



MANONMANIAM SUNDARANAR UNIVERISTY,  
TIRUNELVELI-12

## SYLLABUS

### UG - COURSES – AFFILIATED COLLEGES

Course Structure for M. Sc. Physics  
(Choice Based Credit System)

(with effect from the academic year 2023-2024 onwards )



Semester-III				
Part	Subject Status	Subject Title	Subject Code	Credit
III	CORE VII	QUANTUM MECHANICS-II	WPHM31	5
III	CORE VIII	CONDENSED MATTER PHYSICS	WPHM32	5
III	CORE IX	NUMERICAL METHODS AND PROGRAMMING IN C++	WPHM33	5
III	CORE X	PRACTICAL – III: ADVANCED PHYSICS EXPERIMENTS I AND MICROPROCESSOR 8085 & MICROCONTROLLER 8051 PROGRAMMING	WPHL31	4
III	ELECTIVE V	RESEARCH METHODOLOGY IN PHYSICS	WPHE32	3
III	SEC - 2	SEWAGE AND WASTE WATER TREATMENT AND REUSE	WPHSE36	2
III		INTERNSHIP / FIELD VISIT / INDUSTRIAL VISIT/ RESEARCH KNOWLEDGE UPDATING ACTIVITY	WPHI31	2



**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 **1 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)**

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

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

➤ **Classification**

- First Class with Distinction : CGPA  $\geq$  7.5\*
- First Class : CGPA  $\geq$  6.0
- Second Class : CGPA  $\geq$  5.0 and  $<$  6.0
- Third Class : CGPA  $<$  5.0



## **QUANTUM MECHANICS – II**

### **Learning Objectives**

- Formal development of the theory and the properties of angular momenta, both orbital and spin
- To familiarize the students to the crucial concepts of scattering theory such as partial wave analysis and Born approximation.
- Time-dependent Perturbation theory and its application to study of interaction of an atom with the electromagnetic field
- To give the students a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts
- To introduce the concept of covariance and the use of Feynman graphs for depicting different interactions

### **UNIT 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.

### **UNIT 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 .

### **UNIT 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.

### **UNIT 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)

### **UNIT 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.

## UNIT 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

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

### REFERENCE BOOKS

1. P.A.M. Dirac, The Principles of Quantum Mechanics, 4th Edition, Oxford University Press, London, 1973.
2. B.K. Agarwal & HariPrakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009.
3. Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics, 1st edition, I.K. International Publishing house Pvt. Ltd., 2006
4. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi.
5. E.Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970.

### WEB SOURCES

1. [https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture-notes/MIT8\\_05F13\\_Chap\\_09.pdf](https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture-notes/MIT8_05F13_Chap_09.pdf)
2. [http://www.thphys.nuim.ie/Notes/MP463/MP463\\_Ch1.pdf](http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf)
3. <http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf>
4. <https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf>
5. <https://web.mit.edu/dikaiser/www/FdsAmSci.pdf>



# CONDENSED MATTER PHYSICS

## Learning Objectives

- To describe various crystal structures, symmetry and to differentiate different types of bonding.
- To construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat.
- To critically assess various theories of electrons in solids and their impact in distinguishing solids.
- Outline different types of magnetic materials and explain the underlying phenomena.
- Elucidation of concepts of superconductivity, the underlying theories – relate to current areas of research.

## UNIT 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).

## UNIT 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.

## UNIT 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.

## UNIT 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.

### **UNIT 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.

### **UNIT 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**

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

### **REFERENCE BOOKS**

1. J.S. Blakemore, 1974 , Solid state Physics, 2nd Edition, W.B. Saunder, Philadelphia
2. H.M. Rosenberg, 1993, The Solid State, 3rd Edition, Oxford University Press, Oxford.
3. J.M. Ziman, 1971, Principles of the Theory of Solids, Cambridge University Press, London.
4. C.Ross-Innes and E. H. Rhoderick, 1976, Introduction to Superconductivity, Pergamon, Oxford.
5. J.P. Srivastava, 2001, Elements of Solid State Physics, Prentice-Hall of India, New Delhi.

