-bit asynchronous ripple counter and Mod-5 synchronous counter.

BOOKS FOR STUDY:
1. Electronic Devices and Circuit Theory, Robert Boylstead and Nashelsky, PHI.
2. Principle of Electronics by V K Mehta and Rohit Mehta, S.Chand publication.

REFERENCE BOOKS:
1. Electronic Devices and Circuits, David A Bell, PHI, New Delhi.
2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, Pearson.
3. An Introduction to Operational Amplifiers and their applications, S V Subrahmanyam and Y Narasimha Murthy, Macmillan Publishers.
4. Operational Amplifiers and Linear Integrated Circuits, Robert F Coughlin and Frederick F Driscoll, PHI.

ELECTIVE FOUNDATION
PHY21104 (B): IC FABRICATION TECHNOLOGY

OBJECTIVES - This course enables the students:
1. To learn about the wafer preparation methods, various deposition techniques
2. To study the concepts of crystal growth techniques.
3. To understand the details of oxidation, impurity distribution and photomasking.

OUTCOMES - After the completion of this course, students will be:
1. Understandthe preparation of silicon ingot.
2. Students would develop P-type and N-type silicon crystal growth using Czochralski and Bridgmen techniques.
3. In depth understanding of film thermal and anodic oxidation, diffusion process, etc.
4. Students would be aware the photomaksing, etc.

UNIT – I: IC FABRICATION TECHNOLOGY

Wafer preparation: Silicon crystal growth, Czochralski and Bridgmen techniques. Wafer orientation, Sawing and polishing, Crystal orientation, Doping of crystals during growth.

UNIT – II: EPITAXIAL DEPOSITION:

Epitaxial deposition: Introduction theory, Growth of an Epitaxial layer, evaluation of Epitaxial layers.

UNIT – III: OXIDATION

Introduction, equipment for thermal oxidation, oxidation process, oxide evaluation, recent advances in oxidation technology, oxide thickness determination, oxidation function, redistribution of dopant atoms during thermal oxidation, anodic oxidation.

UNIT - IV: IMPURITY

Introduction and redistribution, the idea of diffusion, diffusion process, diffusion analysis, ion implementation,

UNIT – V: PHOTOMASKING

Introduction – generation of photomask. Metallization: Metallization of requirements, vacuum deposition, deposition techniques, vacuum deposition cycle.

Books for Study

1. Instrumentation Measurement and Analysis by Nakra and Choudary, 4th Edition, Tata McGraw-Hill, 1985.
2. Instrumentation – Devices and Systems by Rangan, Sarma and Mani, 2nd Edition, Tata McGraw-Hill, 1997.
3. Measurement of Systems Applications and Design by Earnest O.Doeblin, 7th Edition, McGraw-Hill, 1990.
4. A course in Electrical; and Electronic Measurements and Instrumentation by A.K. Sawhney, 3rd Edition, DhanpatRai& Company, 2016.
5. Electronic Instrumentation and Measurements Techniques, Cooper and Albert D. Helfriek, 3rd Edition, Pearson India Education, 2016.
6. Applied Electronics by G.K. Mithal, 20th Edition, Khanna Publishers, 1997.
7. Principles of Industrial Instrumentation by D. Patranabis, Tata McGraw-Hill, 1976.
8. Semiconductor device fundamentals by Robert F. Pierret, Addision Wesley Longman, 1996.

ELECTIVE FOUNDATION
PHY21104 (C): PRINCIPLES OF ULTRASONICS

OBJECTIVES:
1. The course gives an introduction of ultrasonic and its properties and production of Ultrasonic by various methods.
2. The course also describes the propagation of ultrasonic in different media and Describes the measurement of ultrasonic velocities using various techniques.
3. The course discusses different methods in non-destructive testing and its applications.
4. The course discusses the applications of both low and high intensity ultrasonic in Various Fields.

OUTCOMES:
1. Students will be able to know the concept of different ranges of frequencies and
2. Ultrasonic waves and its production and properties by various methods.
3. They also able to learn the concept of propagation of ultrasonic waves in different liquid
4. Media with binary and ternary mixtures. They will be able to know the concept Viscoelasticity.
5. They able to measure ultrasonic velocities and absorption coefficients in liquids by Using various instruments.
6. They able to understand non-destructive testing methods and applications and learn applications of low and high intensities ultrasonic in the medical field, imaging, process control.

UNIT I: Introduction of ultrasonics, basic principles of ultrasonic waves, properties, production of ultrasonics i. Magnetostriction method. ii. Piezoelectric method. Detection of ultrasonic waves, basic design of ultrasonic transducer.

UNIT II: Propagation of ultrasonics velocity of plane wave in a medium, absorption of plane longitudinal waves in gases and low viscosity liquids where relaxation effects are absent. Viscoelasticity: Viscoelasticity of a medium, molecular picture of viscoelastic relaxation, propagation of shear wave in a visco elastic medium, The Maxwell model.

UNIT III: Measurements of ultrasonic velocities and absorption coefficients in liquids. i. DSA 5000 M (Density and Sound Velocity Meter) ii. The ultrasonic Interferometer iii. Pulse-echo technique iv. Optical diffraction method, Cavitation process, cleaning technique.

UNIT 1V: Non-destructive testing, different methods in non-destructive testing and applications of ultrasonic waves using non-destructive testing, flaw detection, applications of ultrasonics in medical field.

UNIT-V:
Low intensity ultrasonic application andhigh intensity ultrasonic applications in mechanical, chemical and metallurgical area. Applications of ultrasonics: Ultrasonic imaging, process control.

Reference Books:
1. Fundamental of ultrasonics - Jock Blitz
2. Ultrasonics- the low and high intensity applications - Dale Ensminger
3. Engineering Physics -1 - Dr. D. Tirupati Naidu & M. Veeranjaneyulu
4. Molecular Acoustics - A. J. Matheson

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M.Sc. Physics Syllabus
(Course structure and curriculum for the academic year 2021-2022)

Semester	Components of Study	Course Code	Title of the Course	No. of credits	(Theory) No. of hours per week	Practical/ Project (HRS)	Internal Assessment	Semester End Exams	Total
SEMESTER-II	Mandatory Core	PHY21201	**Statistical and Relativistic Mechanics**	04	04		20	80	100
		PHY21202	**Materials Science**	04	04		20	80	100
	Generic Elective	PHY21203	**Mathematical Physics**	04	04	--	20	80	100
	Open Elective	PHY21204	**(A) Fundamentals of 8085,8086 Microprocessors and Interfacing Devices**	04	04		20	80	100
			(B) Sensors and Transducers						
			(C) Nanomaterials and Devices						
	Practical-I	PHY21205	**General Lab**	04	--	08	--	100	100
	Practical-II	PHY21206	**Electronics Lab**	04	--	08	--	100	100
			Sub-total	24	16	16	80	520	600

MANDATORY CORE
PHY21201: STATISTICAL AND RELATIVISTIC MECHANICS

OBJECTIVES:
- To introduce the concept of phase space, ensemble
- To discuss about different types of partition functions
- To understand MB,BE and FD statistical distributions
- To understand the basic idea of postulates of relativistic mechanics

OUTCOMES:
- Explain different type of ensembles i. e. , micro canonical, canonical and grand canonical ensembles were discussed
- The concept of liquid helium and its transformations from normal fluid to super fluid are discussed.
- The application of BE distribution and BE condensation are discussed
- Understanding the concept of relativity

UNIT I –ENSEMBLES

Basic postulates of statistical mechanics, Phase space, probability, density distribution in phase space, Liouville's theorem, concept of ensemble, ensemble average, classification of ensemble: micro canonical, canonical and grand canonical ensembles. Expression for entropy of a system, entropy of an ideal Boltzmann gas using micro canonical ensemble, Gibb's paradox, sackur-tetrode equation.

UNIT II - PARTITION FUNCTIONS

Partition functions for, micro Canonical, canonical and grand-canonical ensembles – Boltzmann equipartition theorem- Partition function for a system of particles, Partition function for translational,rotational,vibrational and electronic energies. Maxwell- Boltzmann statistics, Maxwell- Boltzmann distribution of velocities.

UNIT III - QUANTUM STATISTICS

Classical and quantum statistics - Maxwelll – Boltzman Statistics- Distribution of Velocities – Calculation of mean values – Equipartition of Energy: Bose- Einstein distribution – Bose- Einstein Condensation – Thermodynamic properties of an Ideal Bose- Einstein Gas– Fermi - Dirac Distribution-Black body radiation and the Planck's radiation law: Dulong and Petit's law – Einstein and Debye's theories of heat capacities- Liquid Helium – Two Fluid model of Liquid Helium II- Super Fluid Phase of He.

UNI IV – RELATIVISTIC MECHANICS

Introduction: postulates of relativistic mechanics. Minkowski space, Geometrical representation of Lorentz transformation of space and time. Application to Lorentz transformation. Geometrical representation of simultaneity, length-contraction and time dilation. Space like and time like intervals. Relativistic classification of particle,Basic ideas of general theory of relativity.

