Python - Theory

UNIT-1	Introduction to Features and Applications of Python; Python Versions; Installation of Python; Python Command Line mode and Python IDEs; Simple Python Program. **Python Basics:** Identifiers; Keywords; Statements and Expressions; Variables; Operators; Precedence and Association; Data Types; Indentation; Comments; Built-in Functions- Console Input and Console Output, Type Conversions; Python Libraries; Importing Libraries with Examples. **Python Control Flow:** Types of Control Flow; Control Flow Statements- if, else, elif, while loop, break, continue statements, for loop Statement; range () and exit () functions.
UNIT-2	**Exception Handling:** Types of Errors; Exceptions; Exception Handling using try, except and finally. **Python Functions:** Types of Functions; Function Definition- Syntax, Function Calling, Passing Parameters/arguments, the return statement; Default Parameters; Command line Arguments; Key Word Arguments; Recursive Functions; Scope and Lifetime of Variables in Functions. **Strings:** Creating and Storing Strings; Accessing Sting Characters; the str() function; Operations on Strings- Concatenation, Comparison, Slicing and Joining, Traversing; Format Specifiers; Escape Sequences; Raw and Unicode Strings; Python String Methods.
UNIT-3	**Lists:** Creating Lists; Operations on Lists; Built-in Functions on Lists; Implementation of Stacks and Queues using Lists; Nested Lists. **Dictionaries:** Creating Dictionaries; Operations on Dictionaries; Built-in Functions on Dictionaries; Dictionary Methods; Populating and Traversing Dictionaries. **Tuples and Sets:** Creating Tuples; Operations on Tuples; Built-in Functions on Tuples; Tuple Methods; Creating Sets; Operations on Sets; Built-in Functions on Sets; Set Methods.
UNIT-4	**File Handling:** File Types; Operations on Files– Create, Open, Read, Write, Close Files; File Names and Paths; Format Operator. **Object Oriented Programming:** Classes and Objects; Creating Classes and Objects; Constructor Method; Classes with Multiple Objects; Objects as Arguments; Objects as Return Values; Inheritance- Single and Multiple Inheritance, Multilevel and Multipath Inheritance; Encapsulation- Definition, Private Instance Variables; Polymorphism- Definition, Operator Overloading.
UNIT-5	**GU Interface:** The Tkinter Module; Window and Widgets; Layout Management- pack, grid and place. **Python SQLite:** The SQLite3 module; SQLite Methods- connect, cursor, execute, close; Connect to Database; Create Table; Operations on Tables- Insert, Select, Update. Delete and Drop Records. **Data Analysis:** NumPy- Introduction to NumPy, Array Creation using NumPy, Operations on Arrays; Pandas- Introduction to Pandas, Series and DataFrames, Creating DataFrames from Excel Sheet and .csv file, Dictionary and Tuples. Operations on DataFrames. **Data Visualisation:** Introduction to Data Visualisation; Matplotlib Library; Different Types of Charts using Pyplot- Line chart, Bar chart and Histogram and Pie chart.

Python - LAB

Part-A

1. Check if a number belongs to the Fibonacci Sequence
2. Solve Quadratic Equations
3. Find the sum of n natural numbers
4. Display Multiplication Tables
5. Check if a given number is a Prime Number or not
6. Implement a sequential search
7. Create a calculator program
8. Explore string functions
9. Implement Selection Sort
10. Implement Stack
11. Read and write into a file

Part-B

1. Demonstrate usage of basic regular expression
2. Demonstrate use of advanced regular expressions for data validation.
3. Demonstrate use of List
4. Demonstrate use of Dictionaries
5. Create SQLite Database and Perform Operations on Tables
6. Create a GUI using Tkinter module
7. Demonstrate Exceptions in Python
8. Drawing Line chart and Bar chart using Matplotlib
9. Drawing Histogram and Pie chart using Matplotlib
10. Create Array using NumPy and Perform Operations on Array
11. Create Data Frame from Excel sheet using Pandas and Perform Operations on DataFrames

Note: A minimum of 10 Programs should be done in each Part.

References

1	**Think Python How to Think Like a Computer Scientist,** Allen Downey et al., 2nd Edition, 2015, Green Tea Press. Freely available online @ https://www.greenteapress.com/thinkpython/thinkCSpy.pdf
2	**Introduction to Python Programming**, Gowrishankar S et al.,2019, CRC Press
3	**Python Data Analytics**: Data Analysis and Science Using Pandas, matplotlib, and the Python Programming Language, Fabio Nelli, 2015, Apress®
4	**Advance Core Python Programming**, Meenu Kohli, 2021, BPB Publications
5	**Core PYTHON Applications Programming**, Wesley J. Chun, 3rd Edition, 2012, Prentice Hall
6	**Automate the Boring Stuff**, Al Sweigart, 2015, No Starch Press, Inc.

Computer Networks - Theory

UNIT-1	**Introduction:** Computer Network: Definition, Goals, Structure;Broadcast and Point-To-Point Networks; Network Topology and their various Types; Types of Network, Network software, Design issues for the layers, Connection-oriented vs. Connectionless service, Applications of Computer network, Protocols and Standards, The OSI Reference Model, The TCP/IP Protocol suite, Comparison between OSI and TCP/IP Reference model.
UNIT-2	**Physical Layer:** Functions of Physical Layer**,** Analog signals, Digital signals, Transmission Impairment, Data Rate Limits, and Performance. Data Transmission Media: Guided Transmission Media, Magnetic Media, Twisted Pairs, Coaxial Cable, Power Lines, Fiber Optics, Wireless Transmission, Electromagnetic Spectrum, Radio Transmission, Microwave Transmission, Infrared Transmission, Light Transmission, Digital Modulation and Multiplexing, Public Switched Telephone Networks. Switching: Circuit switching, Message switching & Packet switching
UNIT-3	**Data Link Layer:** Functions of Data Link Layer, Data Link Control: Framing, Flow and Error Control, Error Detection and Correction, High-Level Data Link Control (HDLC) & point — to — Point protocol(PPP), Channel Allocation Problem, Multiple Access: Radom Access(ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access(Reservation, Polling, Token Passing), Channelization(FDMA, TDMA, CDMA),
UNIT-4	**Wired LAN:** Ethernet Standards and FDDI, Wireless LAN: IEEE 802.1 Ix and Bluetooth Standards. **Transport Layer:** Functions of Transport Layer, Elements of Transport Protocols: Addressing, Establishing and Releasing Connection, Flow Control & Buffering, Error Control, Multiplexing & De-multiplexing, Crash Recovery,
UNIT-5	**User Datagram Protocol (UDP):** User Datagram, UDP Operations, Uses of UDP, RPC, Principles of Reliable Data Transfer: Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocol, Go Back-N(GBN), Selective Repeat(SR). **Application layer :** Functions of Application layer, Application Layer Protocols: DNS, DHCP, WWW, HTTP, HTTPs, TELNET, FTP, SMTP, POP, IIMAP

Computer Networks - LAB

Part A:

1. Prepare hardware and software specification for basic computer system and Networking.
2. Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.
3. Identifying the networking devices on a network.
4. Configure the IP address of the computer.
5. Create a basic network and share file and folders.
6. Study of basic network command and Network configuration commands.
7. Installation process of any open source network simulation software.

