

Category II

**Physical Science Courses (with Electronics)
with Physics and Electronics discipline as Core Disciplines**

DISCIPLINE SPECIFIC CORE COURSE – PHYSICS DSC 7: WAVES AND OPTICS

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Waves and Optics PHYSICS DSC 7	4	2	0	2	Class XII Pass with Science	--

LEARNING OBJECTIVES

This is a core course in Physics curriculum that begins with explaining ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. The course also provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.

LEARNING OUTCOMES

On successfully completing the requirements of this course, the students will have the skill and knowledge to,

- Understand simple harmonic oscillation and superposition principle.
- Understand superposition of a range of collinear and mutually perpendicular simple harmonic motions and their applications.
- Understand concept of normal modes in stationary waves: their frequencies and configurations.
- Understand interference as superposition of waves from coherent sources derived from same parent source.
- Demonstrate understanding of interference experiments: Young's double slit, Fresnel's biprism, Lloyd's mirror, Newton's rings
- Demonstrate basic concepts of diffraction: Superposition of wavelets diffracted from apertures
- Understand Fraunhofer diffraction from apertures: single slit, double Slit, grating
- Demonstrate fundamental understanding of Fresnel diffraction: Half period zones, diffraction of different apertures
- Laboratory course is designed to understand the principles of measurement and skills in experimental designs.

SYLLABUS OF PHYSICS DSC – 7

THEORY COMPONENT

Unit – I

(11 Hours)

Superposition of collinear harmonic oscillations: Simple harmonic motion (SHM); linearity and superposition principle; superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (beats).

Superposition of two perpendicular harmonic oscillations: Graphical and analytical methods. Lissajous figures with equal and unequal frequencies and their uses

Superposition of two harmonic Waves: Standing (stationary) waves in a string; normal modes of stretched strings

Unit – II **(8 Hours)**

Interference: Division of amplitude and division of wavefront; Young's double slit experiment: width and shape of fringes; Fresnel's biprism; Lloyd's mirror; Phase change on reflection: Stokes' treatment; Interference in thin films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger fringes); Fringes of equal thickness (Fizeau Fringes); Newton's rings: Measurement of wavelength and refractive index

Unit – III **(11 Hours)**

Diffraction:

Fraunhofer diffraction: Single slit, double slit, diffraction grating

Fresnel diffraction: Fresnel's assumptions. Fresnel's half-period zones for plane wave.

Explanation of rectilinear propagation of light; Fresnel's diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis

References:

Essential Readings:

- 1) Vibrations and Waves, A. P. French, 1st edition, 2003, CRC press.
- 2) The Physics of Waves and Oscillations, N. K. Bajaj, 1998, Tata McGraw Hill.
- 3) Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- 4) Fundamental of Optics, A. Kumar, H. R. Gulati and D. R. Khanna, 2011, R. Chand Publications.
- 5) Optics, A. Ghatak, 6th edition, 2017, McGraw-Hill Education, New Delhi
- 6) The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.

Additional Readings:

- 1) Principles of Optics, M. Born and E. Wolf, 7th edition, 1999, Pergamon Press.
- 2) Optics, E. Hecht, 4th edition, 2014, Pearson Education.
- 3) Fundamentals of Optics, F. A. Jenkins and H. E. White, 1981, McGraw-Hill

PRACTICAL COMPONENT

(15 Weeks with 4 hours of laboratory session per week)

At least 7 experiments to be performed from the following list

- 1) To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 -T law.
- 2) To study Lissajous figures.
- 3) Familiarization with Schuster's focusing and determination of angle of prism.
- 4) To determine refractive index of the material of a prism using sodium light.
- 5) To determine the dispersive power and Cauchy's constants of the material of a prism using mercury light.
- 6) To determine wavelength of sodium light using Fresnel biprism.
- 7) To determine wavelength of sodium light using Newton's rings.
- 8) To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.

- 9) To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
- 10) To determine dispersive power and resolving power of a plane diffraction grating.