BOOKS FOR STUDY:
1. Statistical Mechanics - B. K. Agarwal and M. Eisner, NAI, New Delhi.
2. Statistical Mechanics and properties of Matter - E.S.RGopal, MacMillan Co.,ND

BOOKS FOR REFERENCE:
1. Relativistic Mechanics – Satyaprakash, PragathiPrakashan, Meerut.
2. Statistical and Thermal Physics - F. Reif.
3. Statistical Physics –Bhattacharjee.
4. Elementary Statistical Mechanism,-Gupta and Kumar,Pragati Prakashan.
5. Elementary Statistical Mechanics - C. Kittle

MANDATORY CORE
PHY21202: MATERIAL SCIENCE

OBJECTIVES:
- To understand the differernt theories of magnetic materials
- To understandthe concept of Superconducting materials
- To understandthe concept of Dielectric materials
- To discuss Fabrication of Nanomaterials and CNT

OUTCOMES:
- Explain Hysteresis behaviour, Ferrites and Garnets
- Distinguish between Type-I & Type-II superconductors
- Explain the Sources of polarizability
- To explain the concept of Quantum size effect in Nanoparticles

UNIT-I: MAGNETIC MATERIALS
Heisenberg Model- exchange energy- origin of domains- Hysteresis behavior. Anti-ferromagnetism- Two sub-lattice model – Ferrimagnetism – Neel's theory of ferrimagnetism – Ferrites and Garnets. Basic principles of magnetic bubble memories.

UNIT – II: SUPERCONDUCTIVITY
Concept of zero resistance, Magnetic behavior, distinction between a perfect conductor and superconductor. Meissner effect–isotope, effect–specific heat behavior. Type-I & Type-II superconductors Two-fluid model. Super fluidity,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 TC superconductors, Preparation, Properties.

UNIT – III: DIELECTRIC MATERIALS
Dielecric constants and polarizability. Clausius-Mossotti relation. Sources of polarizability - electronic,ionic and dipolar polarizability. Frequency dependence of polarizability and dielecric loss. Ferro electricity-general properties and classification of representative ferroelectric materials.

UNIT-IV: NANO MATERIALS
Introduction- size dependence of properties- Quantum size effect in Nanoparticles- Elementary ideas of Quantum wells, Quantum wires and Quantum dots - Fabrication of Nanomaterials- Ball Milling, Ion Sputtering, Laser ablation and Spray pyrolysis- Carbon nanotubes:Structure, Types of CNTs:Single walled carbon Nanotubes (SWNT), Multi walled carbon Nanotubes (MWNT)-Graphene, Fullerenes.Elementary ideas of MEMS and NEMS.

BOOKS FOR STUDY:
1. Materials Science, V.Rajendran, Tata McGraw-Hill publishing Company limited, New Delhi.
2. Solid State Physics-S. O. Pillai. , New Age International publishers (NAIP)**,** New Delhi.

BOOKS FOR REFERENCE:
1. Introduction to Solid State Physics- C. Kittel. JW&S, VII Ed. , NY.
2. Electronic Processes in Materials- L. W. Azaroff and J. J. Brophy, MGH, NY.
3. Nano the Essentials, T Pradeep, McGraw-Hill Education (India) Pvt Limited.
4. Science of Engineering Materials- C. M. Srivastavaand C.Srinivasan, John Wiley & Sons.
5. Solid State Physics-A. J. Dekker, Mac Millan&Co Ltd. London.

GENERIC ELECTIVE
PHY21203: MATHEMATICAL PHYSICS

OBJECTIVES:
- To understand the concept of tensor and group theory.
- To understand the partial differentiation & complex variables
- To discuss the relationship between beta and gamma functions
- To understand the Fourier Transforms&Laplace Transform

OUTCOMES:
- Explain the differences between matrices and determinants.
- Identify different special mathematical functions
- Use Fourier transform to obtain the Fourier series of periodic functions in physics.
- Apply transform methods to solve elementary differential equations of interest in physics

UNIT – I: TENSORS AND GROUP THEORY
Tensors: Introduction: Notations and Conventions-the rank of a tensor-Contra-variant and co-variant tensors- Tensor Algebra: addition, subtraction, contraction, inner product and outer product, Symmetry and anti-symmetric tensors. Application of tensor: Stress, Strain, Piezo- electricity and elasticity tensors.
Group Theory: Isomorphism and Homomorphism, the group of symmetry of an equilateral triangle, group of symmetry of a square.   Representation of groups: Reducible and Irreducible representation, Character representation, Construction of character tables.

UNIT- II: PARTIAL DIFFERENTIATION & COMPLEX VARIABLES
Partial differentiations: Method of separation of variables, equation of vibrating string, solution of wave equation by D'Alembert's method, one dimensional heat flow. two dimensional heat flow Laplace equation in polar co-ordinates and transmission line equation.
Complex Variables: Functions, complex differentiation- Analytic function- Cauchy-Reimann equations- Derivatives of elementary function. Complex integration: Cauchy's theorem-Cauchy integral formula-Taylor's and Laurent's theorem- Singular point- Residues: Calculations of residues and Residue theorem.

UNIT – III: SPECIAL FUNCTIONS
Definitions of Beta and gamma functions and their properties- different forms of beta and gamma functions- relationship between beta and gamma functions. Solutions of differential equations:Bessel's function of first and second kind (recurrence formula, generating function and orthogonality relations only)- Legendre's equations-Laguerre and Hermite polynomials (recurrence formula, generating function and Rodrigue's formulae only).

UNIT – IV: FOURIER AND LAPLACE TRANSFORMS
Fourier Transforms: Fourier transforms and its inverse transform- Linearity and shifting properties - Fourier sine and cosine transforms. Convolution theorem.
Laplace Transform: Definition and notation- Inverse Laplace transforms- Linearity and shifting and derivative properties-Convolution theorem- Evaluation of Integrals- Application to Integral and differential equations**.**

BOOKS FOR STUDY:
1. Matrices and Tensors- A. W. Joshi, New International (P) Ltd. , New Delhi.
2. Mathematical Physics- H. K. Das, S. Chand& Company Ltd. , New Delhi**.**

BOOKS FOR REFERENCE:
1. A Text book of Mathematical Physics- Suresh Chandra, Narosa Publishing house, New York.
2. Elements of Group Theory for Physicists- A. W. Joshi, New International (P) Ltd. , New Delhi.
3. Special function- bell.
4. Introduction to mathematical physics, charlic Harper, PHI, New Delhi.
5. Laplace Transforms- MurraySpiegle, schaum's series, McGrawHill,NY.

OPEN ELECTIVE
PHY21204(A): FUNDAMENTALS OF 8085,8086 MICROPROCESSORS AND INTERFACING DEVICES

OBJECTIVES:
- To discuss INTEL 8085 microprocessor
- To discuss INTEL 8086 microprocessor
- To understand the DAC and ADC
- To understand the concept of Peripheral Interfacing Devices

OUTCOMES:
- Explain Architecture of 8085 microprocessor
- Explain Architecture of 8086 microprocessor and Memory organization
- Find the specifications and applications of ADC & DAC
- Discussion on Microprocessor Applications, Peripheral Interfacing programs

UNIT - I:INTEL 8085 MICROPROCESSOR

Pin out configuration and signals, Functional block diagram and explanation of blocks, Register architecture, De-multiplexing and generating control signals. Memory, I/O and Interrupt structures. Addressing modes: direct, register, register indirect and immediate addressing modes. Instruction format, Brief summary of Instruction Set, Simple Programs (Addition, Subtraction and Multiplication).

UNIT –II: INTEL 8086 MICROPROCESSOR

Pin out configuration and signals, Functional block diagram and explanation of blocks, Register architecture, Maximum mode and Minimum Mode. Memory organization, I/O and Interrupts of 8086/8088. Addressing modes: Instruction format, Brief summary of, Instruction Set, Simple Programs (Addition, Subtraction and Multiplication and division)

UNIT - III: DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS

Digital to analog conversion – Variable resistor network and R/2R ladder. Resolution and Accuracy, Block Diagram of DAC-0800 and its specifications. Analog to digital conversion – Digital Ramp method, Dual slope, Successive Approximation technique and Flash techniques. Resolution and Accuracy, ADC-0804 specifications and applications.

UNIT- IV: BASICS OF PERIPHERAL DEVICES AND INTERFACING

Programmable Serial Interface 8251, Programmable Peripheral Interface 8255,
Programmable Interval Timer 8254, Programmable Interrupt Controller 8259, DMA Controller 8237.

BOOKS FOR STUDY:
1. Microprocessor, Architecture, Programming and Applications with the 8085, Ramesh S Gaonkar, Penram International.
2. Microprocessors and Interfacing, Douglas V Hall and SSSP Rao, McGraw Hill.

