MANONMANIAM SUNDARANAR UNIVERISTY,
TIRUNELVELI-12

SYLLABUS

PG - COURSES – AFFILIATED COLLEGES

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

Semester-II				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
3	Core	STATISTICAL MECHANICS		5
3	Core	QUANTUM MECHANICS		5
3	Practical II	PRACTICAL – II		4
3	Discipline Centric Elective- II	BIO PHYSICS		3
3	Generic Elective - II	MICROPROCESSOR 8085 AND MICROCONTROLLER 8051		3
3	SEC I	PHYSICS FOR COMPETITIVE EXAMINATIONS		2

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

A. **Scheme for internal Assessment**:
Maximum marks for written test: **15 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 and Seminar for 5 marks

The break up for internal assessment shall be:
Written test- 15 marks; Assignment -5 marks; Seminar-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.	Percentage of Marks	Letter Grade	Grade Point	Performance
1	90 - 100	O+	10	Outstanding
2	80 - 89	O	9	Excellent
3	70 - 79	A+	8	Very Good
4	60 - 69	A	7	Good
5	55 - 59	B+	6	Above Average
6	50 - 54	B	5	Pass
7	0 - 49	RA	-	ReAppear
8	Absent	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

STATISTICAL MECHANICS

Learning Objectives

- To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics
- To identify the relationship between statistic and thermodynamic quantities
- To comprehend the concept of partition function, canonical and grand canonical ensembles
- To grasp the fundamental knowledge about the three types of statistics
- To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time

UNIT I

PHASE TRANSITIONS

Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics. Order parameters – Landau's theory of phase transition - Critical indices - Scale transformations and dimensional analysis.

UNIT II:

STATISTICAL MECHANICS AND THERMODYNAMICS

Foundations of statistical mechanics - Specification of states of a system - Micro canonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an ideal gas using the micro canonical ensemble - Entropy of mixing and Gibb's paradox.

UNIT III:

CANONICAL AND GRAND CANONICAL ENSEMBLES

Trajectories and density of states - Liouville's theorem – Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations.

UNIT IV:

CLASSICAL AND QUANTUM STATISTICS

Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT V:

LOW TEMPERATURE, ISING MODEL AND FLUCTUATIONS

Production of Low Temperature – Measurement of Low temperature - Ising model -

Mean-field theories of the Ising model in two and one dimensions - Fluctuations and transport phenomena – Brownian motion - Langevin's theory - Fluctuation-dissipation theorem – The Fokker-Planck equation

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. Dr. S. L. Gupta and Dr. V. Kumar, 2008, ElementaryStatistical Mechanics, 22nd Edition, PragatiPrakashan, Meerut.
2. S. K. Sinha, 1990, Statistical Mechanics, Tata McGraw Hill, New Delhi.
3. B. K. Agarwal and M. Eisner, 1998, Statistical Mechanics, Second Edition New Age International, New Delhi.
4. J. K. Bhattacharjee, 1996, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi.
5. F. Reif, 1965, Fundamentals of Statistical and Thermal Physics, McGraw -Hill, New York.
6. M. K. Zemansky, 1968, Heat and Thermodynamics, 5th edition, McGraw- Hill New York.

REFERENCE BOOKS

1. R. K. Pathria, 1996, Statistical Mechanics, 2nd edition, Butter WorthHeinemann, New Delhi.
2. L. D. Landau and E. M. Lifshitz, 1969, Statistical Physics, Pergamon Press, Oxford.
3. K. Huang, 2002, Statistical Mechanics, Taylor and Francis, London
4. W. Greiner, L. NeiseandH.Stoecker, Thermodynamics and Statistical Mechanics, Springer Verlang, New York.
5. A. B. Gupta, H. Roy, 2002, Thermal Physics, Books and Allied, Kolkata.