Part B:

1. Implement connecting two nodes using network simulator.
2. Implement connecting three nodes considering one node as a central node using network simulator. Implement a network to connect three nodes considering one node as a central node using network simulator
3. Implement bus topology using network simulator.
4. Implement star topology using network simulator.
5. Implement ring topology using network simulator.
6. Demonstrate the use of wireless LAN using network simulator.
7. Implement FTP using TCP bulk transfer using network simulator.
8. Implement connecting multiple routers and nodes and building a Hybrid topology network simulator.

Links for open source simulation software:

- NS3 software: https://www.nsnam.org/releases/ns-3-30/download/
- Packet Tracer Software: https://www.netacad.com/courses/packet-tracer
- GNS3 software: https://www.gns3.com/

	Contents
Unit-1	**Introduction and Web Design:** Introduction to Internet, WWW and Web 2.0,Web browsers, Web protocols and Web servers, Web Design Principles and Web site structure, client-server technologies, Client side tools and technologies, Server side Scripting, URL, MIME, search engine, web server- Apache, IIS, proxy server, HTTP protocol. Introductions to HTML. HTML5 Basics tags, Formatting tags in HTML, HTML5 Page layout and Navigation concepts, Semantic Elements in HTML, List, type of list tags, tables and form tags in HTML, multimedia basics, images, iframe, map tag, embedding audio and video clips on webpage.
Unit-2	**Introduction to XML:** XML Syntax, XML Tree, Elements, Attributes, Namespace, Parser, XSLT DOM, DTD, Schema. Introduction to CSS, CSS syntax, CSS selectors, CSS Background Cursor, CSS text fonts, CSS-List Tables, CSS Box Modeling, Display Positioning, Floats, CSS Gradients, Shadows, 2D and 3 Transform, Transitions, CSS Animations.

Unit-3	**Introduction to JavaScript:** JavaScript Data type and Variables, JavaScript Operators, Conditional Statements, Looping Statements, JavaScript Functions, Number, Strings, Arrays, Objects in JavaScript, Window and Frame objects, Event Handling in JavaScript, Exception Handling, Form Object and DOM, JSON, Browser Object Model.
Unit-4	**Introduction to Servlets:** Common Gateway Interface (CGI), Lifecycle of a Servlets, deploying a Servlets, The Servlets API, Reading Servlets parameters, reading initialization parameters, Handling HTTP Request & Responses, Using Cookies and sessions, connecting to a database using JDBC.
Unit-5	**Web Security:** Authentication Techniques, Design Flaws in Authentication, Implementation Flaws in Authentication, Securing Authentication, Path Traversal Attacks. Injecting into Interpreted Contexts, SQL Injection, NoSQL Injection, XPath Injection, LDAP Injection, XML Injection, HTTP Injection, Mail Service Injection. Types of XSS, XSS in Real World, Finding and Exploiting XSS Vulnerabilities, Preventing XSS Attacks.

Web Technology - LAB

Part A

1. Design web pages for your college containing college name and Logo, departments list using href, list tags.
2. Create a class timetable using table tag.
3. Write a HTML code to design Student registrations form for your collegeAdmission
4. Design Web Pages with includes Multi-Media data (Image, Audio, Video, GIFs etc)
5. Create a web page using frame.
6. Write code in HTML to develop a webpage having two frames that divide the webpage into two equal rows and then divide the row into equal columns fill each frame with a different background color.
7. Write CSS code to Use Inline CSS to format your ID Card.
8. Using HTML, CSS create display a text called ―Hello India !‖ on top of an image of India- Map using an overlay.

Part B

1. Write a JavaScript Program to perform Basic Arithmeticoperations
2. JavaScript Program to Check Prime Number
3. JavaScript Program to implement Javascript Object Concept
4. JavaScript Program to Create Array and inserting Data into Array
5. JavaScript Program to Validate an Email Address
6. Write a Program for printing System Date & Time using SERVLET
7. Write a server side SERVLET program for accept number from HTML file and Display.
8. Write a program to Creating the Life-Cycle Servlet Application

Statistical Computing & R Programming - Theory	
Unit - 1	Introduction of the language, numeric, arithmetic, assignment, and vectors, Matrices and Arrays, Non-numeric Values, Lists and Data Frames, Special Values, Classes, and Coercion, Basic Plotting.
Unit – 2	Reading and writing files, Programming, Calling Functions, Conditions and Loops: stand- alone statement with illustrations in exercise 10.1,stacking statements, coding loops, Writing Functions, Exceptions, Timings, and Visibility.
Unit – 3	Statistics And Probability, basic data visualisation, probability, common probability distributions: common probability mass functions, bernoulli, binomial, poisson distributions, common probability density functions, uniform, normal, student's t-distribution.
Unit – 4	Statistical testing and modelling, sampling distributions, hypothesis testing, components of hypothesis test, testing means, testing proportions, testing categorical variables, errors and power, Analysis of variance.
Unit - 5	Simple linear regression, multiple linear regression, linear model selection and diagnostics. Advanced graphics: plot customization, plotting regions and margins, point and click coordinate interaction, customizing traditional R plots, specialized text and label notation. Defining colors and plotting in higher dimensions, representing and using color, 3D scatter plots.

References	
1	Tilman M. Davies, ―The book of R: A first course in programming and ststistics‖, San Francisco, 2016.
2	Vishwas R. Pawgi, ―Statistical computing using R software‖, Nirali prakashan publisher, e1 edition, 2022.
3	https://www.youtube.com/watch?v=KlsYCECWEWE https://www.geeksforgeeks.org/r-tutorial/ https://www.tutorialspoint.com/r/index.htm

R-Programming - LAB

1. Write a R program for different types of data structures in R.
2. Write a R program that include variables, constants, data types.
3. Write a R program that include different operators, control structures, default values for arguments, returning complex objects.
4. Write a R program for quick sort implementation, binary search tree.
5. Write a R program for calculating cumulative sums, and products minima maxima and calculus.
6. Write a R program for finding stationary distribution of markanov chains.
7. Write a R program that include linear algebra operations on vectors and matrices.
8. Write a R program for any visual representation of an object with creating graphs using graphic functions: Plot(),Hist(),Linechart(),Pie(),Boxplot(),Scatterplots().
9. Write a R program for with any dataset containing dataframe objects, indexing and subsetting data frames, and employ manipulating and analyzing data.
10. Write a program to create an any application of Linear Regression in multivariate context for predictive purpose.

Cyber Security - Theory

UNIT-I

Introduction to Cyber security: Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

UNIT –II

Cyber-crime and Cyber law: Classification of cybercrimes, Common cyber- crimes- cyber-crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi, Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber-crime and offences, Organisations dealing with Cyber- crime and Cyber security in India, Case studies.

UNIT III

Social Media Overview and Security: Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

UNIT IV

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Advantage of e-commerce, Survey of popular e-commerce sites. Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act,2007.

UNIT V

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third-party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

Semester III - Theory

DSC3: Object Oriented Programming Concepts and Programming in Java

UNIT-1	**Introduction to Java:** Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.
UNIT-2	**Objects and Classes:** Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, String Buffer, File, this reference.
UNIT-3	**Inheritance and Polymorphism:** Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.
UNIT-4	**Event and GUI programming:** Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing, Exceptional handling mechanism.
UNIT-5	**I/O programming:** Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. Multithreading in java: Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try catch-finally, Collections in java, Introduction to JavaBeans and Network Programming

References:

Programming with Java, By E Balagurusamy – A Primer, 4th Edition, McGraw Hill Publication.

Core Java Volume I – Fundamentals, By Cay S. Horstmann, Prentice Hall.

Object Oriented Programming with Java: Somashekara M.T., Guru, D.S., Manjunatha K.S, 1st Edition, PHI Learning 2017.