BOOKS FOR REFERENCE:

1. Microprocessors and Microcomputer based system design, Mohammed Rafiquzzaman, Universal Book Stall, New Delhi.
2. Digital Systems-Principles and Applications, Ronald J Tocci and Neal S Widmer, Pearson / PHI.
3. Digital fundamentals, Floyd and Jain, Pearson.
4. Microprocessor-Based Laboratory experiments and Pojects by A.K. Mukhopadhyay, I.K. international publishing house pvt., Ltd.
5. The Intel Microprocessors 8086/8088,…, Pentium,.. Pentium 4, Architecture, Programming and Interfacing- Barry B. Brey, Pearson Education

OPEN ELECTIVE
PHY21204 (B):SENSORS AND TRANSDUCERS

OBJECTIVES - This course enables the students:
1. To understand the fundamentals of sensors and transducers and opto-electronic devices.
2. To learn the principles of transducers, gauges, LEDs, FETs, filters and amplifiers.
3. To learn the characteristics of LVDT, photodiode, couplers, detectors and amplifiers.

OUTCOMES - After the completion of this course, students will be:
1. The students able to construct transistor, FET.
2. The students will able to understand the concepts of optoelectronic devices.
3. They can understand the device structure and characteristics of photovoltaic cell, LED, LCD and photodiode.
4. In depth understanding of filters, detectors and amplifiers.

UNIT – I: General Introduction to sensors/transducers
Definition of a transducer/sensor.Role of a transducer in a generalized measurement system.Classification of transducers.Classification of transducers.Significant parameters of transducer. Temperature scales. Mechanical temperature sensors.Platinum resistance thermometer.Thermistors.Thermocouples.

UNIT –II: Displacement and strain transducers
Displacement transducers - Variable resistance, inductance and capacitance. Linear voltage differential Transformer (LVDT) Strain - Definition, Principal of working of strain gauges. Gauge factor. Types of strain gauges.Materials for strain gauges.Temperature compensation. Application

UNIT –III: Opto - electronic transducers
Photoemission tube.Photomultiplier cell.Photoconductive cell.Photovoltaic cell (solar cell). Photodiode, Photo – transistor, Photo FET, Light emitting diode. Liquid crystal display.Optoelectronic couplers.Laser diode.

UNIT –IV: Single conditioners (Filters & Detectors)
Filters – Integrators, Differentiators and active filters. Detectors: Peak Detectors sample and hold circuits. Phase sensitive detector and precision rectifiers and applications

UNIT –V: Single conditioners (Amplifiers)
Amplifiers – chopper stabilized DC amplifiers. Instrumentation amplifiers. Logarithmic and anti-logarithmic amplifiers Isolation amplifiers, Lock in amplifiers and applications

Books for Study
1. Instrumentation Measurement Analysis, Nakra and Chaudary, 4th Edition, Tata McGraw-Hill, 1985.
2. Instrumentation - Devices and Systems, Rangan, Mani and Sharma, 2nd Edition, Tata McGraw Hill, 1983.
3. A course in Electrical and Electronic Measurements and Instrumentation, AK Sawhney, 4th Edition, DhanpatRai& Company, 2016.
4. Instrumental Methods of Analysis, Willard, Meritt, Dean and Seattle, 7th Edition, Van Nostrand,1981.
5. Hand Book of Biomedical Instrumentation, RS Khandpur, 3rd Edition, Tata McGraw-Hill, 1987.
6. Fundamentals of Electronic Devices, David A. Bell, 5th Edition, Oxford University Press, 2008.
7. An introduction to Operational amplifiers, SV Subramanyam, 2nd Edition, Macmillan India,1980.

OPEN ELECTIVE
PHY21204 (C):NANOMATERIALS AND DEVICES

OBJECTIVES- This course enables the students belong to other subjects:
1. To know the fundamentals of nanomaterials – One, two dimensional.
2. To learn about the quantum confinement, properties of nanomateials.
3. To obtain knowledge on the preparation of nanomaterials.
4. To know the concepts of properties and characterization of nano devices.

OUTCOMES- After the completion of this course, students of the non-physics stream will be:
1. Able to get knowledge on nanomaterials.
2. Exposed to the knowledge on various types of nanomaterials preparations.
3. The students will able to get the knowledge on nano devices and its working.

UNIT-1: 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 C_{60} –Structure of C_{60} and its properties –Synthesis of buckyballs and Applications.

UNIT- IV: CARBON NANOTUBES
Carbon Nanotubes: Fabrication –Structure - Electrical Properties – Mechanical properties – Applications of carbon Nanotubes, Graphene: Fabrication – Structure – Electrical Properties – Mechanical properties – Applications.

UNIT –V: 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.

Books for Study
1. Nanomaterials: Synthesis, Properties and Applications – Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, 2002.
2. Introudction to Nanotechnology – Charles P. Poole Jr and Frant J. Owens, Wiley Interscience, 2003.
3. Nanopracticles from Theroy to Applications edited by Gunter Schmid, Wiley VCH, 2004.
4. Nanoelectronics and Nanosystems by K. Glosekotter and J. Dienstuthi (Springer), 2004.

RAYALASEEMA UNIVERSITY::KURNOOL
Pasupula-518 007, A.P., INDIA
(A State University, Accredited with "B" Grade by NAAC)
M.Sc. Physics Syllabus
(Course structure and curriculum for the academic year 2021-2022)

Semester	Components of Study	Course Code	Title of the Course	No. of credits	(Theory) No. of hours per week	Practical/ Project (HRS)	Internal Assessment	Semester End Exams	Total
SEMESTER-III	Mandatory Core	PHY21301	**Introductory Quantum Mechanics**	04	04		20	80	100
		PHY21302	**Analytical Techniques**	04	04		20	80	100
	Generic Elective	PHY21303	**(A) Electronics-I (8051 Microcontrollers)**	04	04	--	20	80	100
			(B) Physics of Advanced Materials						
			(C) Applied Spectroscopy						
	Open Elective	PHY21304	(A) **Numerical Techniques & Computer Programming**	04	04		20	80	100
			(B) Renewable Energy Sources						
			(C) SWAYAM / MOOCs / NPTEL						
	Skill Oriented Course	PHY21305	**General Lab**	04	--	08	--	100	100
	Practical-I	PHY21306	**Electronics Lab**	04	--	08	--	100	100
			Sub-total	**24**	**16**	**16**	**80**	**520**	**600**

MANDATORY CORE
PHY21301: INTRODUCTORY QUANTUM MECHANICS

OBJECTIVES:
- To bring out limitations and failures of classical mechanics and to discuss need of quantum mechanics. To discuss basic postulates of quantum mechanics
- To introduce quantum mechanical tunnelling and its application to alpha particle decay
- To introduce row and column vectors, Dirac's bracket notations and to introduce the concept of Ladder operators.
- To introduce different commutation relation among angular momentum operators and to discuss Clebsch-Gordon coefficients.

OUTCOMES:
- Explain the differences between Schrödinger's time dependent and time independent equations.
- Identify different operator's formalism, Eigen values and Eigen functions.
- Applying Heisenberg formulation to find the position and momentum equations of linear harmonic oscillator.
- Importance of Eigen functions and Eigen values of AM operators.

UNIT- I: PRINCIPLES OF QUANTUM MECHANICS

Introduction: Limitations of classical Mechanics, Difficulties with classical theories of black body radiation and origin of quantum theory of radiation. Schrödinger wave equation: development of the Schrödinger time independent and time dependent wave equation, solution of the time dependent Schrödinger equation, concept of stationary states. Physical significance of wave function (ψ), orthogonal, normalized and orthonormal functions

Operator formalism: operators, operator algebra, eigen values and eigen vectors and postulates of quantum mechanics.

UNIT- II: ONE DIMENSIONAL PROBLEMS AND SOLUTIONS

Potential step – Reflection and Transmission at the interface. Potential well: Square well potential with rigid walls, Square well potential with finite walls. Potential barrier: Penetration of a potential barrier (tunnelling effect). Radioactive Emission of Alpha particle. Periodic potential and Harmonic oscillator. Energy eigen functions and eigen values. Polynomial (Schrödinger)solutions.

UNIT- III: MATRIX FORMULATION

Matrix representation of wave functions and linear operators. The concept of row and column matrices. Matrix algebra. Hermitian operators - definition. Dirac's bra and ket notation. Expectation values. Heisenberg (operator) representation of harmonic oscillator. Ladder operators and their significance**.**

UNIT- IV: ANGULAR MOMENTUM

Angular momentum operators: Definition. Eigen functions and eigen values of AM operators. Matrix representation of angular momentum operators. System with spin half(1/2). Spin angular momentum, Pauli's spin matrices. Clebsch-Gordon coefficients. Rigid Rotator: Eigen functions and Eigen values**.**

BOOKS FOR STUDY:
1. Quantum Mechanics. Vol 1, Albert Messiah, North-Holland Pub. Co. , Amsterdam.
2. A Text Book of Quantum Mechanics. P. M. Mathews and K. Venkatesam, Tata McGraw Hill, New Delhi.

REFERENCE BOOKS:
1. Introduction to Quantum Mechanics. R. H. Dicke and J. P. Witke, Addison-Wisley Pub. Co. Inc., London.
2. Quantum Mechanics. S. L. Gupta, V. Kumar, H. V. Sarama and R. C. Sharma, Jai PrakashNath& Co, Meerut.
3. Quantum Mechanics. L. I. Schiff, McGraw Hill Book Co. , Tokyo.
4. Quantum Mechanics. V. K. Thankappan.
5. Quantum Mechanics. B. K. Agarwal and HariPrakash.