References for laboratory work:

- 1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House
- 2) A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11th edition, 2011, Kitab Mahal
- 3) Advanced level Physics Practicals, M. Nelson and J. M. Ogborn, 4th edition, reprinted 1985, Heinemann Educational Publishers
- 4) A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani Pub.
- 5) B.Sc. Practical Physics, G. Sanon, 2019, R. Chand & Co

DISCIPLINE SPECIFIC CORE COURSE – PHYSICS DSC 8: MICROPROCESSOR AND MICROCONTROLLER

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Microprocessor and Microcontroller PHYSICS DSC – 8	4	2	0	2	Class XII Pass with Science	Basic Electronics

LEARNING OBJECTIVES

This paper introduces the basic concepts of microprocessor and microcontrollers to the undergraduate students. Basic architecture and building blocks of a microprocessor and microcontrollers will be discussed in detail. Pin out diagram and the assembly language programming is discussed for both of them. The course is supported by a lab where students will apply the learned concepts and write simple programs to strengthen their classroom learning.

LEARNING OUTCOMES

Upon completion of this course, students will be able to,

- Describe the basic difference between a microprocessor and microcontroller and a general computing system.
- Explain the basic architecture and pin out diagram of 8085 microprocessor and 8051 microcontroller.
- Explain the difference between machine code, mnemonics, assembly language (low level) and high level language.
- Explain the concept of memory, different types of memory available in a system. The concept of memory map and how addresses are assigned to each memory element and peripherals.
- Classify instructions 1-, 2- or 3-byte instructions and into arithmetic, logical types etc.
- Describe the different addressing modes available to perform the same task.
- Write simple programs for 8085 microprocessor and 8051 microcontroller.

SYLLABUS OF PHYSICS DSC - 8

THEORY COMPONENT

Unit – I - Microcomputer organization

(4 Hours)

Basic organization of a microcomputer/ microprocessor based system, computer memory, memory classification (RAM and ROM), memory organization and addressing, memory interfacing, memory map

Unit – II - 8085 Microprocessor architecture

(4 Hours)

Main features of 8085, pin-out diagram of 8085, data and address buses, registers, ALU, stack pointer, program counter

Unit – III - 8085 Programming**(7 Hours)**

Instruction classification (data transfer, arithmetic, logical, branch, and control instructions), general discussion on 1 byte, 2 bytes and 3 bytes instructions, subroutines, instruction cycle, timing diagram of MOV and MVI, hardware and software interrupts (general discussion).

Unit – IV - 8051 microcontroller**(8 Hours)**

Microcontroller vs microprocessor, block diagram of 8051 microcontroller, 8051 assembly language programming, program counter and ROM memory map, data types and directives, flag bits and program status word (PSW) register, register banks and stack, jump, loop and call instructions

Unit – V - 8051 I/O port programming**(3 Hours)**

Pin out diagram of 8051 microcontroller, introduction of I/O port and their general features, I/O port programming in 8051 (using assembly language)

Unit – VI - 8051 Programming**(4 Hours)**

8051 addressing modes and accessing memory locations using various addressing modes, arithmetic and logic instructions

References:**Essential Readings:**

- 1) Microprocessor Architecture Programming and applications with 8085, R. S. Goankar, 2002, Prentice Hall.
- 2) Microprocessors and Microcontrollers, K. Kant, 2nd edition, 2016. PHI learning Pvt. Ltd.
- 3) The 8051 Microcontroller, Ayala, Cengage learning, 3rd edition.
- 4) The 8051 Microcontroller and Embedded Systems Using Assembly and C, M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay, 2nd edition, 2007, Pearson Education India.
- 5) Microprocessor and Microcontrollers, N. Senthil Kumar, 2010, Oxford University Press.
- 6) 8051 Microcontroller, S. Shah, 2010, Oxford University Press.

Additional Readings:

- 1) Embedded Systems: Design and Applications, S. F. Barrett, 2008, Pearson Education India.
- 2) Introduction to embedded system, K. V. Shibu, 1st edition, 2009, McGraw Hill.
- 3) Embedded Microcomputer systems: Real time interfacing, J. W. Valvano, 2011, Cengage Learning.

PRACTICAL COMPONENT**(15 Weeks with 4 hours of laboratory session per week)**

There are two options here:

A. Every Student must perform at least 06 experiments each from Section-A and Section-B

Or

B. Every Student must perform at least 04 experiments each from Section-A and Section-B and a suitable project based on Arduino.

