# Syllabus and Model Papers

## M.Sc. Physics
## 3rd Semester

Under Choice Based Credit System (CBCS)
**[Effective from 2021-2022 Admitted Batches]**

## Department of Physics
College of Science and Technology
Andhra University
Visakhapatnam.

# M.Sc. Physics
# Course Curriculum under CBCS

## M.Sc. Physics – III Semester – SECOND YEAR
**[Effective from the admitted batch 2021-2022]**

| | | |
|---|---|---|
| THEORY | P 301 | Solid State Physics |
| | P 302 | Lasers & Fiber Optics |
| | P 303 **Elective-I** | 1. Digital Electronics & Microprocessors |
| | | 2. Principles of Ultrasonics |
| | P 304 **Elective-II** | 1. Materials Science |
| | | 2. Radar Systems and Satellite Communications |
| LABORATORIES | P 305 | Digital Electronics & Microprocessor Lab |
| | P 306 | Solid State Physics Lab |
| | P 307 | MOOCS Paper |
| | P 308 | Value Added Paper (IPR Chair Paper) |

**SCHEME OF INSTRUCTION AND EXAMINATION UNDER CBCS**

## M.Sc. Physics – III Semester – SECOND YEAR
**[Effective from the admitted batch 2021-2022]**

| Theory Code | Title of the Paper | T | P | Semester End Exam Marks | Mid Exam Marks | Total Marks | Pass Minimum | Credits |
|---|---|---|---|---|---|---|---|---|
| P-301 | Solid State Physics | 4 | - | 80 | 20 | 100 | 40 | 4 |
| P-302 | Lasers & Fiber Optics | 4 | - | 80 | 20 | 100 | 40 | 4 |
| P-303 | Elective - I | 4 | - | 80 | 20 | 100 | 40 | 4 |
| P-304 | Elective – II | 4 | - | 80 | 20 | 100 | 40 | 4 |
| P-305 | Digital Electronics & Microprocessor Lab (Practical-80 & Record-20) | - | 3 | 100 | | 100 | 50 | 4 |
| P-306 | Solid State Physics Lab (Practical-80 & Record-20) | - | 3 | 100 | | 100 | 50 | 4 |
| **P - 307** | **MOOCS Paper** | **ON LINE MODE** | | | | | | **4** |
| **P - 308** | **VALUE Added Paper (IPR Chair Paper)** | **Total 30 hours learning, No Examination** | | | | | | **2** |
| | **TOTAL** | **600** | | | | | | **30** |

(**T**- Theory Hrs /Week, **P**- Practical Hrs/Week)

**M.Sc. Degree Examination**
**Physics**

SYLLABUS

**Third Semester**

**P 301 – Solid State Physics**
**(Effective from the admitted batch of 2021-2022-CBCS)**

**Course Objectives:**

1. To provide extended knowledge of principles and techniques of Solid-State Physics.
2. To make the students familiar with the structures having regular and irregular arrangements of atoms and their bonding etc.
3. To explain the peculiar behavior of materials.
4. To understand various thermal properties of materials under different length scales.
5. To explain the free electron Fermi gas energy levels and density of orbits.
6. To understand the band theory of solids.

**Course Outcomes:**

1. The students will be able to formulate basic models for electrons and lattice vibrations for describing the physics of crystalline materials.
2. The students will be able to understand the relation between band structure and the thermal properties of a material.
3. At the end of this course, the students will be able to understand various physical phenomena and the reasons behind them.

**UNIT-I: Crystal Structure**

Periodic array of atoms—Lattice translation vectors, fundamental types of lattices-two- and three-dimensional lattice types, the Basis and the Crystal Structure, Primitive and compound unit cells, determination of number of atoms in a cell and position of atoms, simple crystal structures-- sodium chloride, cesium chloride and diamond structures, Review of Symmetries in solid, Miller Indices, indexing pattern of cubic crystals and non-cubic crystals (analytical methods).

**UNIT-II: X-Ray Diffraction and Reciprocal Lattice**

Diffraction of x-rays by crystals, scattered wave amplitude-Fourier analysis, Bragg's law, Laue's equations, Reciprocal lattice vectors, diffraction conditions, reciprocal lattice to bcc and fcc Lattices, concept of Brillouin Zone, Ewald construction, Structure factor and atomic form factors.

**UNIT-III: Lattice Vibrations**

Vibrations of lattice with monoatomic and diatomic basis, dispersion relation, optical and acoustical branches, quantization of elastic waves and phonons, classical theory of specific heat, phonon density of states, Einstein and Debye models of specific heat.

**UNIT-IV: Free Electron Fermi Gas**

Free electron theory and electronic specific heat, energy levels and density of orbits in one-dimension, free electron gas in three-dimension, thermal properties of an electron gas, Hall effect, thermal conductivity, Wiedemann-Franz law.

**UNIT-V: Band Theory of Solids**

Nearly free electron model and origin of energy gap, Block function, Kronig-Penny Model, wave equation of electron in a periodic potential, Bloch theorem and crystal momentum, classification of metals, insulators and semiconductors.

**Text Books:**


1. Introduction to Solid State Physics - C. Kittel
2. Solid State Physics - A. J .Dekker

**Model Question Paper**

**Andhra University**
**M.Sc. Degree Examination**
**Physics**

**Third Semester**
**P 301 – Solid State Physics**
**(Effective from the admitted batch of 2021-2022-CBCS)**

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**Answer one question from each unit**
**All questions carry equal marks**

**Time: 3 Hrs.** **Max.Marks:80 (16 X 5 = 80)**

## Unit – I

1. a) Explain the concept of translation vectors in lattice.
   b) Describe the fundamental types of two- and three-dimensional lattice types.