### **WEB SOURCES**

1. <http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html>



2. <http://www.cmmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html>
3. <https://www.britannica.com/science/crystal>
4. <https://www.nationalgeographic.org/encyclopedia/magnetism/>
5. [https://www.brainkart.com/article/Super-Conductors\\_6824/](https://www.brainkart.com/article/Super-Conductors_6824/)

## NUMERICAL METHODS AND PROGRAMMING IN C++

### Learning Objectives

- To make students to understand different numerical approaches to solve a problem.
- To understand the basics of programming and its application to solve physical problems

### UNIT 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 .

### UNIT II - CURVE FITTING – INTERPOLATION

Curve fitting: Method of least squares – straight line, fitting a parabola, fitting  $y = ax^n$ ,  $y = aebx$  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

### UNIT III – EIGEN VALUES, DIFFERENTIATION AND INTEGRATION

**Eigenvalues**: Power method to find dominant Eigenvalue - Jacobi method

**Numerical differentiation**: Numerical differentiation – Formulae for derivatives – Taylor's 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.

### UNIT 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).

#### **UNIT 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.

#### **UNIT VI: PROFESSIONAL COMPONENTS**

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

#### **Books for Study**

1. Introductory methods of numerical analysis, S. S. Sastry, Prentice Hall of India, 2010
2. Numerical methods for mathematics, science and engineering, John H. Matthews, Prentice Hall of India, 2nd Edition, 2000
3. 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.
4. Object Oriented Programming with C++ by E. Balagurusamy, Tata McGraw-Hill , India, 4th Edition

#### **Books for Reference**

1. Computer Applications in Physics, S. Chandra, M.K. Sharma, Narosa, 3rd Edition, 2014
2. M. K. Venketraman, Numerical Methods in Science and Engineering 2nd Ed., National Publishing Co., Chennai (2010).
3. E. Balagurusamy, Computer Oriented Statistical and Numerical Methods, Macmillan India Ltd, New Delhi (2000).

#### **Related online resources:**

1. <https://youtu.be/LbKKzMag5Rc>
2. <https://youtu.be/Xb9Ypn77LBo>
3. <https://youtu.be/FfqAII0xkoY>





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

### **Learning Objectives**

- To make students to understand different concepts of physics
- To understand the basics of microprocessor and microcontroller 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 Block 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 the 7segment display virtual hardware available in the simulator. Write and use a proper delay routine.



## **RESEARCH METHODOLOGY IN PHYSICS**

### **UNIT I: RESEARCH THEORY**

Definition and importance of research in physics - Types of research: Theoretical, Experimental, and Computational Physics Research - Key concepts and theoretical frameworks - The role of theory in guiding physics research - Steps in planning a physics research project - Creating a research timeline specific to physics experiments - Importance of literature review - Sources of physics literature (journals, conference proceedings, preprints) - Techniques for effective literature review in physics- Defining the Research Problem in Physics- Steps and methods - Criteria for selecting a research problem - Identifying gaps in existing physics research - Formulating a clear and focused physics research question.

### **UNIT II: RESEARCH DESIGN IN PHYSICS:**

Definition and purpose of research design in physics - Key characteristics of an effective research design in physics- Balancing flexibility and rigor in physics experiments - Variables, hypotheses, and operational definitions in physics - Control and manipulation of variables in physics experiments -Types: Descriptive, correlational, experimental, and quasi-experimental designs in physics - Definition and significance of citation indices -Using citation indices to evaluate the impact of physics research - Impact Factor in the context of physics journals - Its role in academic publishing in physics - h-index and i10-index

### **UNIT III: DATA COLLECTION AND ANALYSIS:**

Measurement in research: Measurement scales, Sources of error in measurement, Tests of sound measurement, Scaling: Meaning of Scaling Classification Bases, Important Scaling Techniques- Methods of Data Collection: Collection of primary data, observation Method, Collection of data through schedules, Some other methods of data collection. Data Analysis Processing and Analysis of Data: Processing Operations, Elements/Types of Analysis: Basic statistics for experimental physics: Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation.