Java 2 - The Complete Reference, Herbert Schildt, 5th Edition, McGraw Hill Publication, 2017.

Java - The Complete Reference, Herbert Schildt, 7th Edition, McGraw Hill Publication, 2017.

Java Fundamentals OOPs in Java - LAB

PART A

1. Program to assign two integer values to X and Y. Using the „if‟ statement the output of the program should display a message whether X is greater than Y.

2. Program to list the factorial of the numbers 1 to 10. To calculate the factorial value, use while loop. (Hint Fact of 4 = 4*3*2*1)

3. Program to add two integers and two float numbers. When no arguments are supplied, give a default value to calculate the sum. Use function overloading.

4. Program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations.

5. Program with class variable that is available for all instances of a class. Use static variable declaration. Observe the changes that occur in the object‟s member variable values.

6. Program
    a. To find the area and circumference of the circle by accepting the radius from the user.
    b. To accept a number and find whether the number is Prime or not

7. Program to create a student class with following attributes; Enrollment No: Name, Mark of sub1, Mark of sub2, mark of sub3, Total Marks. Total of the three marks must be calculated only when the student passes in all three subjects. The pass mark for each subject is 50. If a candidate fails in any one of the subjects his total mark must be declared as zero. Using this condition write a constructor for this class. Write separate functions for accepting and displaying student details. In the main method create an array of three student objects and display the details.

8. In a college first year class are having the following attributes Name of the class (BCA, BCom, BSc), Name of the staff No of the students in the class, Array of students in the class

9. Define a class called first year with above attributes and define a suitable constructor. Also write a method called best Student () which process a first-year object and return the student with the highest total mark. In the main method define a first-year object and find the best student of this class

10. Program to define a class called employee with the name and date of appointment. Create ten employee objects as an array and sort them as per their date of appointment. ie, print them as per their seniority.

11. Create a package „student. Fulltime. BSC „in your current working directory

    a. Create a default class student in the above package with the following attributes: Name, age, sex.

b. Have methods for storing as well as displaying

PART B: Exception Handling & GUI Programming

1. Program to catch Negative Array Size Exception. This exception is caused when the array is initialized to negative values.

2. Program to handle Null Pointer Exception and use the “finally” method to display a message to the user.

3. Program which create and displays a message on the window

4. Program to draw several shapes in the created window 32

5. Program to create an applet and draw grid lines

6. Program which creates a frame with two buttons father and mother. When we click the father button the name of the father, his age and designation must appear. When we click mother similar details of mother also appear.

7. Create a frame which displays your personal details with respect to a button click

8. Create a simple applet which reveals the personal information of yours.

9. Program to move different shapes according to the arrow key pressed.

10. Program to create a window when we press M or m the window displays Good Morning, A or a the window displays Good After Noon E or e the window displays Good Evening, N or n the window displays Good Night

11. Demonstrate the various mouse handling events using suitable example.

12. Program to create menu bar and pull-down menus.

Semester IV : Theory

DSC7: Database Management System (DBMS)

UNIT-1	**Database Architecture:** Introduction to Database system applications Characteristics and Purpose of database approach. People associated with Database system. Data models. Database schema. Database architecture. Data independence Database languages, interfaces, and classification of DBMS.
UNIT-2	**E-R Model:** Entity-Relationship modeling: E – R Model Concepts: Entity, Entity types, Entity sets, Attributes, Types of attributes, key attribute, and domain of an attribute. Relationships between the entities. Relationship types, roles and structural constraints, degree and cardinality ratio of a relationship. Weak entity types, E -R diagram.
UNIT-3	**Relational Data Model:** Relational model concepts. Characteristics of relations. Relational model constraints: Domain constrains, key constraints, primary & foreign key constraints, integrity constraints and null values. Relational Algebra: Basic Relational Algebra operations. Set theoretical operations on relations. JOIN operations Aggregate Functions and Grouping. Nested Sub Queries-Views. Introduction to PL/SQL & programming of above operations in PL/SQL

UNIT-4	**Data Normalization:** Anomalies in relational database design. Decomposition. Functional dependencies. Normalization. First normal form, Second normal form, Third normal form. Boyce-Codd normal form.
UNIT-5	**Query Processing Transaction Management:** Introduction Transaction Processing. Single user & multiuser systems. Transactions: read & write operations. Need of concurrency control: The lost update problem, Dirty read problem. Types of failures. Transaction states. Desirable properties (ACID properties) of Transactions. Concurrency Control Techniques: Locks and Time stamp Ordering. Deadlock & Starvation.

Semester IV - Lab

1. Execute a single line query and group functions.
2. Execute DDL Commands.

3. Execute DML Commands
4. Execute DCL and TCL Commands.
5. Implement the Nested Queries.
6. Implement Join operations in SQL
7. Create views for a particular table
8. Implement Locks for a particular table
9. Write PL/SQL procedure for an application using exception handling.
10. Write PL/SQL procedure for an application using cursors.
11. Write a PL/SQL procedure for an application using functions
12. Write a PL/SQL procedure for an application using package

Artificial Intelligence - Theory

UNIT-I	**Overview of AI:** Definition of Artificial Intelligence, Philosophy of AI, Goals of AI, Elements of AI system, Programming a computer without and with AI, AI Techniques, History of AI. **Intelligent Systems:** Definition and understanding of Intelligence, Types of Intelligence, Human Intelligence vs Machine Intelligence.
UNIT-II	**AI Applications:** Virtual assistance, Travel and Navigation, Education and Healthcare, Optical character recognition, E-commerce and mobile payment systems, Image based search and photo editing. **AI Examples in daily life:** Installation of AI apps and instructions to use AI apps.
UNIT-III	**Robotics:** Introduction to Robotics, Difference in Robot System and Other AI Program, Components of a Robot.

Text Books:

1. Wolfgang Ertel, "Introduction to Artificial Intelligence", 2nd Edition, Springer International Publishing 2017.
2. Michael Negnevitsky, "Artificial Intelligence A Guide to Intelligent Systems", 2nd Edition, Pearson Education Limited 2005.

References:

1. https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_tutorial.pdf
2. Kevin Knight, Elaine Rich, Shivashankar B. Nair, "Artificial Intelligence", 3rd Edition, July 2017.

Computer Fundamentals and Programming in C - Theory

Unit - 1	
Fundamentals of Computers: Introduction to Computers - Computer Definition, Characteristics of Computers, Evolution and History of Computers, Types of Computers, Basic Organisation of a Digital Computer; Number Systems – different types, conversion from one number system to another; Computer Codes – BCD, Gray Code, ASCII and Unicode; Boolean Algebra – Boolean Operators with Truth Tables; Types of Software – System Software and Utility Software; Computer Languages - Machine Level, Assembly Level & High Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program - Algorithm, Flowchart and Pseudo code with Examples.	
Unit - 2	
Introduction to C Programming: Over View of C; History and Features of C; Structure of a C Program with Examples; Creating and Executing a C Program; Compilation process in C. **C Programming Basic Concepts:** C Character Set; C tokens - keywords, identifiers, constants, and variables; Data types; Declaration & initialization of variables; Symbolic constants. **Input and output with C:** Formatted I/O functions - *printf* and *scanf*, control stings and escape sequences, output specifications with *printf* functions; Unformatted I/O functions to read and display single character and a string - *getchar*, *putchar*, *gets* and *puts* functions.	
Unit – 3	
C Operators & Expressions: Arithmetic operators; Relational operators; Logical operators; Assignment operators; Increment & Decrement operators; Bitwise operators; Conditional operator; Special operators; Operator Precedence and Associatively; Evaluation of arithmetic expressions; Type conversion.	