(OR)

2. a) Draw the simple crystal structures of sodium chloride, cesium chloride and diamond.
   b) Explain the indexing pattern of cubic crystals and non – cubic crystals.

## Unit – II

3. a) What is meant by diffraction? Explain the diffraction of X – rays by crystals.
   b) State and prove the Bragg's law.

(OR)

4. a) What are the reciprocal lattice vectors?
   b) Construct the reciprocal lattice to the body centered and face centered cubic crystals.

## Unit - III

5. a) Explain the vibrations of lattice with monoatomic and diatomic basis.
   b) Define dispersion relation.

(OR)

6. a) What is the classical theory of specific heat?
   b) Explain in detail the Einstein and Debye models of specific heat.

## Unit – IV

7. a) Give an account on free electron theory and electronic specific heat.
   b) Explain the energy levels and density of orbits in one dimension.

(OR)

8. a) What are the thermal properties of an electron gas?
   b) Discuss the Wiedemann – Franz law.

## Unit – V

9. a) What is the origin of energy band gap of solids?
   b) Explain the Kronig – Penny model for an electron in one dimensional potential.

(OR)

10. a) Derive the wave equation for an electron in periodic potential.
    b) State and prove Bloch theorem.

**M.Sc. Degree Examination**
**Physics**

**SYLLABUS**

**Third Semester**

**P 302 – Lasers and Fiber Optics**
**(Effective from the admitted batch of 2021-2022-CBCS)**

**Course Objectives:**

1. To explain the basics of LASER.
2. Describing the construction and working of various types of lasers and the applications of lasers.
3. Explaining the propagation mechanism of light through optical fiber.
4. Deriving the relation between Numerical Aperture and Refractive indices.
5. Classification of the types of optical fibers.
6. Explaining about the attenuation mechanisms.
7. Demonstrate an understanding of light propagating through an optical fiber
8. Characterize different types of optical fibers and optical connectors

**Course Outcomes:**

1. Absorption and spontaneous and stimulated emission in two level system, the effects of homogeneous and inhomogeneous line broadening, and the conditions for laser amplification.
2. Operations of the cavity including mode separation and line-widths, laser gain conditions, gain clamping in both homogeneous and inhomogeneous line broadened media.
3. Operations and basic properties of the most common laser types such as Ruby, He-Ne, Nd:YAG and knowledge of other main laser types.
4. The various laser systems, the simple homogeneous laser and its output behavior and optimal operating conditions.
5. Spectral properties of longitudinal and transverse modes, mode locked laser operation, schemes for active and passive mode locking in real laser system.
6. Matrix optics of the laser cavity and stability conditions.
7. Basics of Gaussian beam in laser cavity and optical properties of laser output, design of stable laser cavities using Gaussian beam optics, the ABCD law for Gaussian beams.
8. Better understanding of the Ray and Modal Analysis in Optical Fibers.
9. Basic understanding about the various Fiber Signal Characteristics such as pulse broadening and dispersion.
10. Exhaustive understanding about the Nonlinear optics.

**UNIT-I**

**Laser systems:** Introduction, Characteristics of Laser Light, coherence, directionality, spontaneous and stimulated emission, absorption and emission processes, Einstein coefficients, Optical pumping mechanism, Population inversion, Rate equations for three level and four level systems, Types of Lasers - Ruby laser, He-Ne laser, Nd:YAG laser, $CO_2$ Laser, Dye laser, Excimer laser, Semiconductor laser, Hetero junction laser, Optical resonator, laser power and threshold condition confinement of beam within the resonator, coherence length, stability condition, stability diagram.

**UNIT – II:**

**Laser cavity modes:** Line shape function and Full Width at half maximum (FWHM) for Natural broadening, Collision broadening, Doppler broadening, Saturation behavior of broadened transitions, Longitudinal and Transverse modes. ABCD matrices and cavity Stability criteria for confocal resonators. Quality factor, Q-Switching, Mode Locking in lasers. Expression for Intensity for modes oscillating at random and modes locked in phase. Methods of Q-Switching and Mode locking.

**UNIT-III**

**Optical fiber waveguides**: Basic optical laws and self-focusing. Optical fiber modes and configurations Fiber types, Rays and Modes, Step-index fiber structure. Ray optics representation, wave representation. Mode theory of circular step-index wave guides. Wave equation for step-index fibers, modes in step-index fibers and power flow in step-index fibers. Graded – index fiber structure, Graded-index numerical aperture, modes in Graded-index fibers.

**UNIT-IV**

**Fiber characteristics:** Signal Degradation In Fibers - Attenuation, Absorption, Scattering and Bending losses in fibers, radiative losses, Core and Cladding losses. Signal distortion in optical wave guides: Group delay, material dispersion, waveguide dispersion and intermodal dispersion. Pulse broadening in optical fibers. Power launching in Optical fibers, Source-output pattern, Lensing schemes. Fiber-to-fiber joints: Mechanical misalignment, fiber related losses, Fiber and face preparation. Fiber splicing techniques, fiber connectors.

**UNIT – V**

**Nonlinear Optics:** Second harmonic generation, parametric amplification, Phase matching, parametric oscillation, Frequency up conversion, Electro optic modulation of laser beams, electro optic effect, electro optic retardation, electro optic amplitude modulation, phase modulation of light, electro optic beam deflection.

**Text Books**:


1. Lasers -Theory and Applications – K. Thyagarajan and A.K. Ghatak
2. Optical Fiber Communications – Gerd Keiser
3. Optical Electronics – Amnon Yariv


**Reference Books:**


1. Laser Fundamentals – William T. Silfvast
2. Introduction to Fiber Optics – Ajoy Ghatak and K. Thyagarajan
3. Optical Electronics – Ajoy Ghatak and K.Thyagarajan
4. Optical Electronics – J. Wilson and J.F.B. Hawkes

**Model Question Paper**

**Andhra University**
**M.Sc. Degree Examination**
**Physics**

**Third Semester**
**P 302 – Lasers and Fiber Optics**
**(Effective from the admitted batch of 2021-2022-CBCS)**

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**Answer one question from each unit**
**All questions carry equal marks**

**Time: 3 Hrs.** **Max.Marks:80 (16 X 5 = 80)**

## Unit – I

1. a) Explain in detail the characteristics of Lasers.
   b) What are Einstein's Coefficients in laser?