### **UNIT IV TECHNICAL & SCIENTIFIC WRITING**

Technical & Scientific writing - Technical papers, reviews, electronic communication, Research papers, etc., Poster preparation and Presentation and Dissertation. Reference Management using various software's such as Endnote, reference manager, Refworks, etc. Report Writing: Technique of Interpretation, Precaution in Interpretation. Significance of report Writing, Different Steps in Writing Report, Layout of the Research Report Types of Reports, Precautions for Writing Research Reports.

### **UNIT V: ETHICAL ISSUES**

Understanding research ethics - Significance of ethics in scientific research - Plagiarism ,definition of direct plagiarism, self-plagiarism, mosaic plagiarism , accidental plagiarism -, Tools and techniques to detect and avoiding plagiarism in scientific writing - Ethical issues in collaborative research – Case Studies in



Research: Famous case studies in physics research: Successes and failures - Analysis of landmark research papers -Lessons learned from historical research projects.

## UNIT VI: PROFESSIONAL COMPONENT

Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

### Text Books:

1. S.Gupta, Research Methodology and Statistical techniques (Deep and Deep Publications (P) Ltd. New Delhi, India) 2005.
2. C.R. Kothari, Research Methodology (New Age International, New Delhi, India) 2008.
3. Research Methods the Basics by Nicholas Walliaman, Taylor and Francis London& New York 2011.
4. Research Methodology A Step-By-Step Guide for Beginners 3rd Edition by Ranjit Kumar, Sage Publications
5. Data Reduction and Error Analysis for the Physical Sciences 3rd Ed by Philip R Bevington & D Keith Robinson, McGraw – Hill (2003)
6. Numerical Methods by Balagurusamy, Tata McGraw – Hill(2000)
7. Numerical Analysis, 2nd Ed. by Francis Scheid, McGraw-Hill(2009)

### Books for Reference

1. Research Methodology: Methods and Techniques" by C.R. Kothari and Gaurav Garg
2. Scientific Research Methodology" by P.N. Mukherjee
3. Research Methodology in Science and Technology" by M. Subbiah
4. Research Methodology: Concepts and Cases" by Deepak Chawla and Neena Sondhi
5. Research Methodology in Physical Sciences" by D. K. Bhattacharyya
6. Experimental Physics: Principles and Practice" by R.K. Shukla and Anchal Srivastava
7. Research Methodology for Scientists and Engineers" by Rajat Acharyya and Nandan Bhattacharya
8. Writing and Publishing in Scientific Journals: A Comprehensive Guide" by G. N. Ramachandran
9. Ethics in Science Education, Research and Governance" by Krishna Mani Pathak
10. Responsible Conduct of Research: An Indian Perspective" by P. A. K. Kumara

### Web resources

1. [www.aip.org](http://www.aip.org) [www.aps.org](http://www.aps.org) for reference styles.
2. [www.nature.com](http://www.nature.com) , [www.sciencemag.org](http://www.sciencemag.org) , [www.springer.com](http://www.springer.com) , [www.pnas.org](http://www.pnas.org) , [www.tandf.co.uk](http://www.tandf.co.uk) , [www.opticsinfobase.org](http://www.opticsinfobase.org) for research updates
3. Office of Research Integrity (ORI) – <https://ori.hhs.gov>
4. The National Center for Professional & Research Ethics – <https://nationalethicscenter.org>
5. Committee on Publication Ethics (COPE) – <https://publicationethics.org>



# SEWAGE AND WASTE WATER TREATMENT AND REUSE

## Learning Objectives

- To gain basic knowledge in sewage and waste water Treatment procedures
- To gain industry exposure and be equipped to take up job.
- To harness entrepreneurial skills.
- To analyze the status of sewage and waste water management in the nearby areas.
- To sensitize the importance of healthy practices in waste water management.

