MANONMANIAM SUNDARANAR UNIVERSITY,
TIRUNELVELI-12

SYLLABUS

UG - COURSES – AFFILIATED COLLEGES

Course Structure for B. Sc. Physics
(Choice Based Credit System)
(with effect from the academic year 2023-2024 onwards)

Semester-VI				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
III	CORE	RELATIVITY AND QUANTUM MECHANICS		4
III	CORE	SOLID STATE PHYSICS		4
III	CORE	DIGITAL ELECTRONICS AND MICROPROCESSOR 8085		4
III	CORE	PHYSICS PRACTICAL VII		2
III	CORE	PHYSICS PRACTICAL VIII		2
III	ELECTIVE	ENERGY PHYSICS/ MATERIAL SCIENCE/ NANOSCIENCE AND NANOTECHNOLOGY		2
IV	NAAN MUDHALVAN	NAAN MUTHALAVAN / APPLIED PHYSICS		2
V	EXTENSION ACTIVITY	NSS/ NCC/ YRC/ PHYSICAL EDUCATION		1

Total Marks: 100 Internal Exam: 25 marks + External Exam: 75 marks

A. **Scheme for internal Assessment**:
Maximum marks for written test: **20 marks**
3 internal tests, each of **I hour** duration shall be conducted every semester.
To the average of the **best two** written examinations must be added the marks scored in. The **assignment** for 5 marks.

The break up for internal assessment shall be:
Written test- 20 marks; Assignment -5 marks Total - 25 marks

B. Scheme of External Examination
3 hrs. examination at the end of the semester
A – Part : 1 mark question two - from each unit
B – Part : 5 marks question one - from each unit
C – Part : 8 marks question one - from each unit

- **Conversion of Marks into Grade Points and Letter Grades**

S.No	Marks	Letter Grade	Grade point (GP)	Performance
1	90-100	O	10	Outstanding
2	80-89	A+	9	Excellent
3	70-79	A	8	Very Good
4	60-69	B+	7	Good
5	50-59	B	6	Above Average
6	40-49	C	5	Pass
7	0-39	RA	-	Reappear
8	0	AA	-	Absent

- **Cumulative Grade Point Average (CGPA)**

$$\mathbf{CGPA} = \frac{\mathbf{\Sigma\,(GP \times C)}}{\mathbf{\Sigma C}}$$

- **GP** = Grade point, **C** = Credit
- CGPA is calculated only for Part-III courses
- CGPA for a semester is awarded on cumulative basis

- **Classification**
  a) First Class with Distinction : CGPA $\geq$ 7.5*****
  b) First Class : CGPA $\geq$ 6.0
  c) Second Class : CGPA $\geq$ 5.0 and $<$ 6.0
  d) Third Class : CGPA$<$ 5.0

RELATIVITY AND QUANTUM MECHANICS

Course Objectives

- To understand the theory of relativity, its postulates and the consequences.
- To learn the importance of transformation equations. And also, to learn special theory of relativity.
- To interpret the wave theory of matter with various theoretical and experimental evidences.
- To derive and use Schrodinger‘s wave equation and also learn about various operators.
- To solve Schrodinger‘s wave equation for simple problems and analyse to understand the solutions.

UNIT-I

SPECIAL THEORY OF RELATIVITY: Frames of reference – Galilean Relativity – Postulates of special theory of relativity – Lorentz transformations – length contraction – time dilation – concept of simultaneity – variation of mass with velocity – Einstein‘s mass-energy relation – relativistic momentum – energy relation.

UNIT-II

FAILURE OF CLASSICAL PHYSICS: Black body radiation – Failure of Classical Physics to explain energy distribution in the spectrum of a black body – Planck‘s Quantum theory – Wein‘s distribution law – Rayleigh Jean‘s law. Photo Electric Effect – Difficulty with Classical Physics – Einstein‘s Photo Electric Equation – work function.