WEB SOURCES

1. https://byjus.com/chemistry/third-law-of-thermodynamics/
2. https://web.stanford.edu/~peastman/statmech/thermodynamics.html
3. https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics
4. https://en.wikipedia.org/wiki/Grand_canonical_ensemble
5. https://en.wikipedia.org/wiki/Ising_model

QUANTUM MECHANICS

Learning Objectives

- To develop the physical principles and the mathematical background important to quantum mechanical descriptions.
- To describe the propagation of a particle in a simple, one-dimensional potential.
- To formulate and solve the Schrodinger's equation to obtain eigenvectors and energies for particle in a three-dimensional potential.
- To explain the mathematical formalism and the significance of constants of motion, and see their relation to fundamental symmetries in nature
- To discuss the Approximation methods like perturbation theory, Variational and WKB methods for solving the Schrödinger equation.

UNIT I:

BASIC FORMALISM

Wave Mechanical Concepts: Wave packet - Time dependent Schrodinger equation – Interpretation of the wave function –Ehrenfest's theorem- Time independent Schrodinger equation - Stationary states — Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation.

UNIT II:

GENERAL FORMALISM

Dirac notation – Equations of motions – Schrodinger representation –Heisenberg representation – Interaction representation –Momentum representation – Symmetries and conservation laws: Conservation of linear momentum, Energy and Angular momentum – Parity conservation and time reversal.

UNIT III:

ONE DIMENSIONAL AND THREEDIMENSIONAL ENERGY EIGEN VALUE PROBLEMS

Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig-Penny square – well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles –Rigid rotator– Hydrogen atom.

UNIT IV:

APPROXIMATION METHODS

Time independent perturbation theory: Non-degenerate energy levels – Ground state of Helium atom – First order Stark effect in Hydrogen atom – Degenerate

energy levels - Excited state of Hydrogen atom – WKB approximation – Connection formulae (no derivation) –Application of WKB method: Barrier penetration – Alpha emission.

UNIT V:

ANGULAR MOMENTUM

The Eigenvalue spectrum– Ladder operators– Matrix representation of J – Spin angular momentum – Addition of angular momenta – CG Coefficients – Angular momentum commutation relations – Eigen values of J2 and Jz - Spin angular momentum - Pauli's exclusion principle.

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, 2ndedition (37th Reprint), Tata McGraw-Hill, New Delhi, 2010.
2. G.Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009.
3. David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
4. SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S.Chand& Co., New Delhi, 1982.
5. A.Ghatak and S. Lokanathan, Quantum Mechanics: Theory andApplications, 4th Edition, Macmillan, India, 1984.

REFERENCE BOOKS

1. E.Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970.
2. V.K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985.
3. L.D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976.
4. S.N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata,1999.
5. V.Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford , 2011.

WEB SOURCES

1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf
2. http://www.feynmanlectures.caltech.edu/III_20.html
3. http://web.mit.edu/8.05/handouts/jaffe1.pdf
4. https://hepwww.pp.rl.ac.uk/users/haywood/Group_Theory_Lectures/Lecture_ 1.pdf
5. https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf

PRACTICAL II

Learning Objectives

- To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations.
- To calculate the thermodynamic quantities and physical properties of materials.
- To analyze the optical and electrical properties of materials.
- To observe the applications of FET and UJT.
- To study the different applications of operational amplifier circuits.
- To learn about Combinational Logic Circuits and Sequential Logic Circuits

PRACTICAL I

(Choose any SIX experiments from Part A and SIX from Part B)

PART A

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Determination of Stefan's constant of radiation from a hot body
3. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
4. B-H curve using CRO
5. Measurement of Magnetic Susceptibility - Guoy's method
6. Arc spectrum: Copper
7. Miscibility measurements using ultrasonic diffraction method
8. Determination of Thickness of thin film. - Michelson Interferometer
9. Determination of Refractive index of liquids using diode Laser/ He – Ne Laser
10. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
11. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility
12. Interpretation of vibrational spectra of a given material
13. Measurement of dielectric constant of liquids – LCR circuit.
14. Equipotential lines of different shapes.