Section-A: Programs using 8085 Microprocessor

- 1) Addition and subtraction of two 8 bits numbers using direct addressing mode

- 2) Addition and subtraction of two 8 bits numbers using indirect addressing mode
- 3) Addition and subtraction of two 16 bits numbers using direct addressing mode
- 4) Addition and subtraction of two 16 bits numbers using indirect addressing mode
- 5) Multiplication by repeated addition.
- 6) Division by repeated subtraction.
- 7) Handling of 16-bit Numbers.
- 8) Use of CALL and RETURN Instruction.
- 9) Block data handling.
- 10) Parity checking in an 8-bit and 16 bit number.

Section-B: Experiments using 8051 microcontroller:

- 1) To find that the given numbers is prime or not.
- 2) To find the factorial of a number.
- 3) Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
- 4) Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
- 5) Program to glow the first four LEDs then next four using TIMER application.
- 6) Program to rotate the contents of the accumulator first right and then left.
- 7) Program to run a countdown from 9-0 in the seven segment LED display.
- 8) To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
- 9) To toggle '1234' as '1324' in the seven segments LED display.
- 10) Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
- 11) Application of embedded systems: Temperature measurement & display on LCD

References for laboratory work:

- 1) Microprocessor Architecture Programming and applications with 8085, R. S. Goankar, 2002, Prentice Hall.
- 2) Embedded Systems: Architecture, Programming and Design, R. Kamal, 2008, Tata McGraw Hill.
- 3) The 8051 Microcontroller and Embedded Systems Using Assembly and C, M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay, 2nd edition, 2007, Pearson Education India.
- 4) 8051 microcontrollers, S. Shah, 2010, Oxford University Press.
- 5) Embedded Microcomputer systems: Real time interfacing, J. W. Valvano, 2011, Cengage Learning

Essential Reading

1. Gallian, Joseph. A. (2017). Contemporary Abstract Algebra (9th ed.). Cengage Learning India Private Limited, Delhi. Indian Reprint (2021).

Suggestive Reading

- Beachy, John A., & Blair, William D. (2006). Abstract Algebra (3rd ed.). Waveland Press.

B.Sc. (Physical Sciences/Mathematical Sciences) Semester-IV with Mathematics as one of the Core Discipline Category-III

DISCIPLINE SPECIFIC CORE COURSE – 4 (Discipline A-4): ABSTRACT ALGEBRA

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Abstract Algebra	4	3	1	0	Class XII pass with Mathematics	NIL

Learning Objectives: The primary objective of the course is to introduce:

- Modular arithmetic, fundamental theory of groups, rings, integral domains, and fields.
- Symmetry group of a plane figure, and basic concepts of cyclic groups.
- Cosets of a group and its properties, Lagrange's theorem, and quotient groups.

Learning Outcomes: This course will enable the students to:

- Appreciate ample types of groups present around us which explains our surrounding better, and classify them as abelian, cyclic and permutation groups.
- Explain the significance of the notion of cosets, normal subgroups and homomorphisms.
- Understand the fundamental concepts of rings, subrings, fields, ideals, and factor rings.

SYLLABUS OF DISCIPLINE A-4

UNIT-I: Introduction to Groups (12 hours)

Modular arithmetic; Definition and examples of groups, Elementary properties of groups, Order of a group and order of an element of a group; Subgroups and its examples, Subgroup tests; Center of a group and centralizer of an element of a group.

UNIT-II: Cyclic Groups, Permutation Groups and Lagrange's Theorem (18 hours)

Cyclic groups and its properties, Generators of a cyclic group; Group of symmetries; Permutation groups, Cyclic decomposition of permutations and its properties, Even and odd

permutations and the alternating group; Cosets and Lagrange's theorem; Definition and examples of normal subgroups, Quotient groups; Group homomorphisms and properties.

UNIT-III: Rings, Integral Domains and Fields (15 hours)

Definition, examples and properties of rings, subrings, integral domains, fields, ideals and factor rings; Characteristic of a ring; Ring homomorphisms and properties.

Essential Reading

1. Gallian, Joseph. A. (2017). Contemporary Abstract Algebra (9th ed.). Cengage Learning India Private Limited, Delhi. Indian Reprint (2021).

Suggestive Reading

- Beachy, John A., & Blair, William D. (2006). Abstract Algebra (3rd ed.). Waveland Press.