UNIT-III

CONCEPT OF MATTER WAVES: de Broglie‘s concept of matter waves – expression for de Broglie‘s wave length – phase velocity – group velocity – relationship. Heisenberg‘s Uncertainty Principle – Elementary proof of Heisenberg‘s uncertainty relations.

UNIT-IV

OPERATORS AND SCHRÖDINGER EQUATION: Postulates of quantum mechanics – Wave function and its interpretation – linear operators – Eigenvalue – Hermitian operator – Properties of Hermitian operator – Commutator Algebra.

SCHRÖDINGER EQUATION: Schrodinger‘s wave equation in time dependent form – Steady state Schrodinger‘s wave equation – extension to three dimensions.

UNIT-V

APPLICATIONS OF SCHRÖDINGER EQUATIONS: Particle in a one-dimensional box – Particle in a rectangular three- dimensional box. Simple harmonic oscillator – One dimensional simple harmonic oscillator in quantum mechanics

– zero-point energy. Reflection at a step potential – Transmission across a potential barrier – Barrier Penetration (tunnelling effect).

TEXT BOOKS

1. Modern Physics, R. Murugeshan, KiruthigaSivaprasath,S. Chand and Co.,17th Revised Edition, 2014.
2. Concepts of Modern Physics, A.Beiser, 6th Ed., McGraw-Hill, 2003. 3. Special Theory of Relativity,S. P.Puri, Pearson Education, India, 2013.
3. Quantum Mechanics, GhatakandLoganathan, Macmillan Publications.
4. Quantum mechanics – Satyaprakash and Swati Saluja. KedarNath Ram Nathand Co.

REFERENCE BOOKS

1. Fundamentals of Modern Physics, Peter J. Nolan, 1stEdition, 2014, by Physics
2. Quantum Mechanics, V. Devanathan, Narosa Pub. House, Chennai, 2005.
3. Quantum Mechanics, V.K. Thangappan, New Age International, New Delhi.
4. A Text Book of Quantum Mechanics, Mathews andVenkatesan, Tata McGraw Hill, New Delhi.
5. Introduction to Quantum Mechanics, Pauling and Wilson, McGraw Hill Co., NewYork.

WEB RESOURCES

1. http://hyperphysics.phy-astr.gsu.edu/hbase/qapp.html
2. https://swayam.gov.in/nd2_arp19_ap83/preview
3. https://swayam.gov.in/nd1_noc20_ph05/preview
4. https://www.khanacademy.org/science/physics/special-relativity/minkowski-spacetime/v/introduction-to-special-relativity-and-minkowski-spacetime-diagrams

SOLID STATE PHYSICS

Course Objectives

- To understand constituents, properties and models of nucleus.
- To give reason for radioactivity and study their properties.
- To learn about the principles of various particle detectors and accelerators.
- To acquire knowledge on different types of nuclear reactions and their applications.
- To know the reason for cosmic rays and their effect on the surface of earth and also understand the classification of elementary particles.

UNIT-I

BONDING IN SOLIDS, CRYSTAL STRUCTURE: types of bonding –ionic bonding – bond energy of NaCl molecule –covalent bonding — Van-der-Waals bonding – crystal lattice – lattice translational vectors – lattice with basis – unit cell – Bravais‘ lattices –crystal structure –packing of SCC, BCC, and FCC structures –

structures of NaCl and diamond crystals – Miller indices – procedure for finding them.

UNIT-II

ELEMENTARY LATTICE DYNAMICS: lattice vibrations and phonons: linear monoatomic and diatomic chains. acoustical and optical phonons – Dulong and Petit‘s Law –properties of metals – classical free electron theory of metals (Drude-Lorentz) – Ohm‘s law – electrical and thermal conductivities – Weidemann-Franz‘ law.

UNIT-III

MAGNETIC PROPERTIES OF SOLIDS: permeability, susceptibility, relation between them – classification of magnetic materials – properties of dia, para,ferro, ferri and antiferromagnetism – Langevin‘stheory of diamagnetism – Weiss theory of paramagnetism – Curie-Weiss law – Weiss theory of ferromagnetism(qualitative only) –domains –B-H curve –hysteresis and energy loss – soft and hard magnets.