(OR)

2. a) Describe the working and construction of He – Ne laser.
   b) Explain briefly about the optical resonators in lasers.

## Unit – II

3. a) Give an account on Collision and Doppler broadening in lasers.
   b) Describe the Longitudinal and Transverse modes in lasers.

(OR)

4. a) What is meant by Q -Switching?
   b) Explain the methods of Q – Switching and mode locking.

## Unit – III

5. a) What are the basic optical laws and optical fiber modes?
   b) Describe the mode theory of circular step - index wave guides.

(OR)

6. a) Derive the wave equation for the step – index fibers.
   b) Explain the power flow in step – index fibers.

## Unit – IV

7. a) Explain the different types of losses in fiber optics.
   b) Give an account on Group delay and material dispersion in optical fibers.

(OR)

8. a) Describe the power launching in optical fibers.
   b) Explain in detail the different types of optical fiber connectors.

## Unit – V

9. a) Write a brief note on parametric amplification and parametric oscillation.
   b) What is the frequency up conversion in nonlinear optics?

(OR)

10. a) Define the electro optic retardation.
    b) Describe the electro optic beam deflection in nonlinear optics.

**M.Sc. Degree Examination**
**Physics**

**SYLLABUS**

**Third Semester**

**P 303 – ELECTIVE PAPER**
**1. Digital Electronics and Microprocessors**

**(Effective from the admitted batch of 2021-2022-CBCS)**

**Course Objectives:**

1. To make the students learn the basics of digital electronics.
2. To Introduce the concept of digital and binary systems
3. To be able to design and analyze combinational logic circuits.
4. To be able to design and analyze sequential logic circuits.
5. To understand the basic design and implementation of digital circuits and systems.
6. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
7. To prepare students to perform the analysis and design of various digital electronic circuits.
8. Reinforce theory and techniques taught in the classroom through experiments in the laboratory.
9. To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
10. To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
11. To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

**Course Outcomes:**

1. At the end of the course, a student will be able to:
2. Convert different type of codes and number systems which are used in digital communication and computer systems.
3. Employ the codes and number systems converting circuits and compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.
4. Analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.
5. Design different types of with and without memory element digital electronic circuits for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.
6. Apply the fundamental knowledge of analog and digital electronics to get different types analog to digitalized signal and vice-versa converters in real world with different changing circumstances.

7. Assess the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real world application.
8. Learn microprocessor with the help of basic knowledge of digital electronics.
9. Understand the fundamentals of digital electronics and microprocessor and microcontroller, which will be useful to them in understanding the concept behind Digital India.
10. Assess and solve basic binary math operations using the microprocessor and explain the Microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing and performance.
11. Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.
12. Compare accepted standards and guidelines to select appropriate Microprocessor (8085) and Microcontroller (8051) to meet specified performance requirements.
13. Analyze assembly language programs, select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.
14. Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.
15. Evaluate assembly language programs and download the machine code that will provide solutions to real-time control problems.

**UNIT- I: Combinational Logic Circuits**: **(i)** Simplification of Boolean Expressions: Algebraic method, Karnaugh Map method, **(ii)** Encoder, decoder, Multiplexer, Demultiplexer, Design of Adders and Subtractors, IC parallel adder. **(iii)** Applications of Boolean algebra: Magnitude Comparator, Parity generator, Checker, Code converter, Seven-segment decoder/ Driver display.

**UNIT – II: Sequential Logic Circuits: (i)** Flip-Flops: NAND latch, NOR latch, , Clocked S-C flip-flop, J-K flip-flop, D flip-flop, Asynchronous inputs **(ii)** Counters: Asynchronous counters (Ripple), Counters with MOD number $< 2^N$, Asynchronous down counter, Synchronous counters, Up-down counter **(iii)** Registers: Shift Register, Integrated Circuit registers, Parallel In Parallel Out (PIPO), SISO, SIPO, PISO. **(iv)** Applications of Counters: Frequency Counter.
**(v)** A/D and D/A Converter Circuits**:** D/A Converter, Linear weighted and ladder type, an integrated circuit DAC; Analog-to-Digital Conversion, Digital Ramp ADC, Successive Approximation Method, Sample and Hold Circuit, Digital Voltmeter.

**UNIT – III: Intel 8085 Microprocessor (i)** Architecture, Functional diagram, Pin description, Timing Diagram of Read Cycle, Timing diagram of write Cycle **(ii)** Programming the 8085 Microprocessor**:** Addressing Methods, Instruction set, Assembly language programming **(iii)** Examples of Assembly Language Programming: Addition/Subtraction of two 8-bit/16-bit numbers, Addition of two decimal numbers, Sum of series of 8-bit numbers, Largest element in the array, Multiple byte addition, Delay sub-routine.

**UNIT – IV: Data Transfer Techniques: (i)** Serial transfer, Parallel transfer, Synchronous, Asynchronous, DMA transfer, Interrupt driven Data transfer **(ii)** 8085 Interfacing**:** I/O Interfacing: Programmable Peripheral Interfacing, 8255, Programmable Peripheral Interval Timer 8253.