MANDATORY CORE
PHY21302: ANALYTICAL TECHNIQUES

OBJECTIVES:
- To discuss advanced spectroscopic and microscopic techniques
- Comparison of NMR Instrumentation
- To understand the concepts of ESR
- To understand the MössbauerSpectroscopyand NQR techniques

OUTCOMES:
- Understanding the different characterization techniques
- To explain the theory and applications of NMR
- To interpret and apply ESR spectra
- To explain the Nature of chemical bonds and structural information

UNIT – I : MICROSCOPY, DIFFRACTION AND COMPOSITION :
Crystal structures by transmission Electron Diffraction, Scanning Electron Microscopy, and Atomic force microscopy. Composition analysis by X ray probe microanalysis (EDAX),X-PhotoelectronSpectroscopy (XPS) and Secondary ion mass spectroscopy (SIMS) Theory, Instrumentation and applications.
Neutron Diffraction : Theory of Neutron diffraction : Scattering of Neutrons by Solids and liquids, Magneticscattering, Neutron spectrometer, application:Neutron diffraction of MnO.

UNIT- II: NUCLEAR MAGNETIC RESONANCE:
Magneticproperties of nuclei, theory of NMR spectroscopy, instrumentation, chemical shift and its origin, spin-lattice and spin-spin relaxation, shielding. coupling constant, NMR signals in compounds, NMR imaging, Application:CH_3CHO and C_2H_5OH.

UNIT – III: ELECTRON SPIN RESONANCE:
Theory of ESR spectroscopy, Comparison of NMR and ESR, Instrumentation, Interpretation of ESR spectra and DPPH, Hyperfine splitting, Determination of g-factor, ESR spectra of Methyl radical (CH_3) and p-nitrobenzoate anion, Application to ESR spectra of Mn^{2+} and Cu^{2+} ions, Limitations of ESR, Double resonance in ESR: Electron Nuclear Double Resonance (ENDOR) and Electron Double Resonance (ELDOR).

UNIT – IV: MÖSSBAUER AND NQR SPECTROSCOPY
Recoil-less emission and absorption of γ- rays, Resonance fluorescence, Mössbauer effect, Instrumentation, Mössbauer nuclides, Applications of Mössbauer spectroscopy.   NQR Spectroscopy:Theory of NQR, Instrumentation, Applications (brief details only): Nature of chemical bonds – Structural information about group III halides – Charge transfer compounds.

BOOKS FOR STUDY:
1. Fundamentals of Molecular Spectroscopy, C. N. Banwell, Tata McGraw Hill, New Delhi.
2. Spectroscopy, B. P. Straughan and S. Walker, Vols. 1-3, Chapmann ad Hall, New York.

REFEENCE BOOKS
1. Molecular Structure and Spectroscopy, G. Aruldhas, Prentice-Hall of India, New Delhi.
2. Spectroscopy, Chatwal and Anand, Himalya Publishing House, New Delhi.
3. Spectroscopy,H. Kaus,Pragathi Prakasham,Meerut.
4. Spectroscopy, B. K. Sharma, Goel Publishing House, Meerut.
5. Modern Optical methods of Analysis, E. D. Olson, McGraw-Hill, New York.

GENERIC ELECTIVE
PHY21303(A): ELECTRONICS-I (8051 MICROCONTROLLERS)

OBJECTIVES:
- This subject deals about the basic 16-bit (8086) processor and an 8-bit (8051) controllers,
- Architecture , internal organization and their functions of 8-bit (8051) controllers,
- Basic idea of Assembly language programming Tools
- Interfacing an external device with the processors/ controllers.

OUTCOMES:
- Distinguish and analyze the properties of Microprocessors & Microcontrollers.
- Identify a detailed s/w & h/w structure of the Microprocessor and apply a basic concept of digital fundamentals to Microprocessor based personal computer system.
- Analyze the data transfer information through serial & parallel ports.
- Train their practical knowledge through laboratory experiments.

UNIT I: INTRODUCTION TO MICROCONTROLLERS
Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Embedded versus External Memory Devices, 8 – bit and 16 – bit Microcontrollers, CISC and RISC Processors, Harvard and VonNeumann Architectures, Commercial Microcontroller Devices – Intel, Atmel and PIC families.

UNIT II: ARCHITECTURE ANDINSTRUCTION SET OF 8051 MICROCONTROLLER
Introduction, 8051 architecture, Registers in 8051, Pin description and connections, Parallel I/O ports, Memory Organization. Interrupts, Timer/Counters and Serial Communication (Basic Concepts). Addressing Modes: Immediate addressing, Register addressing, Direct addressing, Register indirect addressing and Indexed addressing modes. Instruction Set: Arithmetic and Logic Instructions, Jump, Loop and Call instructions, Simple programs.

UNIT III: 8051 PROGRAMMINGAND C LANGUAGES
Assembly language programming Tools: Assembler, Data types and directives, Programming Template, Development Systems and Tools, Software simulators.
Programming in C: Data types, Time delay, Logic operations, I/O Programming, Data conversion programs, Accessing code ROM and RAM spaces, Data Serialization.

UNIT IV: INTERFACING TECHNIQUESAND APPLICATIONS USING ASSEMBLYAND C LANGUAGES
Timer/ Counter Programming – Programming 8051 timers, Counter programming. Serial communications – Basics of Serial communications, 8051 connection to RS232, Programming. Interrupt Programming – 8051 Interrupts, Programming timer interrupts, external hardware interrupts. **Interfacing Applications:** ADC, DAC, Stepper motor and DC motor control with opto isolator**.**

BOOKS FOR STUDY
1. The 8051 Microcontroller Architecture, Programming and Applications, K.J.Ayala, West publishing company, Newyork.
2. Microcontrollers - Theory and Applications, Ajay V Deshmukh, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

REFERENCE BOOKS:
1. The Intel Microprocessors: Architecture, Programming and Interfacing, Barry B.Bray, Pearson Publications.
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, Pearson Education, New Delhi.
3. The 8051 Microcontroller & Embedded Systems using Assembly and C, Kenneth J Ayala, Dhananjay V GadreCengageLearing ,India pvt. Ltd,Delhi.
4. Microcomputer systems: The 8086/8088 Family Architecture Programming and Design by Yu Cheng Lin and Glenn A. Gibson, PHI.
5. Designing with PIC Microcontrollers by John B. Peatman, Pearson Education,Inc.

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GENERIC ELECTIVE
PHY21303 (B):PHYSICS OF ADVANCED MATERIALS

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OBJECTIVES - This course enables the students
1. To become familiar with crystal growth techniques and identify imperfection in crystals.
2. To become familiar with the electrical behaviour of dielectric materials and understand the field charge induced by dielectrics.
3. To learn the properties and applications of ferroelectrics
4. To become familiar with the theory behind the ferromagnetic and anti-ferromagnetic materials.
5. To understand the photoconductivity and luminescence properties of solids.

OUTCOMES - After the completion of this course, students will be
1. Able to learn various crystal growth techniques and understand the imperfection if any in the crystals.
2. Able to acquire knowledge about the properties of dielectrics and ferroelectrics.
3. Able to describe the ferromagnetic and anti-ferromagnetic materials and their applications.
4. Able to measure photoconductivity of the given material by using appropriate equipment.
5. Able to acquire knowledge on thermoluminescence, electroluminescence, photoluminescence, cathodoluminescence and chemiluminescence properties of solids.

UNIT - I: CRYSTAL GROWTH

Crystal growth: Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystal growth techniques – Melt growth: Bridgman,Czochralski techniques.

UNIT - II: IMPERFECTIONSIN CRYSTALS
Classification of imperfections – Point defects – Schottky and Frenkel defects -Expressions for equilibrium defect concentrations – Colourcentres –Production of colourcentres – Line defects – Dislocations – Edge and Screw dislocations – Burger vector – Estimation of dislocation densities – Ordered phases of matter- Translational and orientational order

UNIT- III: 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- IV: 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 - V: 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 – Crystalline in polymers Applications.

Books for Study

1. Solid State Physics, C. Kittel, Edition: 8th 2012, John Wiley & Sons.
2. Solid State Physics, A.J. Dekkar, Edition: 1st, 2000. Macmillan India Ltd.
3. Solid State Physics, M.A. Wahab, Edition:3rd, 2020, Narosa Publishing House.
4. Fundamentals of Solid State Physics, Saxena, Gupta, Saxena, Edition: 31st, 2019, Pragathi
5. Solid State Physics, R.L. Singhal,2018, KedarNath, Ram Nath& Co. Publications, Meerut.
6. Science of Engineering Materials and carbon nano tubes, C.M. Srivastsava and C. Srinivasan, Edition:3rd, 2010 New Age Inter. Pub.
7. Crystal Growth, B.R. Pamplin, 1977, Pergmon Press.
8. Crystal Growth from High Temperature Solutions, D. Elwell and H.J. Scheel,1975, Academic Press.