UNIT-IV

DIELECTRIC PROPERTIES OF MATERIALS: Basic definitions -polarization and electric susceptibility –local electric field of an atom – dielectric constant and polarisability – polarization processes: electronic polarization– calculation of polarisability – ionic, orientational and space charge polarization –internal field – Clausius-Mosotti relation –frequency dependence of dielectric constant –dielectric loss – effect of temperature on dielectric constant.

UNIT-V

FERROELECTRIC & SUPERCONDUCTING PROPERTIES OF MATERIALS: ferroelectric effect: Curie-Weiss Law – ferroelectric domains,– elementary band theory: band gap(no derivation) — Hall effect – measurement of conductivity (four probe method) - Hall coefficient.

Superconductivity: general properties of superconducting materials –critical temperature –critical magnetic field – Meissner effect –isotope effect– type-I and type-II superconductors – London‘s equation and penetration depth.

TEXT BOOKS

1. Introduction to Solid State Physics,Kittel, Willey Eastern Ltd (2003).
2. Solid state Physics, Rita John,1st edition, TataMcGraw Hill publishers (2014).
3. Solid State Physics , R L Singhal, Kedarnath Ram Nath& Co., Meerut (2003)
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
5. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
6. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
7. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer

8. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
9. Solid State Physics, M.A. Wahab, 2011, Narosa Publishing House, ND

REFERENCE BOOKS

1. Puri & Babber – Solid State Physics – S.Chand & Co. New Delhi.
2. Kittel - Introduction to solid state physics, Wiley and Sons, 7th edition.
3. Raghavan - Materials science and Engineering, PHI
4. Azaroff - Introduction to solids, TMH
5. S. O. Pillai - Solid State Physics, Narosa publication
6. A.J. Dekker - Solid State Physics, McMillan India Ltd.
7. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
8. Solid State Physics, K. Ilangovan, 1st Edition, MJP Publishers, 2021.

WEBLINKS

1. https://nptel.ac.in/courses/115105099/
2. https://nptel.ac.in/courses/115106061/

DIGITAL ELECTRONICS AND MICROPROCESSOR 8085

Course Objectives

- To learn all types of number systems, Boolean algebra and identities, digital circuits for addition and subtraction, flip-flops, registers, counters.
- To get the knowledge on fundamentals of 8085 architecture, instruction sets and simple programs.

UNIT-I

Decimal, binary, octal, hexadecimal numbers systems and their conversions – codes: BCD, gray and excess-3 codes –code conversions —binary addition, binary subtraction using 1‘s & 2‘s complement methods – Boolean laws – De-Morgan‘s theorem –basic logic gates -universal logic gates (NAND & NOR) –standard representation of logic functions (SOP & POS) – minimization techniques (Karnaugh map: 2, 3, 4 variables).

UNIT-II

Adders: half &full adder – subtractors: half & full subtractor –parallel binary adder – magnitude comparator – multiplexers (4:1) & demultiplexers (1:4), encoder (8-line-to-3- line) and decoder (3-line-to-8-line), BCD to seven segment decoder.

UNIT-III

Flip-flops: R-S Flip-flop , J-K Flip-flop, T and D type flip-flops, master-slave flip-

flop, truth tables, registers:- serial in serial out and parallel in and parallel out – counters asynchronous:-mod-8, mod-10, synchronous - ring counter and up-down counter – A/D and D/A converter.

UNIT-IV

General memory operations, ROM, RAM (static and dynamic), PROM, EPROM, EEPROM, EAROM. IC – logic families: RTL, DTL, TTL logic, CMOS NAND & NOR Gates, CMOS Inverter, Programmable Logic Devices – Programmable Logic Array (PLA), Programmable Array Logic (PAL).