**UNIT – V: 8051 Microcontroller: (i)** 8051 Internal Architecture, Register Structure, I/O pins, Memory Organization, 8051 Addressing modes**,** 8051 Assembly Language Programming Tools**,** 8051 Instruction set**, (ii)** Data Transfer Instructions, Arithmetic instructions, Logical instructions **(iii)** Boolean Variable Manipulation Instructions-Bit Addressability, Single-Bit instructions, Program Branching instructions-Jump, Loop, and Call instructions, Rotate Instructions, Stack Pointer.

**Text Books:**


1. Digital Systems – Principles and applications –Ronald J. Tocci
2. Fundamentals of Microprocessors & Microcomputers - B. RAM
3. Digital principles and applications - A. P. Malvino & Donald P. Leech
4. Micro Controllers: Theory and Applications - Ajay V. Deshmukh
5. Micro Controllers – Rajkamal
6. Micro Controllers – Kenneth J Ayala


**Reference Books:**


1. Digital Electronics – William H Gothmann
2. Digital Fundamentals – Thomas L. Floyd
3. Fundamentals of Digital Circuits - A. Ananda Kumar
4. Introduction to Microprocessors for Engineers and Scientist - P.K.Ghosh and P.R.Sridhar
5. Microprocessor Architecture, Programming and Applications with the 8085 /8080A - Ramesh. S. Gaonkar
6. 8051 Microcontroller and Embedded systems - Mahammad Ali Mazidi & Janice GillispieMazidi
7. 8051 Microcontroller – Mike Predko

**Model Question Paper**

**Andhra University**

**M.Sc. Degree Examination**

**Physics**

**Third Semester**

**P 303 – ELECTIVE PAPER**

**1. Digital Electronics and Microprocessors**

**(Effective from the admitted batch of 2021-2022-CBCS)**

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**Answer one question from each unit**

**All questions carry equal marks**

**Time: 3 Hrs.** **Max.Marks:80 (16 X 5 = 80)**

## Unit – I

1. a) Draw the circuit symbol and truth tables of 3 line-8-line decoder.
   b) Write a detailed note on half adder and full adder.

(OR)

2. a) Write a note on K – Map method of simplification of Boolean function with a variable map.
   b) Write a note on parity generator and checker circuits.

## Unit – II

3. a) With a neat block diagram explain the working of JK flip-flop.
   b) Write a note on shift registers.

(OR)

4. a) With a neat block diagram explain the working of 3 bit Up/Down counter.
   b) Distinguish between ripple counters and parallel counters.

## Unit – III

5. a) Draw the functional diagram of 8085 and explain the register section of 8085.
   b) Write a note on addressing methods of 8085 with examples.

(OR)

6. a) Write an Assembly Language Programming to find the sum of series of 8-bit numbers.
   b) Write a brief note on Delay sub routine.

## Unit – IV

7. a) What are the different data transfer techniques?
   b) Write a note on DMA transfer and Interrupt driven data transfer techniques.

(OR)

8. a) Draw the functional diagram of programmable peripheral interface 8255 and explain the different pin names and functions.
   b) Write a brief note on DAC 0800 and ADC 0800 interfacing.

## Unit – V

9. a) Define the internal architecture of 8051 microcontroller and explain the memory organization of 8051.
   b) Write a note on assembly language programming tools of 8051.

(OR)

10. a) Explain in detail the data transfer and arithmetic instructions of 8051 Microcontroller?
    b) Give a brief account on stack pointer.

**M.Sc. Degree Examination**
**Physics**

**SYLLABUS**

**Third Semester**

**P 303 – ELECTIVE PAPER**
**2. Principles of Ultrasonics**

**(Effective from the admitted batch of 2021-2022-CBCS)**

**Course Objectives:**

1. The course gives introduction of ultrasonics and its properties and production of ultrasonics by various methods.
2. The course also describes the propagation of ultrasonics 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 ultrasonics in various fields.

**Course Outcomes:**

1. Students will be able to know the concept of different ranges of frequencies and ultrasonic waves and its production and properties by various methods.
2. They also able to learn the concept of propagation of ultrasonic waves in different liquid media with binary and ternary mixtures. They will be able to know the concept viscoelasticity.
3. They able to measure ultrasonic velocities and absorption coefficients in liquids by using various instruments.
4. 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:**

Application of ultrasonics (low and high intensities) in mechanical, chemical and metallurgical area. Ultrasonic imaging, process control and applications.

**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

**Model Question Paper**

**Andhra University**
**M.Sc. Degree Examination**
**Physics**

**Third Semester**
**P 303 – ELECTIVE PAPER**
**2. Principles of Ultrasonics**
**(Effective from the admitted batch of 2021-2022-CBCS)**

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**Answer one question from each unit**
**All questions carry equal marks**

**Time: 3 Hrs.** **Max.Marks:80 (16 X 5 = 80)**

## Unit – I

1. a) What is ultrasonics. Explain the production of ultrasonics by Piezoelectric method.
   b) What are ultrasonic transducers. Explain basic design of ultrasonic transducers.

(OR)

2. a) What is meant by Magnetostriction effect and explain how ultrasonic waves are produced using this effect.
   b) Mention Properties of ultrasonic waves and explain how ultrasonic waves are detected.

## Unit – II

3. a) Explain the propagation of ultrasonic waves in different media at various temperatures in liquids.
   b) Explain the absorption of plane longitudinal waves in gases at low viscosity where the relaxation effects are absent in the liquids.

(OR)

4. a) What is Viscoelasticity and explain the molecular picture of Visco elastic relaxation.
   b) Explain the propagation of shear wave in a Visco elastic medium using Maxwell model.

## Unit – III

5. a) Mention different methods for measuring the ultrasonic velocity. Discuss advantages and disadvantages of these methods.
   b) Using DSA 5000M Density and Sound velocity Meter explain the measurement of refractive index and viscosity with variation of the angles.

(OR)

6. a) Explain in detail the Cavitation process.
   b) Discuss various cleaning techniques using ultrasonic waves.