PART B

1. Determination of I-V Characteristics and efficiency of solar cell.
2. IC 7490 as scalar and seven segment display using IC7447
3. Solving simultaneous equations – IC 741 / IC LM324
4. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Butter worth filter
5. Construction of Current to Voltage and Voltage to Current Conversion using IC 741
6. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
7. Construction of square wave generator using IC 555 – Study of VCO
8. Construction of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer
9. Construction of pulse generator using the IC 555 – Application as frequency divider
10. BCD to Excess- 3 and Excess 3 to BCD code conversion
11. Study of binary up / down counters - IC 7476 / IC7473
12. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474
13. Construction of Multiplexer and Demultiplexer using ICs.
14. Construction of series voltage regulator.

TEXT BOOKS

1. Practical Physics, Gupta and Kumar, Pragati Prakasan
2. Kit Developed for doing experiments in Physics- Instruction manual, R.Srinivasan K.R Priolkar, Indian Academy of Sciences
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition

REFERENCE BOOKS

1. An advanced course in Practical Physics, D.Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd
2. Advanced Practical Physics, S.P Singh, PragatiPrakasan
3. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt.ltd
4. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
5. Electronic Laboratory Primer a design approach, S. Poornachandra, B.Sasikala, Wheeler Publishing, New Delhi

PHYSICS FOR COMPETITIVE EXAMINATIONS

Learning Objectives

- To develop the basics of physical principles and the mathematical background important to general mechanics and properties of matter.
- To recollect the ideas of heat and thermodynamics
- Formulation of the concepts of reflection, refraction in optics and longitudinal, transverse waves in sound.
- To explain the formalism of electricity and magnetism
- To discuss the concepts in modern physics.

UNIT I:

GENERAL MECHANICS AND PROPERTIES OF MATTER

Physical quantities - SI system of units - dimensions - scalars and vectors (Concepts) - Newton's equations of motion - impulse - principle of conservation of linear momentum - projectile motion - Kepler's laws - Newton's law of gravitation - acceleration due to gravity - escape velocity - angular momentum - banking of roads - simple harmonic motion – viscosity - surface Tension.

UNIT II:

HEAT AND THERMODYNAMICS

Different scales of temperatures - thermal expansions - calorimetry - specific heat - latent heat - triple point - transmission of heat – heat conductivity - Black body radiation - Stefan Boltzmann law - Wien's displacement law - Gas equation - Boyle's law - Charle's law - Law of equipartition of energy.

UNIT III:

LIGHT AND SOUND

Reflection and refraction - Snell's law - total internal reflection - polarization - Brewster's Law - Huygen's principle – Young's double slit interference and single slit diffraction - longitudinal and transverse waves - velocity of sound - Newton's formula, Laplace correction, effects of pressure - beats - laws of vibrating strings - open and closed organ pipes - resonance.

UNIT IV:

ELECTRICITY

Coulomb's Law - Electric field due to charged particles: a point charge, a dipole, a line of charge - electric flux - Gauss' law and applications – Biot32 AND MAGNETISM Savart law, magnetic field due to a current in: a long straight wire, a circular arc of wire - Ampere's Law - magnetic field outside and inside a long straight wire - solenoids and toroids - Faraday's laws and Lenz's law

UNIT V:

MODERN PHYSICS

Postulates of Einstein's theory of relativity - Galilean and Lorentz transformation - time dilation - length contraction - Planck's radiation - photoelectric effect - Compton shift, matter waves - Bohr's atomic theory. Nuclear properties - binding energy and mass defect -radioactive decay - alpha decay, beta decay and gamma decay - Radioactive dating.

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. J.Walker, D. Halliday, R. Resnick, Fundamentals of Physics, 10th Edition, Wiley, United states of America, 2007.
2. H.C Verma, Concept of Physics, (Volume I), 1st Edition, Bharati Bhawan Publishers & Distributors, New Delhi, 2008.
3. H.C Verma, Concept of Physics, (Volume II), 1st Edition, Bharati Bhawan Publishers & Distributors, New Delhi, 2008.

REFERENCE BOOKS

1. Michael Nelkon, Philip Parker, Advanced Level Physics, 7th Edition, CBS Publishers, India, 1995
2. D.Young Hugh, A. Freedman Roger, University Physics with Modern Physics, 14th Edition, Pearson Education, India, 2017.