UNIT-V

8085 Microprocessor: Introduction to microprocessor – pin configuration of 8085 – Flags – Registers (General and special purpose) –interrupts and its priority – instruction set of 8085 – addressing modes of 8085 - Assembly language programming using 8085 – programs for addition, subtraction, multiplication and division (8-Bit only).

TEXT BOOKS

1. M.Morris Mano, ―Digital Design ―3rd Edition, PHI, NewDelhi.
2. Ronald J. Tocci. ―Digital Systems-Principles and Applications‖ 6/e. PHI. New Delhi. 1999.(UNITS I to IV)
3. S.Salivahana& S. Arivazhagan-Digital circuits and design
4. Microprocessor Architecture, Programming and Applications with the 8085 – Penram International Publishing, Mumbai.- Ramesh S.Gaonakar
5. Microcomputer Systems the 8086/8088 family – YU-Cheng Liu and GlenSA

REFERENCE BOOKS

1. Herbert Taub and Donald Schilling. ―Digital Integrated Electronics‖ . McGraw Hill. 1985.
2. S.K. Bose. ―Digital Systems‖. 2/e. New Age International.1992.
3. D.K. Anvekar and B.S. Sonade. ―Electronic Data Converters: Fundamentals &Applications‖. TMH.1994.
4. Malvino and Leach. ―Digital Principles and Applications‖. TMG HillEdition
5. Microprocessors and Interfacing – Douglas V.Hall
6. Microprocessor and Digital Systems – Douglas V.Hall

WEBLINKS

1. https://youtu.be/-paFaxtTCkI
2. https://youtu.be/s1DSZEaCX_g

ELECTIVE: **Energy Physics/ Material Science/ Nanoscience and Nanotechnology**

ENERGY PHYSICS

Learning Objective:

- To get the understanding of the conventional and non-conventional energy sources, their conservation and storage systems.

UNIT-I

INTRODUCTION TO ENERGY SOURCES: World reserve of energy sources – energy sources and their availability – conventional energy sources – non-conventional and renewable energy sources – comparison – merits, demerits and applications of fossil fuels.

UNIT-II

SOLAR ENERGY: Introduction – solar constant – solar radiation at the Earth‘s surface–solar energy storage and storage systems – solar pond – solar cooker – solar water heater – solar crop dryer - solar greenhouse – types of greenhouses – Merits and demerits of solar energy

UNIT-III

WIND ENERGY: Introduction - Classification and description of Wind Energy Conversion Systems (WECS) – Principle and working of wind energy collectors - Ocean Thermal Energy Conversion (OTEC)- tidal energy - advantages and disadvantages of WECS, OTEC and Tidal energy

UNIT-IV

BIOMASS ENERGY: Introduction – classification – biomass conversion technologies – Thermochemical and biochemical conversion – biogas generation – classification of biogas plants –floating drum plant – fixed dome type plant - advantages & disadvantages.

UNIT-V

ENERGY STORAGE: Importance of energy storage- batteries - lead acid battery - nickel-cadmium battery – fuel cells – types of fuel cells – advantages and disadvantages of fuel cells – applications of fuel cells.

TEXT BOOKS

1. G.D.Rai, Non-Conventional Sources of Energy, Khanna Publishers, 2009, 4thEdn.
2. S P Sukhstme, J K Nayak, Solar Energy, Principles of Thermal Collection and

Storage, McGraw Hill, 2008, 3rdEdn.
3. D P Kothari, K P Singal, RakeshRajan, PHI Learning Pvt Ltd, 2011, 2ndEdn.

REFERENCE BOOKS

1. John Twidell& Tony Weir, Renewable Energy Resources, Taylor & Francis, 2005, 2ndEdn.
2. S.A. Abbasi and NasemaAbbasi, Renewable Energy sources and their environmental impact, PHI Learning Pvt. Ltd, 2008.
3. M. P. Agarwal, Solar Energy, S. Chand & Co. Ltd., New Delhi,1982
4. H. C. Jain, Non-Conventional Sources of Energy, Sterling Publishers,1986.