## Unit – IV

7. a) What is the basic principle of ultrasonic testing. How ultrasonics are used in non-destructive testing.
   b) Mention different methods in non-destructive testing. Give brief note on each method.

(OR)

8. a) Explain two or three applications of ultrasonic waves using non-destructive testing.
   b) Discuss applications of ultrasonics in medical field.

## Unit – V

9. a) Explain applications of ultrasonics at low and high intensities in mechanical area.
   b) Give a note on ultrasonic imaging and process control.

(OR)

10. a) Give applications of ultrasonics at low and high intensities in chemical and metallurgical area.
    b) Discuss the applications of both low and high intensity ultrasonic waves in various fields.

**M.Sc. Degree Examination**
**Physics**

**SYLLABUS**

**Third Semester**

**P 304 – ELECTIVE PAPER**
**1. Material Science**
**(Effective from the admitted batch of 2021-2022-CBCS)**

**Course Objectives:**

1. Give basic knowledge of science behind materials & physical metallurgy.
2. Introduce the concept of structure property relations.
3. To have fundamental understanding of materials behavior, or conceived, designed, and realized useful products and technology platforms within realistic engineering constraints, as demonstrated by, for example, development of new materials, improvement of existing materials, development of new materials processing, or development of new analytical tools and core competence in materials.
4. Lay the groundwork for studies in mechanical behavior of materials & applications of recent materials.
5. Are valued not only for understanding the structure and composition of materials, but equally for analytical and creative abilities fostered by a broad engineering,
6. To work effectively in multidisciplinary areas of materials science to solve complex problems.
7. Ability to deal with business and non-technical aspects of materials science & engineering.
8. Develop intuitive understanding of the subject to present a wealth of real-world engineering examples to give students a feel of how material science is useful in engineering practices.
9. Analyze the Structure of materials at different levels, basic concepts of crystalline materials etc. understanding.
10. Concept of mechanical behavior of materials and calculations of same using appropriate equations understanding.
11. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy understanding.
12. Construction and identification of phase diagrams and reactions Understanding,
13. Understand and suggest the heat treatment process & types.
14. Significance of properties.
15. Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials, etc.

**Course Outcomes:**

1. An ability to apply knowledge of mathematics, science and engineering to materials issues.
2. An ability to design and conduct experiments and critically analyze and interpret data.
3. An ability to design a process and/or material system to achieve specific requirements within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. An ability to work effectively in multidisciplinary teams, be conversant in languages of other fields, and provide leadership to such teams.
5. An ability to identify, formulates, and solves science & engineering problems.
6. An understanding of professional and ethical responsibility.
7. An ability to communicate effectively.
8. The broad education necessary to understand the impact of science & engineering solutions in a global, economic, environmental, and societal context.
9. A recognition of the need for, and an ability to engage in, lifelong learning.
10. A knowledge of contemporary issues in science, engineering and society.
11. An ability to use modern techniques, skills, and science & engineering tools appropriate to materials research.
12. An integrated understanding of structure, properties, processing and performance of materials systems.

**UNIT-I: Structure of Materials:**

Concept of amorphous, single crystal and polycrystalline materials, defects in crystalline materials, point, line and surface imperfections, vacancies, interstitials, dislocations; grain boundaries, twins, stacking faults.

**UNIT-II: Classification of Materials:**

**Metals and Alloys:** alloying nature, concept of formation of alloys, types of alloys, solid solutions, Nd-Fe-B alloy, AlNiCo alloys

**Ceramics:** introduction, classification, oxides, carbides, nitrides, or silicates of metals, glass, porcelain, ferrites

**Polymers:** structure of polymers, strengthening of polymers, crystallization and glass formation, types of polymers, nylon, polyethylene, polyvinyl chloride, rubber

**Composites:** definition, classification, types of matrices and reinforcements, metal-matrix composites, polymer-matrix composites, and ceramic-matrix composites, composite strengths, particles, whiskers and fibers as reinforcements

**Semiconductors:** concept of doping, simple and compound semiconductors, silicon, germanium, gallium arsenide, amorphous silicon, oxide semiconductors.

**UNIT-III: Processing of Materials:**

Heat treatment of alloys; annealing, re-crystallization and grain growth, preparation of ceramic powders, solid-state reaction, sintering; thin film deposition, evaporation and sputtering techniques, and chemical vapor deposition.

**UNIT-IV: Properties of Materials**:
Mechanical Properties: stress, strain, elastic properties, deformation- elasticity, hardness, stress-strain response (elastic, inelastic and plastic deformation)
**Electrical Properties:** dielectric polarization, mechanism of polarization, dielectric constant, dielectric losses and breakdown, piezoelectric and ferroelectric behavior, electrical conduction in semiconductors, temperature dependence of electrical conductivity
**Magnetic Properties:** classification of magnetic materials, ferromagnetism, ferrimagnetism, antiferromagnetism and superparamagnetism, domain theory and hysteresis, magnetization processes in terms of domain theory, Domain wall, properties of domain walls and domain wall motion, magnetic anisotropy.

**UNIT-V: Applications of Materials:**
**Metals and Alloys:** Nd-Fe-B, AlNiCo alloys,
**Ceramics:** soft and hard ferrites, ferroelectric and piezoelectric materials
**Polymers:** plastic fibers, coating adhesives, biomedical applications,
**Composites:** aircraft engineering-space hardware, wind turbine, marine craft-space structure, applications in surgery.

