MANONMANIAM SUNDARANAR UNIVERSITY -TIRUNELVELI

PG **PROGRAMMES**

OPEN AND DISTANCE LEARNING (ODL) PROGRAMMES

(FOR THOSE WHO JOINED THE PROGRAMMES FROM THE ACADEMIC YEAR 2023-2024 ONWARDS)

M.Sc. Physics			
Semester	**Course**	**Title of the Course**	**Course Code**
III	Core-VII	Quantum Mechanics-II	SPHM31
	Core-VIII	Condensed Matter Physics	SPHM32
	Core-IX	Numerical Methods and Programming in C++	SPHM33
	Core X	Practical – III	SPHP31
	Discipline Centric Elective- V	Spectroscopy	SPHE31
	Skill Enhancement Course II	Microprocessor 8085 and Microcontroller 8051	SPHS31
	Internship		SPHT31

Quantum Mechanics-II

Unit	Details
I	SCATTERING THEORY Scattering amplitude – Cross sections – Born approximation and its validity – Scattering by a screened coulomb potential – Yukawa potential – Partial wave analysis – Scattering length and Effective range theory for S wave – Optical theorem – Transformation from centre of mass to laboratory frame.
II	PERTURBATION THEORY Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule – Transition probability - Einstein‘s A and B Coefficients – Adiabatic approximation – Sudden approximation – Semi – classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation .
III	RELATIVISTIC QUANTUM MECHANICS Klein – Gordon Equation – Charge and Current Densities – Dirac Matrices – Dirac Equation – Plane Wave Solutions – Interpretation of Negative Energy States – Antiparticles – Spin of Electron - Magnetic Moment of an Electron Due to Spin.
IV	DIRAC EQUATION Covariant form of Dirac Equation – Properties of the gamma matrices – Traces – Relativistic invariance of Dirac equation – Probability Density – Current four vector – Bilinear covariant – Feynman ‘s theory of positron (Elementary ideas only without propagation formalism)
V	CLASSICAL FIELDS AND SECOND QUANTIZATION Classical fields – Euler Lagrange equation – Hamiltonian formulation – Noether‘s theorem – Quantization of real and complex scalar fields – Creation, Annihilation and Number operators – Fock states – Second Quantization of K-G field.
VI	PROFESSIONAL COMPONENTS Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS
P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics,2nd Edition, Tata McGraw-Hill, New Delhi, 2010.
G. Aruldhas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi,2009
L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill Kogakusha, Tokyo, 1968
V. Devanathan, Quantum Mechanics, 1st Edition, Narosa Publishing House, New Delhi, 2005.
Nouredine Zettili, Quantum mechanics concepts and applications, 2nd Edition, Wiley, 2017.

Condensed Matter Physics

Unit	Details
I	**Crystal Physics** Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures – Atomic Packing Factor-Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal Lattice (SC,BCC, FCC). Structure and properties of liquid crystals. Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).
II	**Lattice Dynamics** Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umklapp processes..
III	**Theory Of Metals And Semiconductors** Free electron gas in three dimensions - Electronic heat capacity - Wiedemann-Franz Law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration – Temperature Dependence - Mobility - Impurity conductivity – Impurity states - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies - De Hass-van Alphen effect.
IV	**Magnetism** Diamagnetism - Quantum theory of Para-magnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferromagnetic material - Neel temperature.
V	**Superconductivity** Experimental facts: Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - Type I and II Superconductors. Theoretical Explanation: Thermodynamics of super conducting transition - London equations - Coherence length – Isotope effect - Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory - Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High Temperature Superconductors – SQUIDS.
VI	**Professional Components** Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS
C. Kittel, 1996, Introduction to Solid State Physics, 7 th Edition, Wiley, New York.
Rita John, Solid State Physics, Tata Mc-Graw Hill Publication.
A. J. Dekker, Solid State Physics, Macmillan India, New Delhi.
M. Ali Omar, 1974, Elementary Solid State Physics – Principle and Applications, Addison - Wesley
H. P. Myers, 1998, Introductory Solid State Physics, 2 nd Edition Viva Book, New Delhi.