GENERIC ELECTIVE
PHY21303(C):APPLIED SPECTROSCOPY

OBJECTIVES -This course enables the students
1. To become familiar with Beer's law and working of Spectrophotometer.
2. To learn about the IR spectrophotometry and Fourier Transform Infrared Spectrometer used for the study of molecular structure.
3. Tofamiliar with the principles of Fluorescence and Phosphorescence spectroscopy and their applications.
4. To learn the theory of Raman scattering and application of Raman Spectroscopy.
5. To learn the technique of structure determination using IR and Raman spectroscopy.
6. To learn non-linear Raman phenomenon and photo-acoustic Raman scattering and multi photon spectroscopy.

OUTCOMES - After the completion of this course, students will be
1. Able to learn absortion principle and spectrophotometers working in different spectral regions.
2. Able to undertake molecular structure elucidation.
3. Able to use effectively the Fluorescence and Phosphorescence spectroscopic techniques for various analytical purposes.
4. Able to determine the structure of molecules using IR and Raman spectroscopy.
5. Able to acquire knowledge about the non-linear Raman phenomenon and photo-acoustic Raman scattering and multi photon spectroscopy.

UNIT I – 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.

UNIT II - IR SPECTROPHOTOMETRY AND FLUORESCENCE
IR spectrophotometry - Fourier Transform Infrared (FTIR) Spectrometer – Molecular structure.Instrumentation and applications.
Fluorescence**:**Introduction – Flourescence- Resonance Flouorescence- Normal Fluorescence-Intensities of Transitions – Non-radioactive decay of fluorescent molecules.

UNIT III: PHOSPHORESCENCE SPECTROSCOPY
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.

UNIT IV - RAMAN SPECTROSCOPY
Introduction- Theory of Raman Scattering – Rotational Raman Spectra- Vibrational Raman Spectra – Mutual Exclusion principle – 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 IR and Raman Spectroscopy.Difference between Raman spectra and Infrared spectra.

UNIT V - NON-LINEAR SPECTROSCOPIC PHENOMENA
Non-linear Raman phenomenon - Hyper Raman spectroscopy – Stimulated Raman spectroscopy – Inverse Raman effect – Coherent Anti-stokes Raman scattering – Photo-acoustic Raman scattering – Multi Photon Spectroscopy.

Prescribed Books:
1. Molecular spectra and Molecular structure Volume I, **G. Herzberg** (2nd Edition, Van. Nostrand London)
2. Fundamentals of Molecular Spectroscopy,**C.N. Banwell**(Tata Mcgraw- Hill Publishing Company Ltd, 1983)
3. Spectroscopy,**Straughan and Walker** (volume 2 and volume3, John wiley and Sons, 1976)
4. Molecular Structure and Spectroscopy,**G. Aruldhas**(Printice- Hall of India, Pvt. Ltd. 2001)
5. Instrumental Methods of Analysis,**Willard, Merritt, Dean and Settle** (CBS Publishers and Distributor, New Delhi, 200)

OPEN ELECTIVE
PHY21304(A): NUMERICAL TECHNIQUES & COMPUTER PROGRAMMING

OBJECTIVES:
- To obtain the solution of algebraic and transcendental equations
- To understand the numerical differentiation & integration
- To understand the basic ideas of 'C' Language
- To discuss the simple programs using 'C' Language

OUTCOMES:
- To solve physics problems through different numerical techniques
- Explain the Numerical solutions of differential equations
- Identify different Operators and expressions in 'C' Language
- To explain user defined functions and tools in C-programs

UNIT- I: NUMERICAL TECHNIQUES
Solution of algebraic and transcendental equations: Bisection method, Method of false position and Newton-Raphson method. Principle of least squares – fitting of polynomials. Interpolation: Finite differences(forward, backward and central difference), Newton's formula for Interpolation, Central difference Interpolation formula (Gauss's &Sterling formula), Lagrange's Interpolation formula, Inverse Interpolation.

UNIT-II: NUMERICAL DIFFERENTIATION & INTEGRATION
Differentiation: Cubic Spline Method, Maximum and Minimum values of a Tabulated function
Numerical Integration: Trapezoidal Rule, Simpson's 1/3 Rule and 3/8 Rule. Solutions of linear systems- Direct methods: Matrix Inversion method, Gaussian Elimination method, Modification of Gaussian Elimination method (Gauss-Jordan Method). Iterative methods: Jacobi method, Gauss Seidel method. Numerical solutions of ordinary differential equations: Solution by Taylor's series, Picard's method of successive approximations, Euler's method (Error estimates for the Euler's method, Modified Euler's method) and Runge-Kutta method.

UNIT- III: INTRODUCTION TO 'C' LANGUAGE
Character Set, C tokens, Key words and Identifiers, Constants and Variables, Data types, Declaration of variables. Operators and expressions: Arithmetic, Relational, Logical, Assignment, Increment and Decrement operators, Conditional, Bitwise and special operators. Precedence in evaluating arithmetic operators. Reading and Writing a character. IF, IF-ELSE, Nesting IF-ELSE, ELSE IF ladder and GOTO statements, WHILE, DO, FOR loop statements. Simple programs

UNIT- IV: PROGRAMMING IN C -LANGUAGE
Arrays: One and Two dimensional arrays, Declaring and initializing string variables. Reading strings from terminal and writing strings to screen. **User defined functions**: definition of functions, Return values and their types. Function calls and function declaration. Pointers: Declaring and initializing pointers, Accessing a variable through its pointer. C-Programming: Linear regression, Sorting of numbers, Calculation of standard deviation and matrix multiplication

BOOKS FOR STUDY:
1. Mathematical Physics. H. K. Dass, S. Chand& Co.
2. Programming in ANSI C, E Balaguruswamy, TMH New Delhi.

REFERENCE BOOKS:
1. Numerical Methods. S. Sastry
2. Numerical Methods. B. S. Gopal&S. N. Mittal
3. Let us C, YashavantKanetker, BPB Publications, New Delhi.
4. Computer oriented numerical methods, Rajaraman
5. Computer-Oriented Numerical Methods, P. Thangaraj, PHI Learning Pvt. Ltd.

OPEN ELECTIVE
PHY21304 (B): RENEWABLE ENERGY SOURCES

OBJECTIVES:
1. Understand the various forms of conventional energy resources.
2. Learn the present energy scenario and the need for energy conservation
3. Explain the concept of various forms of renewable energy like Wind, Solar energy.
4. Analyse the environmental aspects of renewable energy resources and industrial application

OUTCOMES:
1. Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
2. Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
3. Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
4. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations and acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

UNIT-I: BIO DIVERSITY CONCEPTION INDIVIDUALS
Introduction to Renewable energy, biogas cogeneration, wood as source of energy, energy crops, Bio-diesel, fuel from plantation, ethanol, synthesis fuels.
Renewable energy (78-96),chapter-5

UNIT-II: SOLAR ENERGY
Solar Thermal: solar collectors, hot water from sun, cooling with the sun. Solar drying, air collectors, Solar thermal power plants.
Solar Electric: Photo voltaic effect, the heart of a PV array, The solar cell, Grid connected, PV arrays, Off grid PV arrays, Solar energy as part of sustainable development, The outlook for PV lower cost from New technologies and production.
Renewable energy (40-60), chapter-2

UNIT-III: WIND ENERGY
Power in the wind: Aerodynamics principles of wind turbines, Power available in the wind, Rotor efficiency, Factors effecting wind power, Impact of tower height, Wind turbine sitting, Idealized wind turbine, Power curve, Cpeed control for maximum power.Wind Turbine design considerations: Basic design, choice between two and three blade rotors, weight and size considerations.

UNIT-IV: WIND CHARACTERISTICS OF SITE
Wind Characteristics of site: Annual average wind speed, annual diurnal wind speed, monthly, diurnal wind speed, monthly variations in wind speed, frequency distribution of wind speed.
Renewable energy (98-112), chapter-6

UNIT-V: OCEAN AND SMALL HYDRO- ENERGY
Water power, Ocean wave and tidal energies, Hydro power nature conservation, underground heat, Micro Hydro plants
Renewable energy (114-128), chapter-7

BOOKS FOR STUDY
1. Hand book of Renewable energy technology. Editors A F Zobba and R Bansal World scientific publications
2. Renewable energy: The facts, Dieter Scirfried and Walter Witzel Earth Scan Publications for Sustainable Future. London

RAYALASEEMA UNIVERSITY::KURNOOL

Pasupula-518 007, A.P., INDIA
(A State University, Accredited with "B" Grade by NAAC)
M.Sc. Physics Syllabus
(Course structure and curriculum for the academic year 2021-2022)

Semester	Components of Study	Course Code	Title of the Course	No. of credits	(Theory) No. of hours per week	Practical/ Project (HRS)	Internal Assessment	Semester End Exams	Total
SEMESTER-IV	Mandatory Core	PHY21401	**Advanced Quantum Mechanics**	04	04		20	80	100
		PHY21402	**Atomic and Molecular Physics**	04	04		20	80	100
	Generic Elective	PHY21403	**(A) Electronics-II (Communication Electronics and Digital Signal Processing)**	04	04	--	20	80	100
			(B) Properties & Characterization of Materials						
			(C) Communication Systems						
	Elective Foundation	PHY21404	**(A) Nuclear And Particle Physics**	04	04		20	80	100
			(B) Vacuum and Thin Film Physics						
			(C) Frontiers Of Physics						
	Multi-Disciplinary Course / Project/Lab	PHY21405	**General Lab**	04	--	08	--	100	100
		PHY21406	**Electronics Lab**	04	--	08	--	100	100
			Sub-total	**24**	**16**	**16**	**80**	**520**	**600**

MANDATORY CORE
PHY21401: ADVANCED QUANTUM MECHANICS

OBJECTIVES:
- To apply and distinguish ability of particles to Pauli's exclusion principle
- To discuss approximation methods like perturbation method, variational method and WKB approximation methods.
- To introduce quantum mechanical theory of scattering and scattering cross-section.
- To apply relativistic mechanics to the Klein-Gordan equation.