Control Structures: Decision making Statements - *Simple if*, *if_else*, *nested if_else*, *else_if ladder*, *Switch-case*, *goto*, *break* & *continue* statements; Looping Statements - Entry controlled and Exit controlled statements, *while*, *do-while*, *for* loops, Nested loops.	
Unit - 4	
Arrays: One Dimensional arrays - Declaration, Initialization and Memory representation; Two Dimensional arrays - Declaration, Initialization and Memory representation. Strings: Declaring & Initializing string variables; String handling functions - *strlen*, *strcmp*, *strcpy and strcat;* Character handling functions - *toascii*, *toupper*, *tolower*, *isalpha*, *isnumeric* etc. **Pointers in C:** Understanding pointers - Declaring and initializing pointers, accessing address and value of variables using pointers; Pointers and Arrays; Pointer Arithmetic; Advantages and disadvantages of using pointers;	
Unit - 5	

User Defined Functions: Need for user defined functions; Format of C user defined functions; Components of user defined functions - return type, name, parameter list, function body, return statement and function call; Categories of user defined functions - With and without parameters and return type. **User defined data types:** Structures - Structure Definition, Advantages of Structure, declaring structure variables, accessing structure members, Structure members initialization, comparing structure variables, Array of Structures; Unions - Union definition; difference between Structures and Unions.	

Text Books

1. Pradeep K. Sinha and Priti Sinha: Computer Fundamentals (Sixth Edition), BPB Publication
2. E. Balgurusamy: Programming in ANSI C (TMH)

References

1. Kamthane: Programming with ANSI and TURBO C (Pearson Education)
2. V. Rajaraman: Programming in C (PHI – EEE)
3. S. ByronGottfried: Programming with C (TMH)
4. Kernighan & Ritche: The C Programming Language (PHI)
5. Yashwant Kanitkar: Let us C
6. P.B. Kottur: Programming in C (Sapna Book House)

C Programming - Lab

Part A:

1. Write a C Program to read radius of a circle and to find area and circumference
2. Write a C Program to read three numbers and find the biggest of three
3. Write a C Program to demonstrate library functions in *math.h*
4. Write a C Program to check for prime
5. Write a C Program to generate n primes
6. Write a C Program to read a number, find the sum of the digits, reverse the number and check it for palindrome
7. Write a C Program to read numbers from keyboard continuously till the user presses 999 and to find the sum of only positive numbers
8. Write a C Program to read percentage of marks and to display appropriate message (Demonstration of else-if ladder)
9. Write a C Program to find the roots of quadratic equation (demonstration of switch-case statement)
10. Write a C program to read marks scored by n students and find the average of marks (Demonstration of single dimensional array)
11. Write a C Program to remove Duplicate Element in a single dimensional Array
12. Program to perform addition and subtraction of Matrices

Part B:

1. Write a C Program to find the length of a string without using built in function
2. Write a C Program to demonstrate string functions.
3. Write a C Program to demonstrate pointers in C
4. Write a C Program to check a number for prime by defining *isprime( )* function
5. Write a C Program to read, display and to find the trace of a square matrix
6. Write a C Program to read, display and add two m x n matrices using functions
7. Write a C Program to read, display and multiply two m x n matrices using functions
8. Write a C Program to read a string and to find the number of alphabets, digits, vowels, consonants, spaces and special characters.
9. Write a C Program to Reverse a String using Pointer
10. Write a C Program to Swap Two Numbers using Pointers
11. Write a C Program to demonstrate student structure to read & display records of n students.
12. Write a C Program to demonstrate the difference between structure & union.

Note: Student has to execute a minimum of 10 programs in each part to complete the Lab course

Data Structures Using C - Theory

Unit - 1	
Introduction to data structures: Definition; Types of data structures - Primitive & Non-primitive, Linear and Non-linear; Operations on data structures. Algorithm Specification, Performance Analysis, Performance Measurement Recursion: Definition; Types of recursions; Recursion Technique Examples - Fibonacci numbers, GCD, Binomial coefficient ${}^{n}C_{r}$, Towers of Hanoi; Comparison between iterative and recursive functions.	
Unit - 2	
Arrays: Basic Concepts – Definition, Declaration, Initialisation, Operations on arrays; Types of arrays; Arrays as abstract data types (ADT); Representation of Linear Arrays in memory; Traversing linear arrays; Inserting and deleting elements; Sorting – Selection sort, Bubble sort, Quick sort, Selection sort, Insertion sort; Searching - Sequential Search, Binary search; Iterative and Recursive searching; Multidimensional arrays; Representation of multidimensional arrays; Sparse matrices.	
Unit - 3	
Dynamic memory allocation: Static & Dynamic memory allocation; Memory allocation and de-allocation functions - *malloc*, *calloc*, *realloc* and *free*. Linked list: Basic Concepts – Definition and Representation of linked list, Types of linked lists - Singly linked list, Doubly liked list, Header liked list, Circular linked list; Representation of Linked list in Memory; Operations on Singly linked lists – Traversing, Searching, Insertion, Deletion; Memory allocation; Garbage collection,	

Unit - 4	
Stacks: Basic Concepts – Definition and Representation of stacks; Operations on stacks; Applications of stacks; Infix, postfix and prefix notations; Conversion from infix to postfix using stack; Evaluation of postfix expression using stack; Application of stack in function calls. Queues: Basic Concepts – Definition and Representation of queues; Types of queues - Simple queues, Circular queues, Double ended queues, Priority queues; Operations on Simple queues;	
Unit – 5	
Trees: Definition; Tree terminologies –node, root node, parent node, ancestors of a node, siblings, terminal & non-terminal nodes, degree of a node, level, edge, path, depth; Binary tree: Type of binary trees - strict binary tree, complete binary tree, binary search tree and heap tree; Array representation of binary tree. Traversal of binary tree; *preorder*, *inorder* and *postorder* traversal; Reconstruction of a binary tree when any two of the traversals are given.	

Text Books

1. Satraj Sahani: Fundamentals of Data Structures

Programming Lab

Part A:

1. Write a C Program to find GCD using recursive function
2. Write a C Program to display Pascal Triangle using binomial function
3. Write a C Program to generate n Fibonacci numbers using recursive function.
4. Write a C Program to implement Towers of Hanoi.
5. Write a C Program to implement dynamic array, find smallest and largest element of the array.
6. Write a C Program to create two files to store even and odd numbers.
7. Write a C Program to create a file to store student records.
8. Write a C Program to read the names of cities and arrange them alphabetically.
9. Write a C Program to sort the given list using selection sort technique.
10. Write a C Program to sort the given list using bubble sort technique.

Part B:

1. Write a C Program to sort the given list using insertion sort technique.
2. Write a C Program to sort the given list using quick sort technique.
3. Write a C Program to sort the given list using merge sort technique.
4. Write a C Program to search an element using linear search technique.
5. Write a C Program to search an element using recursive binary search technique.
6. Write a C Program to implement Stack.
7. Write a C Program to convert an infix expression to postfix.
8. Write a C Program to implement simple queue.
9. Write a C Program to implement linear linked list.
10. Write a C Program to display traversal of a tree.