**Text & Reference Books:**


| | |
|---|---|
| Composite Materials | Krishnan K. Chawla |
| Materials Science and Engineering | V Raghavan |
| Electronic Processes in Materials | L.W. Azaroff and J.J.Brophy |
| Introduction to Solid State Physics | C.Kittel |
| Science of Engineering Materials | C.M.Srivastava and C. Srinivasan |
| Solid State Physics | A.J.Dekkar |
| Solid State Physics | S.O.Pillai |
| Solid State Devices and Materials | Ben.G Streetman |

**Model Question Paper**

**Andhra University**

**M.Sc. Degree Examination**

**Physics**

**Third Semester**

**P 304 – ELECTIVE PAPER**

**1. Material Science**

**(Effective from the admitted batch of 2021-2022-CBCS)**

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**Answer one question from each unit**

**All questions carry equal marks**

**Time: 3 Hrs.** **Max.Marks:80 (16 X 5 = 80)**

## Unit – I

1. a) Explain about the single crystal and polycrystalline materials.
   b) Describe the defects in crystalline materials.

(OR)

2. a) Write a note on line and surface imperfections.
   b) Give an account on grain boundaries and stacking faults.

## Unit – II

3. a) Explain the nature and formation of alloys.
   b) What are the different types of ceramics?

(OR)

4. a) Describe the crystallization and glass formation of polymers.
   b) Discuss about the different types of matrices and reinforcements of composites.

## Unit – III

5. a) What is meant by annealing?
   b) Explain the re – crystallization and grain growth of alloys.

(OR)

6. a) Describe the preparation of ceramic powders.
   b) Write a detailed note on thin film deposition and evaporation techniques.

## Unit – IV

7. a) Write the mechanical properties of materials.
   b) Define the dielectric polarization.

(OR)

8. a) Give an account on piezoelectric and ferroelectric behaviour of materials.
   b) Distinguish between dia, para and ferro magnetic materials.

## Unit – V

9. a) What are the applications of metal and alloy materials?
   b) Describe the ferroelectric and piezoelectric materials.

(OR)

10. a) What are the biomedical applications of polymers?
    b) Write the applications of composite materials.

**M.Sc. Degree Examination**
**Physics**

**SYLLABUS**

**Third Semester**

**P 304 – ELECTIVE PAPER**
**2. Radar Systems and Satellite Communications**
**(Effective from the admitted batch of 2021-2022-CBCS)**

**Course Objectives:**

1. To learn about Radar systems, Design and Tracking of Radars.
2. To study about MTI and Pulsed Radar Systems.
3. To study Satellite basics and Satellite communication systems.
4. To learn about satellite link design and multiple access techniques.

**Course Outcomes**:

On completion of the course, students will be able to

1. Describe the working principle of different RADAR systems and their applications.
2. Identify the various RADAR systems in existence, specify their applications and limitations, and explain the principles of how they work.
3. Describe the most commonly used techniques in processing RADAR signals.
4. Recognize and describe the various technologies used in the design of RADAR systems: antennas, transmitters, duplexers, data display screens, etc.
5. Design simple radar systems and the associated signal processing, at block diagram level.
6. Understand the Satellite fundamentals and types of satellite.
7. Explain the working of a Satellite communication system and its other subsystems.
8. Know the applications of Satellites in different areas.
9. Describe the principles of radio navigation systems (including secondary radar and GPS).
10. Identify the fundamentals of orbital mechanics, the characteristics of common orbits used by communications and other satellites, and be able to discuss launch methods and technologies.
11. Describe the systems required by a communications satellite to function and the trade-offs and limitations encountered in the design of a communications satellite system.
12. Describe the radio propagation channel for Earth station to satellite and satellite to satellite communications links, and the basics of designing antenna systems to accommodate the needs of a particular satellite system.
13. Analyze an accurate link budget for a satellite or other wireless communications link.

**Unit – I:**

**Radar Systems:** Fundamental – A simple RADAR – overview of frequencies – Antenna gain Radar Equation – Accuracy and Resolution – Integration time and the Doppler shift

**Designing a surveillance radar** – Radar and surveillance – Antenna beam – width consideration – pulse repetition frequency – unambiguous range and velocity – pulse length and sampling – radar cross section – clutter noise

**Tracking Radar** – Sequential lobbing – conical scanning – Mono pulse Radar – Tracking accuracy and Process – Frequency Agility – Radar guidance, Signal and data processing.

**UNIT – II:**

**MTI and Pulse doppler Radar**: Introduction to Doppler and MTI radar, MTI and pulse radar, Doppler frequency shift, simple CW Doppler Radar, sweep to sweep subtraction and delay line cancellers, MTI radar block diagram Radar Antenna – Antenna parameters – Antenna Radiation Pattern and aperture distribution – Parabolic reflector – cosecant squared antenna pattern.

**UNIT – III:**

**Satellite Communication:** Satellite System – Historical development of satellites – communication satellite systems – communication satellites – orbiting satellites – satellite frequency bands – satellite multiple access formats, Satellite orbits and inclination – Look angles, orbital perturbations, space craft and its subsystems – attitude and orbit control system – Telemetry, Tracking and Command – Power system – Transponder – Reliability and space qualification – launch vehicles

**UNIT – IV**:

**Satellite Link Design:** Introduction, General Link Design Equation, System Noise Temperature, C/N and G/T Ratios, Uplink Design, Downlink Design, Downlink Rain Fade Margin, Complete Link Design, Satellite Link Design with Specified (C/N), Dependence of (C/N) Ratio on Earth Station Parameters.

**UNIT V:**

**Multiple Access Techniques** – Time division multiple access – Frequency division multiple access – Code division multiple access – Space domain multiple access, Earth Station technology – Subsystem of an earth station – Transmitter – Receiver, Tracking and pointing – Small earth station – different types of earth stations – Frequency coordination – Basic principles of special communication satellites – INMARSAT, VSAT, GPS, RADARSAT, INTELSAT.