OUTCOMES:
- To explain Hydrogen molecule and to differentiate ortho and para hydrogen.
- The approximation methods were applied to find the energy values of perturbed harmonic oscillator, to find the ground state energy of helium atom and to the problem of alpha particle decay.
- To explain the scattering method and find scattering cross- section by square-well potential.
- The limitations of Klein-Gordan equation and its rectification by Dirac, and solution of Dirac equation.

UNIT-I : IDENTICAL PARTICLES AND MOLECULES
Identical Particles: Symmetric and anti-symmetric wave functions, Indistinguishability of identical particles, Pauli's exclusion principle. Hydrogen molecule ion, Hydrogen molecule: Hitler London treatment. Oscillations and Rotations of H_2. Concept of Ortho and Para Hydrogen.

UNIT-I I: APPROXIMATION METHODS
Time-independent perturbation method. Effect of anharmonicity on the solution of harmonic oscillator problem. Time-dependent perturbation theory, transition probabilities. Variation technique: application to solve the ground state energy of He atom. WKB approximation method: α-particle decay. Sudden and Adiabatic perturbations.

UNIT-III: THEORYOF SCATTERING
The scattering experiment. The method of partial waves. Scattering by a central potential. Zero energy scattering. Scattering by square-well potential, effective range. Resonance scattering. Born Approximation, Validity of Born Approximation.

UNIT-IV: RELATIVISTIC QUANTUM MECHANICS
Klein-Gordan equation, Probability and current density, Inadequacies of Klein-Gordan equation. Dirac matrices, Dirac relativistic equation for free particles and solution. Concept of negative energy states. Theory of holes**.**

BOOKS FOR STUDY
1. Quantum Mecanics, G. Aruldhas, Prentice Hall of India Pvt. Ltd, New Delhi.
2. Introduction to Quantam Mechanics with applications to chemistry. Linus Pauling and E. BrightWilson,Jr. McGraw Hill,BookCompany, New York and London.

REFERENCE BOOKS
1. Quantum Mechanics. B. K. Agarwal and Hariprakash, Prentice-Hall of India Ltd. , New Delhi.
2. Quantum Mechanics. L. I. Schiff, McGraw Hill Book Co. ,Tokyo.
3. A Text Book of Quantum Mechanics. P. M. Mathews and K. Venkateswaran, Tata McGraw Hill, New Delhi.
4. Introduction to Quantum Mechanics, R. H. Dicke and J. P. Witke, Addison-Wisley Pub. Co. Inc.,London.
5. Quantum Mechanics, V. K. Tankappan, Wiley-Eastern Ltd. ,New Delhi.

MANDATORY CORE
PHY21402: ATMOIC AND MOLECULAR PHYSICS

OBJECTIVES:
- To understand the principles of Atomic Absorption Spectroscopy (AAS),
- To understand the types of molecular spectra and Instrumentation.
- Understand the basic idea of UV & Visible Spectrophotometry
- To understand the Infrared and Raman Spectroscopy

OUTCOMES:
- Distinguish between the Absorption and Emission Spectroscopy
- Able to explain different types of molecular spectra.
- Explain the applications of Visible spectroscopy
- Explain the advantages of Raman spectroscopy over IR.

UNIT- I: ATOMIC ABSORPTION AND EMISSION SPECTROSCOPY
Principle of Atomic Absorption Spectroscopy (AAS), Instrumentation, Atomic absorption spectrometers, Differences between atomic absorption and flame emission spectroscopy, Determination of lead in petrol.
Emission Spectroscopy: Line spectra of atoms and ions – Excitation and Ionization potentials – Emission spectrographs –Constant deviation spectrometer – Qualitative analysis – Quantitative methods (Internal standard).

UNIT- II: MOLECULAR SPECTRA
Born-Oppenheimer approximation, Types of molecular spectra, Diatomic molecule as a rigid rotator and its spectra (Microwave), Vibrations of a molecule and its spectra (IR), Vibration-rotational spectra, Electronic Spectra: vibrational coarse structure –rotational fine structure, Effect of isotopic substitution on rotation and vibration spectra of CO, Franck-Condon principle, Dissociation energies and Pre-dissociation.

UNIT- III: UV & VISIBLE SPECTROPHOTOMETRY
Beer-Lambert's law, Deviations from Beer's law, Instrumentation: radiation sources – Monochromators – Detectors – Non recording single and double spectrophotometers – Recording double spectrophotometers, Differences between single and double beam spectrophotometers – Applications of Visible spectroscopy: Structures of simple organic and inorganic compounds – Evaluation of molar absorptivity (ϵ) and molecular weight of isoprene**.**

UNIT- IV: INFRARED AND RAMAN SPECTROSCOPY
Theory of IR, IR double beam spectrometer, Vibrations of polyatomic molecules, Analysis of IR spectra of thymidine and hydro carbons.
Raman Spectroscopy: Classical and quantum theories of Raman Effect, Laser Raman spectrometer, Raman spectra of CO_2, N_2O, SO_2. Differences between IR and Raman, Advantages of Raman spectroscopy over IR.

BOOKS FOR STUDY
1. Fundamentals of Molecular Spectroscopy, C. N. Banwell, Tata McGraw Hill, New Delhi.
2. Molecular Structure and Spectroscopy, G. Aruldhas, Prentice-Hall of India, New Delhi.

REFERENCE BOOKS
1. Spectroscopy,Chatwal and Anand, Himalya Publishing House,New Delhi.
2. Spectroscopy, B. K. Sharma, Goel Publishing House, Meerut.
3. Spectroscopy, H. Kaur, PragatiPrakashan, Meerut.
4. Spectroscopy, B. P. Straughan&S. Walker,Vols. 1-3,Chapmann ad Hall, NY.
5. Molecular Spectroscopy, J. D. Graybeal, Tata McGraw Hill, New York.

GENERIC ELECTIVE
PHY21403(A): ELECTRONICS-II
(COMMUNICATION ELECTRONICS ANDDIGITAL SIGNAL PROCESSING)

OBJECTIVES:
- To describe model communication system of AM & FM.
- To understand the power spectra of digital modulated signals.
- To discuss word length issues, multi rate signal processing and application
- Describe various Digital filter specifications

OUTCOMES:
- Understanding Amplitude and Angle Modulations for communications systems.
- UnderstandingPulse Modulation with different methods
- Compare the architectures of DSP and General Purpose Processors.
- Design FIR and IIR type digital filters.

UNIT-I: ANALOG COMMUNICATIONS
Amplitude Modulation: Principles of AM, AM modulator circuits, AM transmitter, Trapezoidal Patterns, Super Heterodyne receiver, AM detector-Peak detector, Single Side Band (SSB) communication systems - SSB systems, Comparison of SSB to conventional AM, SSB generation-Balanced Ring Modulator, Amplitude Compandoring SSB.
Angle Modulation: Principles of frequency modulation, FM Modulator- Varactor diode modulator, FM transmitter, FM receiver, FM Demodulator-Balanced slope detector.

UNIT-II: DIGITAL COMMUNICATIONS
Shannon limit for Information capacity, Digital Amplitude Modulation, Frequency Shift Keying(FSK), Phase Shift Keying (PSK), M-ary encoding, Quadrature Amplitude Modulation(QAM), Bandwidth Efficiency, Carrier recovery, Differential Phase Shift Keying (DPSK). Pulse Modulation: Different methods, Pulse Code Modulation (PCM): PCM transmission system, Sampling circuit, Sample rate, Folded Binary Code, Dynamic range,Delta Modulation PCM, Adaptive Delta Modulation PCM.

UNIT-III: INTRODUCTION TO DIGITAL SIGNAL PROCESSING (DSP)
Simple examples of DSP, The common DSP equation and explanation, Periodic sampling of cosine signal, Periodicity of DSP system, frequency response, Aliasing and Nyquist criterion, Antialiasing, Nyquist criterion in terms of frequency of a sampled signal. Digital filter specification – Low pass, High pass, Band pass and Band stop, Graphical Specifications.