WEB SOURCE

1. https://hcverma.in/

BIO PHYSICS ELECTIVE

Learning Objectives

- To understand the physical principles involved in cell function maintenance.
- To understand the fundamentals of macromolecular structures involved in propagation of life.
- To understand the biophysical function of membrane and neuron.
- To understand various kinds of radiation and their effects on living system and

to know the hazards posed by such radiations and the required precautions.

- To understand the physical principles behind the various techniques available for interrogating biological macromolecules.

UNIT I:

CELLULAR BIOPHYSICS

Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape – Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system – Extracellular matrix - Molecular mechanisms of Vesicular traffic -Electrical activities of cardiac and neuronal cells.

UNIT II:

MOLECULAR BIOPHYSICS

Macromolecular structure: Protein structure – amino acids, peptide bonds, primary, secondary, tertiary and quaternary structures of proteins Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation. Special Bio-macromolecules: Metalloproteins, nucleoproteins, ribozymes, chaperons and prions.

UNIT III:

MEMBRANE AND NEURO BIOPHYISCS

Models membranes - Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels. Nervous system: Organization of the nervous system –Membrane potential – Origins of membrane potential - Electrochemical potentials – Nernst equation – Goldman equation.

UNIT IV:

RADIATION BIO PHYSICS

X-Ray: Effects on bio-macromolecules – Gamma Radiation: Molecular effects of gamma radiation, Radiation effects on nucleic acids and membranes, Effects on cell and organelles – UV radiation: Effects on biomacromolecules and proteins – Radiation hazards and protection – use of radiations in cancer.

UNIT V:

PHYSICAL METHODS IN BIOLOGY

Spectroscopy: UV-Visible absorption spectrophotometry – Optical Rotatory Dispersion (ORD) – Structure Determination: X-ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Thin layer chromatography (TLC), Gas liquid chromatography (GLC) – Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel

electrophoresis, polyacrylamide gel electrophoresis.

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. The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013.
2. Biophysics, VasanthaPattabhi, N. Gautham, Narosa Publishing, 2009
3. Biophysics, P. S. Mishra VK Enterprises, 2010.
4. Biophysics, M. A Subramanian, MJP Publishers, 2005.
5. Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006.

REFERENCE BOOKS

1. Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008).
2. Essential cell biology by Bruce Albert et al (Garland Science)
3. Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983).
4. Membrane Biophysics by Mohammad Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media).
5. Biological spectroscopyby Iain D. Campbell, Raymond A. Dwek

WEB SOURCES

1. General Bio: http://www.biology.arizona.edu/DEFAULT.html
2. Spectroscopy: http://www.cis.rit.edu/htbooks/nmr/inside.htm
3. Electrophoresis:http://learn.genetics.utah.edu/content/labs/gel/
4. Online biophysics programs: http://mw.concord.org/modeler/
5. https://blanco.biomol.uci.edu/WWWResources.html

MICROPROCESSOR 8085 AND MICROCONTROLLER 8051

Learning Objectives

- To provide an understanding of the architecture and functioning of microprocessor 8085A and to the methods of interfacing I/O devices and memory to microprocessor
- To introduce 8085A programming and applications and the architecture and instruction sets of microcontroller 8051

UNIT 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.

UNIT 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).

UNIT III:

8051 MICROCONTROLLER HARDWARE

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.

UNIT 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.

UNIT 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).

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. A.NagoorKani, Microprocessors & Microcontrollers, RBA Publications (2009).
2. A.P. Godse and D. A. Godse, Microprocessors, Technical Publications, Pune (2009).
3. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing (2013).
4. B.Ram, Fundamentals of Microprocessors & Microcontrollers, DhanpatRai publications New Delhi (2016).
5. V.Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.

REFERENCE BOOKS

1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).
3. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.
4. J.Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.
5. W.A.Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

WEB SOURCES

1. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html
2. http://www.electronicsengineering.nbcafe.in/peripheral-mapped-io-interfacing/
3. https://www.geeksforgeeks.org/programmable-peripheral-interface-8255/
4. http://www.circuitstoday.com/8051-microcontroller
5. https://www.elprocus.com/8051-assembly-language-programming/