**Text Books:**


1. Understanding Radar Systems – Simon Kingsley and Shaun Quegan.
2. Satellite Communication – Robert M. Gagliardi
3. Satellite Communication – Monojit Mitra


**Reference Books**


1. Introduction to Radar Systems – MI Skolnik
2. Satellite communications – Timothy Pratt,Carles Bostian and Jeremy Allnutt

**Model Question Paper**

**Andhra University**

**M.Sc. Degree Examination**

**Physics**

**Third Semester**

**P 304 – ELECTIVE PAPER**

**2. Radar Systems and Satellite Communications**

**(Effective from the admitted batch of 2021-2022-CBCS)**

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**Answer one question from each unit**

**All questions carry equal marks**

**Time: 3 Hrs.** **Max.Marks:80 (16 X 5 = 80)**

## Unit – I

1. a) Explain the design of surveillance Radar.
   b) Write a note on Radar cross section of targets.

(OR)

2. a) Explain the unambiguous range and velocity of a Radar.
   b) With a neat block diagram explain the signal and data processing in Radars.

## Unit – II

3. a) With a neat block diagram explain the working of MTI Doppler Radar.
   b) Explain in detail about the Doppler frequency shift.

(OR)

4. a) What are the antenna parameters?
   b) Describe the radiation pattern and aperture distribution of antenna.

## Unit – III

5. a) Explain the historical development of satellites.
   b) State Kepler's second law of planetary motion, with reference to Geo-stationery Satellites, with necessary illustrations.

(OR)

6. a) Give an account on Look angles and orbital perturbations.
   b) Explain the Reliability and space qualification of satellite systems.

## Unit – IV

7. a) Derive the general link equations of satellites.
   b) Explain C/N and G/T ratios.

(OR)

8. a) Write a note on Uplink and Downlink designs.
   b) Explain how the C/N ratio depends on the Earth Station Parameters.

## Unit – V

9. a) Discuss about the time and frequency division multiple access techniques.
   b) Explain the working of transmitter and receiver of a system.

(OR)

10. a) What are the basic principles of special communication satellites?
    b) Write a brief note on GPS.

**M.Sc. Degree Examination**
**Physics**

SYLLABUS

**Third Semester**

**P 305 – Digital Electronics and Microprocessor Laboratory**
**(Effective from the admitted batch of 2021-2022-CBCS)**

## Course Objectives:

1. This course will enable the students to learn the basic concepts and techniques and application of knowledge in digital electronic circuits and systems.
2. To acquire the basic knowledge of digital logic levels.
3. The learning objective of this course is to understand the concepts of digital circuits and systems with adequate introduction to both combinatorial and sequential logic circuits, such as, adders, comparator, decode counter, etc.
4. This course introduces the assembly language programming of 8085.
5. The course objective is to introduce the basic concepts of microprocessor and to develop in students the assembly language programming skills and real time applications of Microprocessor as well as microcontroller. It gives a practical training of interfacing the peripheral devices with microprocessor.
6. The objective of this laboratory is to understand various Modulation techniques in time domain and frequency domain to impart hands on experience and train the students to analyze various modulation techniques and understand their performance to comprehend various coding techniques on transmission medium in Digital communications.

## Course Outcomes:

After studying this course, the students would gain enough knowledge

1. Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.
2. Identify the various digital ICs and understand their operation.
3. Learn about comparator and decade counter.
4. The ability to identify and prevent various hazards and timing problems in a digital design.
5. Ability to identify basic requirements for a design application and propose a cost-effective solution.
6. The student will be able to design AM, FM, Mixer and analyze the modulation techniques.
7. Design interfacing circuits with 8085.
8. Practice different types of programming keeping in mind technical issues and evaluate possible causes of discrepancy in practical experimental observations in comparison.

## LIST OF EXPERIMENTS

1. Adders: Half Adder, Full Adder and Parallel Adder
2. Digital Comparator (IC 7485)
3. Decade Counter (IC 7490)
4. Addition/ Subtraction of 8-bit numbers using 8085.
5. Largest number in an Array, Sum of Series of 8 – bit and Sum of two 16 – bit numbers
6. Interfacing of 8255 PPI: Generation of Square Wave and Rectangular Wave
7. Amplitude Modulation
8. Butterworth First Order Low Pass and High Pass Filters
9. Mixe**r**

**Reference Books:**


1. Digital Principles and Applications - Malvino and Leach
2. Digital Fundamentals - Thomas L Floyd
3. Digital Logic and Computer Design - M. Morris Mano
4. Digital Design - M. Morris Mano
5. Advanced Microprocessors & Peripherals - A K Ray and K M Bhurchandi
6. 8051 microcontroller and embedded systems - M A Mazidi and J G Mazidi
7. An introduction to analog and digital communications – Simon Haykin
8. Modern Analog and Digital Communication Systems – B P Lathi
9. Basic *Electronics: A Text-Lab Manual* - Paul Zbar & Albert P Malvino
10. Experiments in Electronics - S V Subrahmanyam

**M.Sc. Degree Examination**
**Physics**

**SYLLABUS**

**Third Semester**

## P 306 – Solid State Physics Laboratory
## (Effective from the admitted batch of 2021-2022-CBCS)

**Course Objectives:**

1. This course will concentrate on experiments in solid state physics covering a broad range of topics representative of the field.
2. This course is an upper division lab with some focus on solid state physics.
3. This course integrates theory of Solid-State Physics with experimental demonstrations in the Research Physics Lab.
4. This course will provide a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids.
5. This course includes theoretical description of crystal and electronic structure, lattice dynamics, and properties of different materials (metals, semiconductors, dielectrics, magnetic material), based on the classical and quantum physics principles.
6. However, the student is expected to master the topic of the experiment in depth and produce an experiment procedure before attempting data collection.
7. After the experiment is completed, each student will write a record that includes experimental results, and analysis and discussion of these results.
8. Several advanced experiments like X-ray diffraction, Raman Scattering, etc., will be carried out in the Research Physics Lab followed by their theoretical discussion.