MATERIALS SCIENCE

Learning Objective:

To learn imperfections in crystals, deformation of materials and testing of materials. To get knowledge on behavior of a material, under the action of light and their applications. To know the applications of crystal defects.

UNITS

COURSE DETAILS

UNIT-I

CRYSTAL IMPERFECTIONS: introduction – point defects: vacancies(problems), interstitials, impurities, electronic defects –point defects –line defects: edge dislocation(problems), screw dislocation – surface defects: extrinsic defects – intrinsic defects: grain boundaries, tilt &twist boundaries, twin boundaries, stacking faults – volume defects – effect of imperfections.

UNIT-II

MATERIAL DEFORMATION: introduction – elastic behavior of materials – atomic model of elastic behavior –modulus as a parameter in design – rubber like elasticity – inelastic behavior of materials – relaxation process – viscoelastic behavior of materials.

UNIT-III

PERMANENT DEFORMATION AND STRENGTHENING METHODS OF MATERIALS: introduction –plastic deformation: tensile stress-strain curve – plastic deformation by slip – creep: mechanism of creep – creep resistant materials – strengthening methods: strain hardening, grain refinement – solid solution strengthening.

UNIT-IV

OPTICAL MATERIALS: introduction – optical absorption in metals, semiconductors and insulators – NLO materials and their applications – display devices and display materials: fluorescence and phosphorescence – light emitting diodes –liquid crystal displays.

UNIT-V

MECHANICAL TESTING: destructive testing: tensile test, hardness test – nondestructive testing (NDT): radiographic methods – thermal methods of NDT: thermography – equipment used for NDT:
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metallurgical microscope
TEXT BOOKS
1. Materials science and Engineering, Raghavan V, Prentice Hall of India, Sixth Edition, 2015
2. Materials science, V. Rajendran, McGraw Hill publications2011
REFERENCE BOOKS
1. William D. Callister, Jr., Material Science & Engineering – An Introduction, 8th Edition, John Wiley & Sons, Inc., 2007
2. W. Bolton, ―Engineering materials technology‖, 3rd Edition, Butterworth & Heinemann, 2001.
3. Donald R. Askeland, Pradeep P. Phule, ―The Science and Engineering of Materials‖, 5th Edition, Thomson Learning, First Indian Reprint, 2007.
8. William F. Smith, ―Structure and Properties of Engineering Alloys‖, Mc-Graw-Hill Inc., U.S.A, 2nd edition, 1993.

SIXTH SEMESTER –ELECTIVE COURSE (EC -6)
NANOSCIENCE AND NANO TECHNOLOGY
Learning Objective: This course aims to provide an overall understanding of Nanoscience and Nanotechnology and introduces different types of nanomaterials, their properties, fabrication methods, characterization techniques and a range of applications.
UNITS
COURSE DETAILS
UNIT-I
NANOSCIENCE AND NANOTECHNOLOGY: Introduction
Nanoscale. Nanostructures: 0D, 1D,2D– surface to volume ratio– size effect – excitons – quantum confinement– metal based nanoparticles (metal and metal oxide) – nanocomposites (non-polymer based) – carbon nanostructures – fullerene –SWCNT and MWCNT
UNIT-II
PROPERTIES OF NANOMATERIALS:
Introduction –mechanical behavior –elastic properties – hardness and strength – ductility and toughness– optical properties – surface plasmon resonance – electrical properties – dielectric materials and properties – magnetic properties – super paramagnetism – properties of CNTs.
UNIT-III

FABRICATION METHODS AND VACUUM TECHNIQUES:

Top-down and bottom-up approaches – electrochemical method – chemical & physical vapour depositions (CVD & PVD) – thermal evaporation. Lithography: photolithography – sol-gel methods – synthesis of CNT.

UNIT-IV

CHARACTERIZATION TECHNIQUES:

Atomic force microscopy – scanning electron microscopy – transmission electron microscopy. Powder XRD method: determination of structure and grain size analysis – UV-visible and photoluminescence spectroscopy.