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Hosur-Malur Main Road, Alambady, Malur, Karnataka- 563160

Department of Science

Physics Syllabus SEP 2024-25

UG Program - As per State Education Policy- Karnataka (SEP 2024-25)

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Paper I-PHYUG 101: MECHANICS

Unit 1 : Motion in resistive media - Newton's Laws of Motion (Statement and illustration), Motion in a resistive medium; concept of terminal velocity, Drag force and Drag Coefficient. Motion of a body falling under gravity through a fluid at low speed - expression for velocity, acceleration, and displacement. Terminal velocity - expression for terminal velocity of a body falling under gravity through a fluid at high speed. **Friction** - Friction as a self-adjusting force. Laws of friction. Coefficient of Static and dynamic friction; Expression for acceleration of a body moving along an inclined plane with and without friction. Free Body Diagrams for the following cases:

(i) Two masses connected by a string hanging over a frictionless pulley

(ii) Two masses in contact and connected by a string on a smooth horizontal surface

(iii) Two masses connected by a string passing over a frictionless pulley fixed at the edge on a horizontal plane.

Unit 2

Gravitation and Planetary motion: Law of Gravitation, Gravitational Field, and Potential - relation between them, Field and Potential due to a solid sphere (derivation), Kepler's law (with derivation), Satellite motion, Orbital and Escape Velocity (derivation). Polar and Geostationary satellites. (Qualitative). **Work and Energy**: Work done by a constant and variable force; Work energy theorem; potential energy; examples of potential energy; Work done by gravitational

force; Work done by a spring force. Conservative and non-conservative forces, elastic and inelastic collisions. Concept of a system of particles, general expression for Centre of mass, Newton's law for a system of particles. Motion of rockets (qualitative).

Unit 3

Dynamics of Rigid bodies: Rotational motion about an axis, Relation between torque and angular momentum (derivation), Conservation of angular momentum with illustrations, Rotational energy (derivation). Definition of MI and Radius of gyration, Theorems on Moment of inertia (2 Dimension), MI of a circular disc, sphere, rectangular lamina. **Simple harmonic motion (SHM)**: Definition of simple harmonic motion, Differential equation of SHM and its solutions, different forms of the wave equation, expressions for amplitude, period, frequency of oscillations, Simple pendulum and compound pendulum; damped oscillations; forced oscillations, concept of resonance, coupled oscillations in phase and out of phase, energy transfer.

UNIT 4

Elasticity: Hooke's law, Stress – Strain diagram, definitions of three elastic moduli; Relationship between three elastic constants (derivation); Poisson's ratio; Theory of single cantilever, Torsional oscillations, Couple per unit twist (derivation). **Relativity**: Inertial and Non-inertial frames of reference. Galilean relativity - Transformation of Position, Distance, Velocity, Acceleration; Michelson – Morley Experiment, Search for ether. Postulates of the special theory of relativity; Lorentz Transformations – Length Contraction, Time Dilation, Velocity Addition Theorem; Variation of mass with velocity; Mass – Energy equivalence.

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PHYUG 102: MECHANICS PRACTICAL

List of Experiments (Minimum 8 experiments should be performed)

1. Error Analysis (Mandatory)
2. Determination of g using bar pendulum
3. Determination of Moment of Inertia and mass of Fly Wheel

4. Determination of Rigidity modulus of material of wire using torsional pendulum
5. Determination of elastic constants of a material of spring
6. Verification of Parallel axis theorem
7. Verification of Perpendicular axis theorem
8. Determination of Spring constant and effective mass of Spiral spring
9. Determination of Young's modulus of material of wire by uniform stretching
10. Verification of Law of conservation of energy
11. Determination of g using spiral spring
12. Determination of Rigidity modulus of material of wire by dynamic method
13. Simple pendulum - study of effect of mass of the bob on time period
14. Simple pendulum - study of variation of T with amplitude
15. To determine the Height of a Building using a Sextant
16. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

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Paper II-PHYUG 201: Thermodynamics and Statistical Physics

UNIT-I

Kinetic Theory of Gases: Assumptions of Kinetic Theory of Gases, derivation for pressure of a perfect gas, $PV=1/3\ nmc^2$. Maxwell's law of distribution of velocities (qualitative). Deduction of most probable velocity, mean velocity, and rms velocity. Expression for mean free path, degrees of freedom, and the principle of equipartition of energy. Specific heats of an ideal gas and atomicity of gases with derivation. **Transport Phenomena**: Viscosity and thermal conductivity in gases (with derivation). Relation between the coefficient of viscosity and the coefficient of thermal conductivity of a gas. **Real Gases**: Derivation of Vander Waal's equation of state. Expression for critical constants. Andrew's experiment on carbon dioxide. Comparison of Vander Waal's isotherms with Andrew's isotherms.

UNIT-II

Introduction to Thermodynamics: Basic concepts of Thermodynamics: system, surroundings, intensive and extensive properties. Microscopic and macroscopic description of a system. Zeroth law of Thermodynamics and its significance. **Laws of Thermodynamics**: First law of Thermodynamics and its significance. Equation of state PV^{γ}=Constant . Work done in isothermal and adiabatic processes for a perfect gas. Internal energy as a state function. Application of the first law for cyclic, isothermal, adiabatic, isochoric, and isobaric processes. **Carnot Engine and Cycle:** Efficiency derivation, second law of thermodynamics (Kelvin's & Clausius statements). Carnot theorem (proof). Refrigerator - coefficient of performance. **Entropy:** Basic concept of entropy. Change in entropy in reversible and irreversible processes. Entropy and disorder. Relation between entropy and the second law.T-S diagram of a Carnot cycle.

UNIT-III

Thermodynamic Potentials: Basic concepts of internal energy, enthalpy, Helmholtz free energy, Gibbs free energy, and their importance. Derivation of Maxwell's thermodynamic relations using thermodynamic potentials. TdS equations, energy equations, heat capacity equations, and Clausius-Clapeyron equation. **Black Body Radiation**: Blackbody radiation and its spectral energy distribution. Emissive power, absorptive power, emissivity. Kirchhoff's law, Stefan's law, Stefan-Boltzmann law. Wien's displacement law, Wien's fifth power law, Wien's distributive law. Rayleigh-Jeans law (qualitative). Derivation of Planck's law. Deduction of Wien's law. Rayleigh-Jeans law from Planck's Radiation law, Solar Constant, Estimation of Surface temperature of Sun.

UNIT-IV

Statistical physics: Phase space, microstate and macrostates, Ensemble- Canonical, Micro Canonical, grand canonical. Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distribution function with derivation and their comparison. Applications of BE Statistics - Specific heat and pressure of a BE gas, Einstein's Theory of Specific heat, Bose Einstein Condensation, Applications of FD Statistics - the pressure and specific heat of Fermi gas.

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PHYUG 201: Thermodynamics and Statistical Physics Practical

List of Experiments: (A minimum 8 experiments should to be performed).

1. Specific heat by Newton's law of cooling.

2. Specific heat of water by electrical method.

3. Calibration of thermocouple for Temperature measurement

4. Verification of Clausius-Clapeyron equation using pressure cooker

5. Determination of Solar constant.

(15hours)

6. Verification of Gaussian distribution using Monte Carlo technique (Pascal triangle).

7. Verification of Stefan's law by electrical method

8. Determination of Stefan's Constant by electrical method.

9. Thermal behaviour of a torch filament-Determination of temperature of the filament of the bulb.

10. Calibration of Thermistor for temperature measurement.

11. Determination of Thermal Conductivity of Rubber.

12. Determination of Thermal Conductivity of bad conductor- Lee's & Charlton's method.

13. Determination of Thermal Conductivity of metal.

14. Determination of emissivtiy of surface.

15. Determination of surface temperature of sun by using solar spectrum.

16. Estimation of value of pi using Monte Carlo Technique.

Note: Results of all the experiments should be analyzed through errors and uncertainties.