## UNIT I:

### RECOVERY & REUSE OF WATER

Recovery & Reuse of water from Sewage and Waste water: Methods of recovery: Flocculation - Sedimentation - sedimentation with coagulation - Filtration - sand filters - pressure filters - horizontal filters - vector control measures in industries - chemical and biological methods of vector eradication

## UNIT II:

### DISINFECTION

Disinfection: Introduction to disinfection and sterilization: Disinfectant - UV radiation - Chlorination - Antisepsis - Sterilant - Aseptic and sterile - Bacteriostatic and Bactericidal - factors affecting disinfection.

## UNIT III:

### CHEMICAL DISINFECTION

Chemical Disinfection: Introduction - Theory of Chemical Disinfection - Chlorination Other Chemical Methods - Chemical Disinfection Treatments Requiring - Electricity - Coagulation/Flocculation Agents as Pretreatment - Disinfection By-Products(DBPs)

## UNIT IV:

### PHYSICAL DISINFECTION

Physical Disinfection: Introduction - Ultraviolet Radiation – Solar Disinfection - Heat Treatment - Filtration Methods - Distillation - Electrochemical Oxidation Water Disinfection by Microwave Heating.

## UNIT V:

### INDUSTRIAL VISIT

Industrial visit – data collection and analysis - presentation

## UNIT 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**

1. Drinking water and disinfection technique, Anirudhha Balachandra. CRC press (2013)
2. Design of Water and Wastewater Treatment Systems (CV-424/434), ShashiBushan, )0202( siai icl
3. Integrated Water Resources Management, Sarbhukan M M, CBS PUBLICATION (2013)
4. C.S. Rao, Environmental Pollution Control Engineering, New Age International, 2007
5. S.P. Mahajan, Pollution control in process industries, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.

**REFERENCE BOOKS**

1. Handbook of Water and Wastewater Treatment Plant Operations, Frank. R Spellman, CRC Press, 2020
2. Wastewater Treatment Technologies, MritunjayChaubey, Wiley, 2021.
3. Metcalf and Eddy, Wastewater Engineering, 4th ed., McGraw Hill Higher Edu., 2002.
4. W.Wesley Eckenfelder, Jr., Industrial Water Pollution Control, 2<sup>nd</sup> Edn., McGraw Hill Inc., 1989
5. Lancaster, Green Chemistry: An Introductory Text, 2nd edition, RSC publishing, 2010.

**WEB SOURCES**

1. [https://www.google.co.in/books/edition/Drinking\\_Water\\_DisinfectionTechniques/HVbNBQAAQBAJ?hl=en](https://www.google.co.in/books/edition/Drinking_Water_DisinfectionTechniques/HVbNBQAAQBAJ?hl=en)
2. <https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-Principles-And-Management-Issues-125648?>
3. [https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsACgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw\\_wcB](https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsACgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB)
4. [https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsACgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw\\_wcB](https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsACgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB)
5. [https://www.amazon.in/Design-Wastewater-Treatment-Systems-CV-424/dp/B00IG2PI6K/ref=asc\\_df\\_B00IG2PI6K/?tag=googleshopmob21&linkCode=df0&hvadid=397013004690&hvpos=&hvnetw=g&hvrnd=4351305881865063672&hvpone=&hvptwo=&hvmqmt=&hvdev=m&hvdvcmdl=&hvlocint=&hvlocphy=9061971&hvtargid=pla-890646066127&psc=1&ext\\_vrnc=hi](https://www.amazon.in/Design-Wastewater-Treatment-Systems-CV-424/dp/B00IG2PI6K/ref=asc_df_B00IG2PI6K/?tag=googleshopmob21&linkCode=df0&hvadid=397013004690&hvpos=&hvnetw=g&hvrnd=4351305881865063672&hvpone=&hvptwo=&hvmqmt=&hvdev=m&hvdvcmdl=&hvlocint=&hvlocphy=9061971&hvtargid=pla-890646066127&psc=1&ext_vrnc=hi)