Numerical Methods And Programming In C++

Unit	Details
I	**Roots Of Equation** Roots of equation: Bisection method – False position method – Newton Raphson method – Secant method – Order of convergence. Simultaneous Equations: Existence of solutions- Basic Gauss elimination method – Gauss Jacobi iteration method – Gauss Seidal iteration method – Inverse of a matrix using Gauss elimination method .
II	**Curve Fitting – Interpolation** Curve fitting: Method of least squares – straight line, fitting a parabola, fitting y = axn , y = aebx type curves – Interpolation: Polynomial Interpolation – Lagrange polynomial – Newton polynomial - Forward and Backward differences – Gregory Newton forward and backward interpolation formula for equal intervals – Divided difference – properties of divided differences – Newton's divided differences formula – Lagrange's interpolation formula for unequal interval..
III	**Eigen Values, Differentiation And Integration** Eigenvalues: Power method to find dominant Eigenvalue - Jacobi method **Numerical differentiation**: Numerical differentiation – Formulae for derivatives – Taylors Series Method - Forward backward differences and central difference formula **Numerical Integration** : Newton – cotes formula – Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, – Error estimates in trapezoidal and Simpson's rule – Monte Carlo Method.
IV	**Differential Equations** **Ordinary differential equation**: Solution by Taylor's series –- Basic Euler method –Improved and Modified Euler method – Runge Kutta fourth order method – solution of simultaneous first order differential equations and second order differential equations by RK fourth order Method **Partial differential equation**: Introduction- Classification of partial differential equation of the 2nd order – Finite Difference approximations - Solution of Laplace's equation – Solution of Poisson's Equation –standard five point formula and diagonal five point formula (Jacobi and Gauss Seidal Methods).
V	**Programming In C++** Program structure and header files - Basic data types- operators - Control Structures: decision making and looping statements. Arrays, Strings, Structures, Pointers and File handling. Application programs – Solution to Algebraic and transcendental equations by Newton Raphson Method - Charging and discharging of a condenser by Euler's Method – Radioactive Decay by Runge Kutta fourth order method - Currents in Wheatstone's bridge by Gauss elimination method - Cauchy's constant by least square method - Evaluation of integral by Simpson's and Monte-Carlo methods - Newton's Law of cooling by Numerical differentiation.
VI	**Professional Components** Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	
Introductory methods of numerical analysis, S. S. Sastry, Prentice Hall of India, 2010	
Numerical methods for mathematics, science and engineering, John H. Matthews, Prentice Hall of India, 2nd Edition, 2000	
M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering computation, 3 rd edition, New age international (P) Ltd, Chennai , 1998.	
Object Oriented Programming with C++ by E. Balagurusamy, Tata McGraw-Hill , India, 4th Edition	

PRACTICAL III

Advanced Physics Experiments – I and Microprocessor 8085 & Microcontroller 8051 Programming

Section A (Any 6 Experiments)

1. Determination of Cauchy's Constant of the given prism – material. Obtain data by doing the Cauchy's Experiment and fitting a straight line using any software.

2. Determination Rydberg constant using Hydrogen Vapor lamp source.

3. Determination of Magnetoresistance of the given material.

4. Determination of Dielectric constant of the given liquid medium using Colpitt's oscillator or LCR circuit.

5. Photo Transistor Characteristics.

6. Temperature measurement using Si Diode as a Temperature Sensor (Calibrate the sensor using LM35)

7. Analysis of rotation and vibration spectrum /Interpretation of vibrational spectra of a given material

8. Determination of e/k using Transistors

9. Temperature coefficient of a Thermistor using 555 timer or any other method.

10. To study I-V Characteristics, Load Response, and Spectral Response of Photovoltaic Solar Cell

11. Pspice Simulation: Designing and simulating an Astable Multivibrator using a 555 Timer for the given frequency.

12. Pspice Simulation: Simulation of a Zener diode characteristics and voltage regulator.

Section B : Microprocessor 8085 and Microcontroller 8051 Programming
(Any 6 Experiments)
All Programs should contain Algorithms and Flowcharts
8085 Microprocessor Programs

1. Arithmetic Operations

a) Addition of two 8 bit and two 16 bit numbers
b) Subtraction of two 8 bit and 16 bit numbers
c) Multiplication of two 8 bit numbers –16-bit result.

2. Data Manipulation

a) Arrange the given data items in Ascending or Descending order
b) Finding the Minimum or Maximum value in the given data set.
c) Search of a given character/number in the given data set.

3. System Call and Rolling character

a) Calculation of time delay for a given interval.
b) Roll a given character from Left to Right / Right to Left on the 7 segment displays with the specified time interval.

4. ADC Interfacing and Conversion

a) Interfacing ADC with 8085 – ADC chip Bloc k diagram – 8085 - ADC interfacing diagram
b) Conversion of analog input to digital – Resolution – Graph between input and output.

5. DAC interfacing and Wave form generation.

Interfacing DAC with 8085 – DAC Chip Block diagram – 8085 - DAC - 8085 interfacing diagram Wave Form Generation using DAC

a) Square wave with the specified period T
b) Rectangular Wave with Specified TH and TL
c) Ramp Wave

8051 Programs using Simulator - MCU8051 IDE (Freeware)

6. Data Transfer Programming

a) Write an assembly language program to transfer N bytes of data from location A: XX H to location B: YYH in the internal RAM
b)Write an assembly language program to exchange N bytes of data at location A: XX h and at location B:YY H.

7. Data Manipulation

a) Write an assembly language program to find the largest element in a given array of N =___ h bytes at location 4000h. Store the largest element at location 4062h.
b) Write an assembly language program to count number of ones and zeros in an eight bit number.