**Course Outcomes:**

1. Student will be able to observe and analyze physical data relevant to some of the experiments in solid state physics.
2. Provide students with a thorough understanding of the basic concepts of physics and the methods scientists use to explore natural phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical analysis.
3. Interpreting results through analyzing data and analysis, writing record.
4. Learning more advanced physics topics, not encountered at the introductory level.
5. Students are expected to develop a clear concept of the crystal classes and symmetries.
6. Students will be able to calculate the Braggs conditions for X-ray diffraction in crystals and will calculate the conditions for allowed and forbidden reflections in crystals.
7. Students will learn the basics of the phonons in crystals.
8. Students will become familiar with the free-electron model for metals and use the concept of Fermi energy and Fermi temperature.
9. Basic concepts of the band theory of solids will be given to Students, who will be able to predict the properties of materials and compounds.
10. Students will master their skills for oral presentations on the selected topics of the modern Solid-State Theory.

## LIST OF EXPERIMENTS

1. Hall Effect: Determination of Hall coefficient and estimation of carrier concentration and its mobility
2. Coupled Oscillations**:** Study of the frequencies of normal modes of two coupled pendulums, strength of the coupling constant
3. X-ray Diffraction: Study of the X-ray diffraction and determination of lattice parameter and the number of atoms per unit cell in NaCl and KCL
4. Four –probe**:** Determination of energy gap of a semiconductor using four-probe method
5. Magneto resistance**:** Observe the magneto resistance of a semiconductor using four – probe arrangement
6. Thermo electric power**:** Calculation of Thermoelectric power and carrier concentration of a Ferrite material
7. Lattice Dynamics**:** Study of the Phonon dispersion characteristics for mono atomic lattice
8. Measurement of ultrasonic velocity in binary liquid mixtures at different temperatures using ultrasonic interferometer at a fixed frequency.

**Reference Books:**


1) Solid State Electronic Devices - Ben G. Streetman and Sanjay Kumar Banerjee
2) Semiconductor Physics and Devices - Donald A. Neamen and Dhrubes Biswas
3) Physics for Scientists and Engineers - Raymond A. Serway and John W. Jewett
4) Introduction to Modern Solid-State Physics - Yuri M. Galperin
5) Solid State Physics – Laboratory Manual – Lucian ION
6) Advanced Practical Physics - B.L. Worsnop & H.T. Flint

# M.Sc. Physics Programme

## Matrix Mapping of PO's vs CO's

## (THIRD SEMSTER)

**P 301: SOLID STATE PHYSICS**

| | CO-1 | CO-2 | CO-3 | CO-4 | CO-5 |
|---|---|---|---|---|---|
| PO-1 | | | ✓ | | |
| PO-2 | ✓ | | | | |
| PO-3 | | ✓ | | | |
| PO-4 | | | | | |
| PO-5 | | | | | |

**P 302: LASERS & FIBER OPTICS**

| | CO-1 | CO-2 | CO-3 | CO-4 | CO-5 |
|---|---|---|---|---|---|
| PO-1 | | | | | |
| PO-2 | ✓ | | | | |
| PO-3 | | | ✓ | | |
| PO-4 | | | | | |
| PO-5 | | | | | ✓ |

**P 303: ELECTIVE PAPER: 1. DIGITAL ELECTRONICS AND MICROPROCESSORS**

| | CO-1 | CO-2 | CO-3 | CO-4 | CO-5 |
|---|---|---|---|---|---|
| PO-1 | | | | | |
| PO-2 | | ✓ | | | |
| PO-3 | | | ✓ | | |
| PO-4 | | | | ✓ | |
| PO-5 | | | | | ✓ |

**P 303: ELECTIVE PAPER: 2. PRINCIPLES OF ULTRASONICS**

| | CO-1 | CO-2 | CO-3 | CO-4 | CO-5 |
|---|---|---|---|---|---|
| PO-1 | ✓ | | | | |
| PO-2 | | ✓ | | | |
| PO-3 | | | | | |
| PO-4 | | | | ✓ | |
| PO-5 | | | | | |

**P 304: ELECTIVE PAPER: 1. MATERIAL SCIENCE**

| | CO-1 | CO-2 | CO-3 | CO-4 | CO-5 |
|---|---|---|---|---|---|
| PO-1 | ✓ | | | | |
| PO-2 | | ✓ | | | |
| PO-3 | | | ✓ | | |
| PO-4 | | | | | |
| PO-5 | | | | ✓ | |

**P 304: ELECTIVE PAPER:**

**2. RADAR SYSTEMS AND SATELLITE COMMUNICATIONS**

| | CO-1 | CO-2 | CO-3 | CO-4 | CO-5 |
|---|---|---|---|---|---|
| PO-1 | ✓ | | | | |
| PO-2 | | | | | |
| PO-3 | | ✓ | ✓ | | |
| PO-4 | | | | ✓ | |
| PO-5 | | | | | |

**P 305: DIGITAL ELECTRONICS & MICROPROCESSOR LAB**

| | CO-1 | CO-2 | CO-3 | CO-4 | CO-5 |
|---|---|---|---|---|---|
| PO-1 | | ✓ | | | |
| PO-2 | | | ✓ | | |
| PO-3 | | | | | |
| PO-4 | ✓ | | | | |
| PO-5 | | | | ✓ | |

**P 306: SOLID STATE PHYSICS LAB**

| | CO-1 | CO-2 | CO-3 | CO-4 | CO-5 |
|---|---|---|---|---|---|
| PO-1 | | | ✓ | | |
| PO-2 | ✓ | | | | |
| PO-3 | | | | | |
| PO-4 | | ✓ | | | |
| PO-5 | | | | | |