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Department of Science

Physics Syllabus NEP 2020-23

UG Program - Framed according to the National Education Policy (NEP 2020)

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Phy-DSCT1: Mechanics and Properties of Matter	**Course Credits (L+T+P) : 4+0+2**
Total Contact Hours: 52	**Duration of ESA: 3 Hours**

1st Semester - Phy. DSCT1: Mechanics & Properties of Matter

Unit – 1

Chapter No. 1: Units and measurements: System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae[review]. Mean deviation, errors and types of errors.

Chapter No. 2: Momentum and Energy: Work and energy, Conservation of linear momentum, Conservation of energy with examples,

Chapter No. 3: Frames of reference: Inertial and non- inertial frames, Galilean transformation, Principle of invariance, accelerated frames and Michelson -Morley Experiment.

Chapter No. 4: Special Theory of Relativity: Lorentz transformations, Constancy of speed of light. Postulates of Special Theory of Relativity. Lorentz transformation equations, Length contraction. Time dilation. Relativistic addition of velocities, mass -energy equivalence (E = mc2)

Unit – 2

Chapter No. 5 : Laws of Motion: Newton‟s Laws of motion, Dynamics of single particle and a system of particles, Centre of mass.

Chapter No. 6. : Dynamics of Rigid bodies: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy, Moment of inertia (MI): MI of a rectangular lamina and solid cylinders, Flywheel, Theory of compound pendulum and determination of g.

Chapter No. 7 : Gravitation: Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler‟s laws (statements). Satellite in a circular orbit.

Unit – 3

Chapter No. 8. Elasticity**:** Hooke‟s law - Stress-strain diagram, elastic moduli relation between elastic constants, Poisson‟s Ratio-expression for Poisson‟s ratio in terms of elastic constants. Work done in stretching and work done in twisting a wire Twisting couple on a cylinder. Beams, bending of beams, expression for bending moment, theory of single cantilever.

Chapter 9: Torsional pendulum, expression for time-period of torsional oscillations, determination of rigidity modulus (static and dynamic methods) and moment of inertia, determination of q, η and σ by Searle‟s double bar with necessary theory.

Unit – 4

Chapter No. 10 : Surface tension: Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface, excess pressure inside spherical liquid drop, angle of contact, examples

Chapter No. 11 : Viscosity: Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poiseuille‟s method, Stoke‟smethod.

Textbooks

Sl No	Title of the Book	Author(s)	Publisher	Year of Publication
1	Mechanics	D. S. Mathur	S.Chand &Co.	2000
2	Mechanics and Relativity (3rd Edition)	Vidwan Singh Soni,	PHI Learning Pvt.Ltd.	2013
3	Mechanics (In SI Units): Berkeley Physics Course Vol 1	Charles Kittel, Walter Knight, et al	TataMcGraw-Hill	2007
4	Properties of Matter	Brijlal&Subrahmanyam	S.Chand &Co.	2002

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Phy-DSCP1 - Lab I List of Experiments to be performed in Lab I

1. Error Analysis, Data Analysis and graphing techniques to be learnt(Mandatory)
2. Determination of g using bar pendulum (L versus T and L versus LT2 graphs)
3. Determination of moment of inertia of a Fly Wheel.
4. Determination of rigidity modulus using torsional pendulum
5. Verification of parallel and perpendicular axis theorems.
6. Determine the Young's Modulus a bar by uniform bending method
7. Determination of elastic constants of a wire by Searle‟s method
8. Young‟s modulus by Koenig‟s method
9. Modulus of rigidity of a rod –Static torsion method.
10. Viscosity by Stoke‟s method
11. Verification of Hooke‟s law.
12. Determination of surface tension of a liquid and the interfacial tension between two liquids using drop weight method.
13. Critical pressure for streamline flow
14. Determine the Young's Modulus a bar by single cantilever method.
15. Study of motion of a spring and to calculate Spring constant, g, and unknown mass.

Reference Books for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B.Saraf	Vikas Publications	2013
2	A laboratory manual of Physics for undergraduate classes, 1st Edition,	D P Khandelwal	Vikas Publications.	1985
3	B.Sc. Practical Physics (Revised Edition)	C. L Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chattopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd.	2002

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Phy-DSCT2: Electricity and Magnetism	Course Credits (L+T+P) : 4+0+2 =4
Total Contact Hours: 52	Duration of ESA: 3 Hours

2nd Semester - Phy-DSCT2: Electricity and Magnetism

Unit – 1

Chapter No. 1 Electric charge and field: Electric charge, field ,potential ,Gauss law (review), applications of Gauss law

Chapter No. 2 Electrostatic Potential: Electric potential, line integral, gradient of a scalar function, relation between field and potential. Constant potential surfaces, Potential due to a dipole and electric quadrupole.

Chapter No. 3 Network Theorems: Thevenin‟s theorem, Norton‟s Theorem, Superposition Theorem and Maximum power transfer theorem: Statements and proofs. Application to dc circuits

Unit – 2

Chapter No. 4. Conductors in electrostatic field: Conductors and insulators, conductors in electric field. Capacitance and capacitors, expression for capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, Dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Gauss‟s law.

Chapter No. 5. DC Currents:Electric currents and current density. Electrical conductivity and Ohm‟s law. Physics of electrical conduction, conduction in metals and semiconductors, circuit elements and circuits: Transient currents in RC, LR and LCR circuits. Force on a moving charge.

Unit – 3

Chapter No.6 Magnetism: Force on a moving Charge in a magnetic field, Lorentz force, Force on a current carrying conductor in a uniform magnetic field, Biot -Savart‟s law, field due to a straight conductor carrying current, force and torque on a current loop in a magnetic field ,Principle and theory of a moving coil galvanometer, Theory of HTG , Ampere‟s circuital law, EMI, Faraday‟s law, Lenz‟s law, Expression for self-inductance , energy stored in an inductor.

Chapter No. 7 AC circuits: RMS and average value of AC, Response of series RL, RC, LC, LCR circuits using j-operator method, quality factor, admittance and impedance, power and energy in AC circuits.

Unit – 4

Chapter No. 8 Electromagnetic waves: Equation of continuity, Maxwell‟s equations, displacement current, equation for propagation of electromagnetic wave, transverse nature of electromagnetic wave, energy transported by electromagnetic waves. Poynting vector, Electromagnetic waves in conducting media and skin effect.

Chapter No. 9 Magnetic materials: Magnetic intensity and magnetic induction, Intensity of magnetization, Susceptibility, Permeability, Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. Classical Langevin‟ s theory of para magnetism and diamagnetism, B-H hysteresis curves, Hard and soft magnetic materials.

Textbooks

Sl No	Title of the Book	Author(s)	Publisher	Year of Publication
1	Physics-Part-II,	David Halliday and Robert Resnick	Wiley Eastern Limited	2001
2	Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition	Edward M Purcell	Tata Mc GrawHill Publishing Company Ltd, New Delhi	2008

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Phy-DSCP1-Lab II

1. Determination of high resistance by leakage using B.G.
2. Determination of mutual inductance using BG.
3. L and C by equal Voltage method.
4. Charging and discharging of a capacitor (energy dissipated during charging, Dielectric constant and time constant measurements).
5. Verification of the Thevenin‟s Theorem
6. Verification of the Maximum power transfer theorem.