UNIT-V

APPLICATIONS OF NANOMATERIALS:

Medicine: drug delivery – photodynamic therapyEnergy: fuel cells –rechargeable batteries – supercapacitors. Sensors: nanosensors based on optical and physical properties – Nanoelectronics: CNTFET – display screens– GMR read/write heads — applications of CNTs .

TEXT BOOKS

1. K.K.Chattopadhyay and A.N.Banerjee, (2012), Introduction to Nanoscience and Nanotechnology, PHI Learning Pvt. Ltd.,

2. M.A. Shah, Tokeer Ahmad (2010), Principles of Nanoscience and Nanotechnology, Narosa Publishing House Pvt Ltd.

3. Mick Wilson, et al (2005) Nanotechnology, Overseas Press.

REFERENCE BOOKS

1. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA

2. J.H.Fendler (2007) Nano particles and nano structured films; Preparation, Characterization and Applications, John Wiley & Sons

3. B.S.Murty, et al (2012) Textbook of Nanoscience and Nanotechnology, Universities Press.

PHYSICS PRACTICAL VII

Course Objectives

- Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.

GENERAL PHYSICS EXPERIMENTS - II

Minimum of **Six** Experiments from the list:

1. Spectral response of photo conductor (LDR).
2. Potentiometer –Resistance and Specific resistance of the coil.
3. Potentiometer – E.M.F of a thermocouple.
4. Carey Foster‘s bridge - Temperature coefficient of resistance of the coil..
5. Conversion of Galvanometer into Voltmeter and Ammeter

6. Young‘s Modulus – Hyperbolic Fringes
7. Potentiometer – Temperature Coefficient of Resistance
8. Spectrometer - Hartmann‘s interpolation formula
9. Self-inductance – Rayleigh‘s Bridge
10. Impedance and power factor – LR Circuit
11. Comparison of mutual inductance M1 / M2 - Ballistic Galvanometer
12. Moment of Magnet - Tan C position

PHYSICS PRACTICAL 8

Course Objectives

- To perform basic experiments on characteristics of electronic devices and then get into the applications such as amplifiers, oscillators, counters, multivibrators. Perform fundamental experiments on microprocessor 8085 and learn to write programs by themselves.

ELECTRONICS EXPERIMENTS - II

Minimum of **Six** Experiments from the list:.

1. Operational amplifier – Voltage follower
2. Operational amplifier - differentiator and integrator.
3. Wein‘s Bridge Oscillator using IC 741
4. Hartley oscillator - transistor.
5. Study of gate ICs – NOT, OR, AND, NOR, NAND, XOR
6. Verification of De Morgan's theorem using ICs –NOT, OR, AND
7. Verification of Boolean Algebra (any four)
8. NAND as universal building block.
9. NOR as universal building block.
10. Half adder / Full adder using ICs
11. Monostable Multivibrator suing 555 Timer
12. Seven Segment Display using IC7490 and IC 7447
13. Microprocessor 8085 – addition (8 bit only)
14. Microprocessor 8085 – subtraction (8 bit only)

NAAN MUTHALVAN / APPLIED PHYSICS

Course Objectives

- This paper enables the students to understand variable energy sources and the need for finding alternate energy source..

UNIT-I

Conventional energy sources

Conventional energy sources –world‘s reserve of conventional energy sources–various forms of energy-renewable and conventional energy systems- comparison

UNIT-II

Fossil fuels

Fossil fuels – coal, oil, and natural gas-availability-statistical details- applications-merits and demerits.

UNIT-III

Biomass energy: Biomass energy-biomass classification-biomass conversion process-biogas plants- wood gasification-advantages and disadvantages of biomass

UNIT-IV

Renewable energy sources

Renewable energy sources-solar energy - importance - storage of solar energy - applications of solar energy -solar pond - solar water heater-solar crop dryers-solar cookers- solar cell.

UNIT-V

Geothermal energy

Geothermal energy-Geothermal power plant-wind energy and wind farms- wind mills.

TEXT BOOKS

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand & Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd., New Delhi.