8. Arithmetic Programming

a) Write an assembly language program to perform the addition of two 16-bit numbers.
b) Write an assembly language program to perform the subtraction of two 16-bit numbers.
c) Write an assembly language program to perform the multiplication of two 8-bit numbers.
d) Write an assembly language program to find the square of a given number N.

9. Code Conversion

a) Write an assembly language program to convert a BCD number into ASCII.
b) Write an assembly language program to convert a ASCII number into Decimal.
c) Write an assembly language program to convert a decimal number into ASCII.
d) Write an assembly language program to convert a binary (hex) number into decimal.
e) BCD to 7 Segment Code

10. Counter

Write an assembly language program to implement a decimal counter and show the count on the7segment display virtual hardware available in the simulator. Write and use a proper delay routine.

Spectroscopy

Unit	Details
I	**Microwave Spectroscopy** Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules - Instrumentation techniques – block diagram -Information Derived from Rotational Spectra - Problems.
II	**Infra-Red Spectroscopy** Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch- Fundamental modes of vibration of H2O and CO2 -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy - Interpretation of vibrational spectra – Simple applications.
III	**Raman Spectroscopy** Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- SR branch -Raman activity of H2O and CO2 -Mutual exclusion principle- determination of N2O structure -Instrumentation technique and block diagram -structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy- Surface Enhanced Raman Spectroscopy.
IV	**Resonance Spectroscopy** Nuclear and Electron spin- Interaction with magnetic field - Population of Energy levels - Larmor precessionRelaxation times - Double resonance- Chemical shift and its measurement - NMR of Hydrogen nuclei - Indirect Spin -Spin Interaction – interpretation of simple organic molecules - Instrumentation techniques of NMR spectroscopy – NMR in Chemical industries- MRI Scan Electron Spin Resonance: Basic principle –Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors – Instrumentation - Medical applications of ESR
V	**Uv Spectroscopy** Origin of UV spectra - Laws of absorption – Lambert Beer law - molar absorptivity – transmittance and absorbance - Color in organic compounds-

	Absorption by organic Molecule -Chromophores -Effect of conjugation on chromophores - Choice of Solvent and Solvent effect - Absorption by inorganic systems - Instrumentation - double beam UV-Spectrophotometer -Simple applications
VI	**Professional Components** Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Knowledge about sample preparations and equipment – cells and cuvettes – sample holders - software and computational tools for spectroscopic data analysis and interpreting spectroscopic data.
TEXT BOOKS	
C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi.	
G Aruldhas, 1994, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi.	
D.N. Satyanarayana, 2001, Vibrational Spectroscopy and Applications, New Age International Publication.	
B.K. Sharma, 2015, Spectroscopy, Goel Publishing House Meerut.	
Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7th Edition), New Age International Publishers	

Microprocessor 8085 And Microcontroller 8051

Unit	Details
I	**8085 Programming, Peripheral Devices And Their Interfacing** Instruction set - Addressing modes - Programming techniques -Memory mapped I/O scheme- I/O mapped I/O scheme -Memory and I/O interfacing- Data transfer schemes – Interrupts of 8085 - Programmable peripheral interface (PPI) - Control group and control word- Programmable DMA controller - Programmable interrupt controller – Programmable communication interface - Programmable counter /interval timer.
II	**8085 Interfacing Applications** Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter – Stepper motor interface - Measurement of electrical quantities –Voltage and current) Measurement of physical quantities (Temperature an strain).
III	**8051 Microcontrollerhardware** Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input/Output pins, Ports and Circuits – External data memory and program memory: External program memory, External data memory**.**
IV	**8051 Instruction Set And Assembly Language Programming** Addressing modes – Data moving (Data transfer) instructions: Instructions to Access external data memory, external ROM /program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions: byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions: Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions: Jump and Call program range, Jump, Call and subroutines – Programming.

V	**Interrupt programming and interfacing to external World** 8051 Interrupts – Interrupt vector table – Enabling and disabling an interrupt – Timer interrupts and programming – Programming external hardware interrupts – Serial communication interrupts and programming – Interrupt priority in the 8051 : Nested interrupts , Software triggering of interrupt. LED Interface Seven segment display interface- Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities – Voltage and current) Measurement of physical quantities (Temperature an strain).
VI	**Professional Components** Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS

A. NagoorKani, Microprocessors & Microcontrollers, RBA Publications (2009).

A. P. Godse and D. A. Godse, Microprocessors, Technical Publications, Pune (2009).

Ramesh Gaonkar, Microprocessor Architecture, Programming and 98 Applications with 8085, Penram International Publishing (2013)

B. Ram, Fundamentals of Microprocessors & Microcontrollers, DhanpatRai publications New Delhi (2016).

V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition
S.Visvanathan Pvt, Ltd.