7. Verification of the superposition theorem

8. Black box: Identification of elements and measurement of their values

9. Impedance of series RC circuits - determination of frequency of AC.

10. Frequency response of LCR Series resonance circuit.

11. Frequency response of LCR Parallel resonance circuit.

12. Verification of laws of combination of capacitances and determination of unknown capacitance using de-Sauty bridge.

13. Maxwell‟s impedance bridge to determine L.

14. Determination of BH using Helmholtz double coil galvanometer and potentiometer.

Reference Books for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B. Saraf	Vikas Publications	2013

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Phy-DSCT3: Wave Motion and Optics	Course Credits (L+T+P) : 4+0+1
Total Contact Hours: 52	Duration of ESA: 4 hours

3rd Semester -Phy.DSCT3: Wave Motion and Optics

Unit – 1: Waves and Superposition of Harmonic Waves

Chapter No. 1 Waves: Plane and Spherical Waves. Longitudinal and Transverse Waves. Characteristics of wave motion, Plane Progressive (Travelling) Wave and its equation (derivation), Wave Equation – Differential form (derivation). Particle and Wave Velocities - Relation between them, Energy Transport – Expression for intensity of progressive wave, Newton's Formula for Velocity of Sound. Laplace's Correction (Derivation). Brief account of Ripple and Gravity Waves.

Chapter No. 2 Superposition of Harmonic Waves: Linearity and superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats) – Analytical treatment. Superposition of two perpendicular harmonic oscillations: Lissajous Figures with equal and unequal frequency- Analytical treatment. Uses of Lissajous' figures.

Unit – 2 - Standing Waves and Acoustics

Chapter No. 3 Standing Waves: Velocity of transverse waves along a stretched string (derivation), Standing (Stationary) Waves in a String - Fixed and Free Ends (qualitative). Theory of Normal modes of vibration in a stretched string, Energy density and energy transport of a transverse wave along a stretched string. Vibrations in rods – longitudinal and transverse modes (qualitative). Velocity of Longitudinal Waves in gas (derivation). Normal Modes of vibrations in Open and Closed Pipes – Analytical treatment. Concept of Resonance, Theory of Helmholtz resonator.

(Text Book : 1-4)

Chapter No. 4 Acoustics: Absorption coefficient, Reverberation time - Sabine's Reverberation formula (derivation), Factors affecting acoustics in buildings, Requisites for good acoustics. Acoustic measurements – intensity and pressure levels. (Text Book : 1-4)

Unit – 3: Nature of light and Interference

Chapter No. 5 Nature of light :Corpuscular theory- laws of reflections and refraction; The Wave model, Group velocity & wave (phase) velocity - relation between them ,Maxwell's electromagnetic waves.(Text Book No 5)

Chapter No. 6 Interference of light by division of wave front: Coherent source-Interference of light waves by division of wave-front, Young's double slit interference-theory and experiment, Fresnel Biprism- theory and experiment (determination of wavelength) (Text Book No 5)

Chapter No. 7 Interference of light by division of amplitude: Interference at thin films - reflected and transmitted light, Colours of thin films; Theory of air wedge; Theory of Newton's rings (Reflection). Determination of Refractive index of a liquid, Michelson Interferometer-Determination of wavelength of light(Text Book No 5)

Unit – 4 - Diffraction and Polarisation

Chapter No. 8 Fraunhofer diffraction: Introduction- Fraunhofer diffraction- Theory of single slit diffraction, Two slit diffraction pattern, Theory of diffraction Grating, Normal and oblique incidence – experimental determination of wavelength, Resolving power – Rayleigh criterion, Expression for resolving power of grating and telescope(Text Book No 5)

Chapter No. 9 Fresnel Diffraction- Concept of Fresnel half period zones, Comparison of Zone plate with lens, Theory of diffraction at a straightedge, Qualitative discussion on diffraction by a circular aperture and diffraction by an opaque disc (Text Book No 5)

Chapter No. 10 Polarisation: Production of polarized light, Malus' law, Phenomenon of double refraction in crystals, Quarter wave plate and half wave plate, Optical activity, Laurent's half shade polarimeter (Text Book No 5)

Text books				
Sl No	**Title of the Book**	**Authors Name**	**Publisher**	**Year of Publication**
1	The Physics of Waves and Oscillations,	N K Bajaj	Tata McGraw-Hill Publishing Company Ltd., Second Edition,	1984
2	Waves and Oscillations	N Subramanyam and Brij Lal	Vikas Publishing House Pvt. Ltd., Second Revised Edition	2010
3	A Text Book of Sound	D R Khanna and R S Bedi	Atma Ram & Sons, Third Edition	1952
4	Oscillations and Waves	Satya Prakash	PragathiPrakashan, Meerut, Second Edition	2003
5	A Text Book of Optics	Brij Lal, M N Avadhanulu& N Subrahmanyam	S. Chand Publishing	2012

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Phy-DSCP3 - Lab III

1.Velocity of sound through a wire using Sonometer.

2Frequency of AC using Sonometer.

3.Study of Lissajous' Figures-analysis

4.To verify the laws of transverse vibration using Melde's apparatus.

5.Helmholtz resonator using tuning fork.

6.Helmholtz resonator using electrical signal generator.

7.Study of Lissajous figures using CRO

8.To determine refractive index of the material of a prism using sodium source.

9.To determine refractive index of a liquid by parallax method.

10.To determine the dispersive power and Cauchy constants of the material of a prism using Hg source.

11.To determine wavelength of sodium light using Fresnel Biprism.

12.Determination of radius of curvature of a lens using Newton's rings.

13.To determine the thickness of a paper using air-wedge.

14.Study of Fraunhofer diffractionat single slit

15.Study of Diffraction at a straight edge.

16.To determine wavelength of spectral lines of Hg source using plane diffraction grating.

17.To determine resolving power of a plane diffraction grating.

18.To verify Brewster's law.

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Phy-DSCT4: Thermal Physics & Electronics	**Course Credits (L+T+P) :4+0+0**
Total Contact Hours: 52	**Duration of ESA: 4 hours**

4th Semester -Phy.DSCT4: Thermal Physics & Electronics

Unit – 1: Thermodynamics

Chapter No. 1 Laws of Thermodynamics: Review of the concepts of Heat and Temperature – the zeroth law of thermodynamics, Thermodynamic variables - extensive and intensive, Equations of state, PV diagrams.

Chapter No.2: First Law of Thermodynamics: Differential form of the First Law of Thermodynamics, Work done in an isothermal and adiabatic process for an ideal gas, Internal Energy as a state function, Equation of state for an adiabatic process Application of the first law for (i) Cyclic Process (ii) Adiabatic Process (iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process (qualitative).