UNIT-IV: INTRODUCTION TO DIGITAL FILTER DESIGN
Frequency response of Digital Filters and DSP Systems – The Euler equation, Frequency scaling, Computing the frequency response. IIR Filter design: Basic analog filter approximations, impulse invariant IIR filter, Step invariant IIR filter, the Bilinear Transformation (BLT) filter. Digital filter stability - Z-Plane unit circle, Properties using Z-Plane. FIR Filter design: Introduction, General FIR filter coefficients equation and its solution, the causal and non-causal filter coefficients. Windows for FIR Filters: Gibbs effect, Hamming window, Von Hann window, Bartlett window.

BOOKS FOR STUDY
1. Electronic Communication Systems, Fundamentals through advanced, Wayne Tomasi, Pearson Education.
2. Digital Signal Processing, Steve White, Vikas publishing house.

REFERENCE BOOKS
1. Spectroscopy, Chatwal and Anand, Himalya Publishing House,New Delhi.
2. Digital Signal Processing 6/e, P.Ramesh Babu, SCITECH Publications India PVT Ltd.
3. Understanding Digital Signal Processing, 3rd Ed, Richard G Lyons, PHI.
4. Digital Signal Processing, Principle, Algorithms and applications, Dimitris and John, Pearson Publication.
5. Electronic Communaication Systems 6th Ed, Bernard Davis & SRM Prasanna, Mc-Graw Hill, George Kennedy

GENERIC ELECTIVE
PHY21403 (B):PROPERTIES AND CHARACTERIZATION OF MATERIALS

OBJECTIVES:
1. This course presents the properties and characterization of materials, emphasizing onsurface, interface and microanalysis, using the underlying analytical techniques as a unifying framework, carrying through to illustrative applications.
2. To provide with the knowledge to: define a characterization strategy appropriate to the problem/situation - select the most appropriate/promising techniques -analyze and interpret the results – utilizing interpretation/simulation tools - develop state of the art expertise – hardware, software, systems integration - understand new techniques as theyemerge.

OUTCOMES:
1. The course provides some knowledge that is state-of-the-art techniques in the study ofproperties and characterization of materials.
2. A further benefit of the course is to provide students a fundamental and practicalunderstanding of the interaction of particle radiation with condensed matter.
3. This knowledge finds applications in optoelectronics, microelectronics and, in general, all aspects of materials processing and characterization.

UNIT-I: STRUCTURAL CHARACTERIZATION:

Properties: Lattice parameter, crystallite size.Characterization: X-ray powder diffraction, Neutron diffraction, instrumentation, specimenpreparation, ASTM catalogue of Materials identification, Phase identification, intensity ofdiffracted peaks, indexing of x-ray diffraction peaks, data analysis and interpretation, Rietveldrefinement technique, Williamson-Hall plots, determination of crystal structure, latticeparameter.

UNIT-II: MICROSTRUCTURAL CHARACTERIZATION:

Properties: Particle size, grain size, transmissivity, absorptivity, photoconductivity,polarization.Characterization: Transmission electron microscopy (TEM), basic principle, brief idea of setup, specimen preparation, image formation, particle size determination. Scanning electronmicroscopy (SEM), Instrumentation basics, specimen preparation, imaging modes, grain sizeestimation.Optical microscopy, instrumentation, specimen preparation, imaging modes,applications, limitations.

UNIT-III: ELECTRICAL CHARACTERIZATION:

Properties: DC and AC conductivity, dielectric properties-dielectric constant, dielectric loss,dielectric strength and breakdown.Characterization: Two-probe, four probe methods for resistivity measurement, P-E loops, HallEffect experiment, dielectric characterization using impedance analyzer.

UNIT-IV: MAGNETIC CHARACTERIZATION:

Properties: Hysteresis loop, initial permeability, saturation magnetization, coercivity, remnantmagnetization, magnetic domains, magnetic anisotropy, Curie temperature.Characterization: Vibration sample magnetometer, SQUID magnetometer, M-H hysteresisloops, AC magnetic susceptibility.

UNIT-V: THERMAL CHARACTERIZATION:

Properties: Heat capacity, thermal expansion, thermal conductivity, and thermoelectricityCharacterization: Differential thermal analysis (DTA), Differential Scanning Calorimeter(DSC), Thermo gravimetric analysis (TGA), principle, instrumentation, experimentalparameters, data analysis and interpretation.

Text & Reference Books:

1. B. D. Cullity and S. R. Stock, "Elements of X-ray Diffraction", Third Edition, Prentice HallInc., New Jersey, 2001.
2. Characterization of Materials, (Volumes 1 & 2) Elton N. Kaufmann, John Wiley and Sons.
3. Materials Characterization, Introduction to Microscopic and Spectroscopic Methods byYangLeng, JohnWiley& Sons (Asia) Pvt Ltd.
4. Materials Characterization - S. Sankaran and ViajayaAgarwal
5. Advanced Characterization Techniques - K.Biswas and Gurao
6. S. Zhang, L. Li and A. Kumar, "Materials Characterization Techniques", CRC Press, BocaRaton, 2008.

GENERIC ELECTIVE
PHY21403 (C):COMMUNICATION SYSTEMS

OBJECTIVES - This course enables the students:
1. To learn details of Computer Communications systems like ISDN, LAN, TDMA, FDMA, ALOHA and CSMA.
2. To know the concept of CDMA.
3. To acquaint with optical Fiber systems and Coherent optical fiber systems used for the communication.
4. To learn wireless communication systems like GSM, cellular, 1G, 2G, 3G etc.
5. To get basic knowledge on Satellite and optical communications.

OUTCOMES - After the completion of this course, students will be:
1. Able to learn technology behind computer communication systems.
2. Able to acquire knowledge on optical Fiber systems and Coherent optical fiber systems used for the communication.
3. Able to understand and work on wireless communication systems like GSM, cellular, 1G, 2G, 3G etc.
4. Able to understand Satellite and optical communications and technology involved.

UNIT I: COMPUTER COMMUNICATIONS SYSTEMS
Types of networks, Design features of computer communication networks – ISDN, LAN Time Division Multiple Access (TDMA), Frequency division multiple Access (FDMA), ALOHA, slotted ALOHA and carrier sense multiple Access (CSMA), Introduction to CDMA.

UNIT II: FIBER OPTICS COMMUNICATION
Optical Fiber System **:** Intensity modulation/direct detection, optical transmitter circuit, Optical receiver circuit, system design considerations, Digital Systems & planning considerations, Analog systems, distribution systems, Advanced multiplexing strategies.

UNIT III: COHERENT OPTICAL FIBER COMMUNICATIONS
Basic Systems of coherent communications, Detection principles, Practical Constraints, Modulation formats, Demodulation schemes, Receiver sensitive, Signal and Multi carrier systems.
Introduction to Optical communications systems: Optical fibers, sources and detectors, analog and digital systems.

UNIT IV: SATELLITE 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.

UNIT V: 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.

Text Book
1. Modern Digital and Analog communication system, B.P. Lathi: Oxford 3rdEdition.
2. Digital Communications Fundamentals and Applications, Bernard Sklar, Sklar Pearson Education.
3. Taub and Schilling, "Principles of Communication Systems", Second edition, Tata McGraw Hill edition, 1991.
4. Simon Haykin, "Communication Systems, Third Edition", John Willey & Sons, Inc.1994.
5. Wayne Tomasi, "Advanced Electronics Communications Systems",IV Edi, P. Hall,Inc,1998
6. John M. Senior, "Optical Fiber Communications", Second Edition, PHI, 1999
7. GerdKesier "Optical Fiber Communications" Second Edition, McGrw- Hill International Editions,1991.
8. Principles of Communication, R.E. Ziemer, WH Tranter 5thEdition, John Wiley (Fifth module).

Reference Books
1. Morden Electronic Communication Systems, Wayne Tomoasi, Person Education/PHI.
2. Digital Communication, John G Proakis, MGH.
3. Digital Communication Techniques Simon, Hindey Lindsey PHI.
4. Communication Systems, Simon Haykin, John Wiley & Sons. Pvt. Ltd.
5. Communication Systems Engineering, Proakis, Pearson Education.
6. Digital and Analog Communication System, Leon W Couch, Pearson Education/PHI.
7. Introduction to Statistical Signal Processing with Applications, M.D. Srinath, P.K.
8. Digital Modulation and Coding. Wilson, Pearson Education.

ELECTIVE FOUNDATION
PHY21404(A): NUCLEAR AND PARTICLE PHYSICS

OBJECTIVES:
- Introduction to nuclear forces and models
- Explain the types of nuclear reactions
- Concept of interaction of gamma radiation with matte
- Basic concept of low and high energy circular accelerators

OUTCOMES:
- Discovery and classification of elementary particles
- General aspects of reactor design and Classification of reactors
- Classification of elementary particles
- Find various particle detectors and accelerators

UNIT-I: GENERAL PROPERTIES OF THE NUCLEUS

Introduction to Nuclear Properties – Radius, Mass, Packing fraction and binding energy. Nuclear angular momentum, parity and symmetry. Magnetic dipole moment and electric quadrupole moment. Nuclear Two-Body Problem: The Deuteron- Introduction, Simple theory of Deuteron. Spin dependence of Nuclear forces, Tensor Forces. Meson theory of Nuclear forces.

UNIT-II: NUCLEAR MODELS AND NUCLEAR REACTIONS

Introduction, the nuclear Shell or independent particle model, The Liquid Drop Model and semi-empirical binding energy formula, the collective nuclear model for the nuclear reactions. Reaction Dynamics: Q-equation, The compound nucleus, Cross sections for nuclear reactions, Compound nucleus formation and break-up, Stripping and photo-nuclear reactions.

UNIT-III: ELEMENTARY PARTICLES

Stable particles against decay through nuclear forces – parameters: Mass, particles and anti-particles, strangeness, decay times. Conservation Laws: Conservation of Baryons, Conservation of strangeness, Conservation of parity and isotopic spin, Stable particles: Mass-less Bosons, Leptons, Mesons, Baryons. Resonance and short-lived Particles: Detection method for very short-lived particles, Discovery of unstable particles, significance of short-lived particles.

UNIT-IV: PARTICLE DETECTORS AND ACCELARATORS

Particle detectors: Gas filled detectors, Solidstate detectors, Scintillation counter Nuclear Emulsions. High-energy particle detectors, Cerenkov detectors. Bubble chamber and Cloud chamber.

Particle accelerators: Ion sources, Direct current accelerators, The Cyclotron. The linear accelerators, Betatron. The electron synchrotron. The proton synchrotron.

BOOKS FOR STUDY
1. Introduction to Nuclear Physics. Herald Enge, Addison-Wesley, New York.
2. Nuclear Physics. Irving Kaplan, Oxford& IBH Co. New Delhi.

REFERENCE BOOKS
1. Nuclear Physics, DC Tayal, Himalaya Publishing House, Mumbai
2. The Fundamental Particles. C. E. Swartz, Addison-Wesley, London.
3. Atomic and Nuclear Physics. V. W. Kulkarni, Himalaya Publishing House.
4. Modern Physics, G. Aruldhas, P. Rajagopal, Prentice-Hall of India, New Delhi.
5. Concepts of Modern Physics, Arthur Beiser, Tata McGraw-Hill, India.

ELECTIVE FOUNDATION
PHY21404 (B):VACUUM AND THIN FILM PHYSICS

OBJECTIVES- This course enables the students to:
1. Definevacuum and compare various vacuum pumps and gauges.
2. Outline the thermodynamics of thin films.
3. Illustrate the mechanism of thin film formation.
4. Explain various techniques of thin film formation.
5. Summarize various properties of thin films.

OUTCOMES-After the completion of this course, students will be able to:
1. Demonstrate various types of pumps and gauges inspect leak in vacuum and can design avacuum system.
2. Define the thermodynamical parameters of thin films and can outline interdiffusion in thin films.
3. Demonstrate the stages of thin film formation and can outline the conditions for the formation of amorphous, crystalline and epitaxial films.
4. Illustrate and compare physical vapour deposition (PVD) and chemical vapour deposition (CVD) techniques.
5. Define various thin film properties and outline the techniques of their determination.

UNIT I – PRODUCTION AND MEASUREMENT OF VACUUM
Fundamentals of kinetic theory of gases – Vacuum fundamentals
Production of Vacuum: Mechanical oil sealed Rotary pumps - Roots pump – Turbo molecular pump - Vapor pumps – Diffusion pump - Sorption pump
McLeod gauge- Thermal conductivity gauges-Pirani gauge – Cold cathode Ionization gauges- Penning gauge – Hot cathode ionization gauge - Bayard- Alpert gauge- Quadruple mass spectrometer; Vacuum application – Tungsten filament and discharge lamps – Electron tubes- Vacuum metallurgy- Space simulators and freeze drying

UNIT II - METHODS OF THIN FILM PREPARATION
Physical methods: Vacuum evaporation, Types of evaporation sources - Resistive heating electron beam evaporation – Co-evaporation - Two source evaporation and three source evaporation - Flash evaporation- Laser ablation - Reactive evaporation - Epitaxial deposition- Hot wall epitaxy and Molecular beam epitaxy

UNIT III -THIN FILM PREPARATION-SPUTTERING
Sputtering: Glow discharge, DC sputtering, RF sputtering, Magnetron sputtering, Reactive sputtering; Chemical Methods: Electroplating – Spray Pyrolysis – Chemical vapor deposition (CVD)

UNIT IV - GROWTH AND THICKNESS MEASUREMENT OF THIN FILMS
Condensation – Nucleation – and growth of thin films – Langmuir Frenkel theory of condensation – Theories of thin film nucleation – Capillary theory – Statistical or Atomistic theory – Comparison of nucleation theories – The four stages of film growth – Incorporation of defects during growth
Thickness Measurement: Multiple beam Interferometer (MBI) – Quartz Crystal Thickness Monitor

UNIT V – PROPERTIES OF THIN FILMS
Sources of electrical resistivity in metallic conductors – Sheet resistance – Temperature coefficient of resistance – Influence of thickness on the resistivity – Fuchs-Sondheimier theory – Hall Effect
Reflection and Transmission at an Interface - Reflection and Transmission by a single film – Reflection from an absorbing film – Multilayer films – Determination of optical constants by ellipsometry
Applications of thin films
Thin film resistors – Capacitors – Beam splitters – reflection and anti-reflection coatings – Optical filters

Reference Books:
1. "Vacuum Technology" A.Roth, North Holland, 1986.
2. "Vacuum Science and Technology" V.V. Rao, T.B. Ghosh and K.L. Chopra, Allied Publications, 1998.
3. "Fundamentals of Vacuum", Ward & Bann
4. "Hand book of Thin Film Technology" L.I. Maissel and R.L. Glang, McGraw Hill Bool Co., 1970.
5. "Thin Film Phenomenon" K.L. Chopra, McGraw Hill Bool Co., New York1969.
6. " Hand Book of Technologies for Films and Coatings" R.F. Bunshah, Noyes Publication, 1996.
7. "The Material Science of Thin Films", M. Ohring, Acddemic Press, New York, 1992.
8. "Preparation of Thin Films", JoyGeorge

ELECTIVE FOUNDATION
PHY 21404(C): FRONTIERS OF PHYSICS

OBJECTIVES - This course enables the students belong to other subjects:
1. To know the life sketchs of great Indian Physisists and their concributions.
2. To learn about the different conventional energy sources available on Earth and their characteristics.
3. To obtain knowledge on Non-Conventional Energy sourses.
4. To know the concepts of Nuclear Physics and advantages and disadvantages of Nuclear power.

OUTCOMES- After the completion of this course, students of non-physics stream will be:
1. Able to get knowledge on great Indian Physisists and their research contributions.
2. Exposed to the knowledge on various energy sourses available and their advantages and future treats.
3. Develop a good understanding about the Nuclear power and Nuclear power stations of India.

UNIT I: CONTRIBUTION OF INDIAN SCIENTISTS:
J.C.Bose, Dr.C.V.Raman, S.N.Bose, M.N.Saha, Prof. SatishDhawan, Dr.B.D.NagChaudhary, H.J.Bhabha, Dr.A.P.J.AbdulKalaam, Dr.Vikram Sarabhai, Prof.S.Bhagavantham, Prof. C.N.R.Rao

UNIT II: CONVENTIONAL ENERGY- SOLAR ENERGY
Role of new and renewable energy source; solar energy-solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT II: CONVENTIONAL ENERGY- WIND ENERGY
Wind energy-Sources and potentials, horizontal and vertical axis windmills, performance characteristics,Tidal and wave energy: Potential and conversion techniques.

UNIT-IV   NON-CONVENTIONAL ENERGY
Non-renewable sources such as petroleum, natural gas, coal (Rayalaseema Thermal Power Project and Ramagundam Thermal Power Project)andHydel power plants – Srisailam Hydroelectric power plant and NagarjunaSagar Hydroelectric power plant

UNIT V: NUCLEAR ENERGY
Introduction Nuclear Physics concepts; Nuclear power plants – Advantages and disadvantages
   1. Kalpakkam Atomic power station
   2. Tarapur Atomic power station

Source: The relevant material of the above units must be down loaded from authenticated web location from https://www.google.com

M. Sc. DEGREE EXAMINATIONS, MONTH, YEAR
SEMESTER MODEL QUESTION PAPER
PHY XXX : TITLE OF THE PAPER

Time : 3 Hours   **Max. Marks : 80**

SECTION – A

Answer **ALL** the Questions

4 X 5 = 20 Marks

1.   Question from Unit I

OR

2.   Question from Unit I

3.   Question from Unit II

OR

4.   Question from Unit II

5.   Question from Unit III

OR

6.   Question from Unit III

7.   Question from Unit IV

OR

8.   Question from Unit IV

SECTION – B

Answer **ALL** the Questions

4 X 15 = 60 Marks

9.   Question from Unit I

OR

10.   Question from Unit I

11.   Question from Unit II

OR

12.   Question from Unit II

13.   Question from Unit III

OR

14.   Question from Unit III

15.   Question from Unit IV

OR

16.   Question from Unit IV