Chapter No. 3 Second Law of Thermodynamics: Second law of thermodynamics (Kelvin's & Clausius' statements and their equivalence) Reversible and irreversible processes with examples; Heat engines: Carnot Engine; Carnot Cycle and its efficiency Carnot theorem, Refrigerator- Coefficient of performance. Concept of Entropy, Second Law of Thermodynamics in terms of Entropy, Entropy in reversible and irreversible process, Third Law of

Thermodynamics (Nernst Heat theorem): Statement, Significance and Unattainability of Absolute Zero

Unit – 2

Chapter No. 4 Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, Maxwell's Thermodynamic Relations: Maxwell's thermodynamic relations (using Thermodynamic potentials), Applications of Maxwell's Relations (1) Gibbs potential, First order Phase Transitions with examples, Clausius - Clapeyron Equation (2) Liquefaction of gases, regenerative cooling coupled with Joule Thomson cooling; Adiabatic expansion with Joule Thomson cooling (qualitative)

Chapter No. 5 Kinetic Theory of Gases: Maxwell's law of distribution of velocity (without derivation), Deduction of most probable velocity, mean velocity and root mean square velocity, Degrees of Freedom, Law of Equipartition of Energy. Derivation of pecific heats of ideal gas

Chapter No. 6 Black body radiation and its spectral energy distribution; Kirchhoff's law, Stefan-Boltzmann's law, Wien's displacement law, Rayleigh-Jeans law (Statements), Planck's law – deduction of Wien's Law & Rayleigh – Jeans Law.

Unit – 3: Semiconductor devices

Chapter No. 7 Semiconductor devices: Review of Intrinsic and extrinsic semiconductors, concept of holes effective mass expression for carrier concentration and electrical conductivity – p-n junction and its characteristics and parameters, diode current, PN Junction as a rectifier ,Half wave rectifier, full wave rectifier, Zener diode as voltage regulator, regulator circuit with no load& loaded regulator.

Chapter No. 8 Junction Transistors: Basics of Bipolar Junction Transistors (BJT), BJT operation, Common Base, Common Emitter and Common Collector Characteristics. Field Effect Transistor (FET) and its characteristics. Transistor as an Amplifier and Oscillator.

Unit – 4: Electronics

Chapter No. 9 Electronics: Integrated Circuits and logic families (Analog and Digital), Operational Amplifier, Ideal characteristics of Op-Amp, Inverting and NonInverting Configurations. Applications- Voltage Follower, Addition and Subtraction.

Chapter No. 10 Digital Electronics: Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Converting Decimal to

Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary. Boolean Algebra Theorems: De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, NAND Gate, NOR Gate, Algebraic Simplification, Implementation of NAND and NOR functions.

Textbooks				
Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1.	Heat and Thermodynamics	Brij lal, N. Subrahmanyam and P.S.Hemne	S. Chand Publishing	2001
2.	Heat and Thermodynamics	D. S. Mathur	S. Chand Publishing	2008
3.	Heat and Thermodynamics	M.W. Zemansky and Richard Dittman	McGraw-Hill Education	2017
4.	Thermal Physics	S C Garg, R M Bansal & C K Ghosh	McGrawHill Education (India)	2013
5.	Fundamentals of Classical Thermodynamics	G. J. V. Wylen, R. E. Sonntag, C. Borgnakke	John Wiley	1994
6.	Integrated Electronics	J. Millman, C. Halkias& C. Parikh	McGraw Hill Education	2017
7.	Digital Fundamentals	T. L. Floyd	Pearson Education	2005
8.	Principals of Electronics	V.K Mehta and Rohit Mehta	S. Chand Publishing	2020

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Phy-DSCP4 - Lab IV

1.Specific heat by Newton's law of cooling

2. Verification of Newton's law of cooling

3. Calibration of thermocouple for Temperature measurement

4. Thermal conductivity of a bad conductor by Lee's and Charlton's method

5. Thermal conductivity of rubber

6. Mechanical Equivalent of Heat by Callender and Barne's method

7. Coefficient of thermal conductivity of Copper by Searle's method

8. Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method

9. Determination of Stefan's constant/ Verification of Stefan's law

10. Variation of thermo-emf across two junctions of a thermocouple with temperature

11. Verification of Clausius-Clapeyron equation

12 Study of Gaussian distribution using Monte Carlo method.

13 Determination of Planck's constant.

Any FOUR of the above listed experiments 1-13must be conducted in Lab IV

14. V-I Characteristics of Silicon & Germanium PN Junction diodes (FB & RB)

15. (i) V-I Characteristics of Zener Diode (ii) Regulated power supply (using zener diode).

16. Characteristics of BJT in Common Emitter Configuration

17. Half Wave and Full Wave Rectifier without Filter

18. Half Wave and Full Wave Rectifier with Filter Determination of transistor h-parameters.

19. Frequency response of a CE amplifier.

20. Frequency response of CC Amplifier (Emitter Follower).

21. Applications of Operational Amplifier:

(i)Non-inverting and Inverting op-amp circuits

(ii)Voltage follower, Adder and Subtractor circuits

22. Truth table verification of logic gates using TTL 74 series ICs.

23. Logic Gates; Combinational Circuits; Sequential Circuits

24. Transfer characteristics of a TTL gate using CRO.

Reference Books for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Advanced Practical Physics for students	B.L. Flint and H.T. Worsnop	Asia Publishing House.	1971
2	Basic Electronics Lab Manual 2015-16,	National Institute of Science Education and Research, Bhubaneswar, 2015.	NISER, Bhubaneswar	**2015**
3	Engineering Practical Physics	S. Panigrahi, B. Mallick	Cengage Learning India Pvt. Ltd	**2015**

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Program Name	BSc in Physics	**Semester**	**V**
Course Title	**Classical Mechanics and Quantum Mechanics- I (Theory)**		
Course Code	**PHY DSCT-5**	**No. of Credits**	04
Contact Hours	60 Hours	**Duration of SEA/Exam**	2 ½ Hours
Formative Assessment Marks	40	**Summative Assessment Marks**	60

5th Semester -PHY DSCT-5 - Classical Mechanics and Quantum Mechanics- I (Theory)

Unit1: Introduction to Newtonian Mechanics: Mechanics of system of particle, Conservation of linear momentum, Angular momentum and total energy in terms of system of particles. **Lagrangian formulation**: Constraints, Holonomic constraints, non-holonomic constraints, Scleronomic and Rheonomic constraints. Generalized coordinates, degrees of freedom, Principle of virtual work, D'Alembert's principle, Lagrange equations. Newton's equation of motion from Lagrange equations, Applications: simple pendulum, Atwood's machine and linear harmonic oscillator.

Unit2: Relativity: Inertial and Non-Inertial Frames: Fictious forces. Uniformly rotating frame. Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz Contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass energy Equivalence.Relativistic Kinematics. Transformation of Energy and Momentum

Unit3: Introduction to Quantum Mechanics Brief discussion on limitations of classical physics to explain black body radiation, Photoelectric effect, Compton effect, stability of atoms and spectra of atoms. Compton scattering: Expression for Compton shift (With derivation). Matter waves: de Broglie hypothesis of matter waves, Electron microscope, Wave description of particles by wave packets, Group and Phase velocities and relation between them, Experimental evidence for matter waves: Davisson- Germer experiment, G.P Thomson's

experiment and its significance. Heisenberg uncertainty principle: Elementary proof of Heisenberg's relation between momentum and position, energy and time, angular momentum and angular position, illustration of uncertainty principle by Gamma ray microscope thought experiment. Consequences of the uncertainty relations: Diffraction of electrons at a single slit, why electron cannot exist in nucleus?

Unit4: Foundation of Quantum Mechanics

Probabilistic interpretation of the wave function - normalization and orthogonality of wave functions, Admissibility conditions on a wave function, Schrödinger equation: equation of motion of matter waves - Schrodinger wave equation for a free particle in one and threedimension, time-dependent and time-independent wave equations, Probability current density, equation of continuity and its physical significance, Postulates of Quantum mechanics: States as normalized wavefunctions. Position, momentum, angular momentum and energy operators. Expectation values of operators and their time evolution.

Particle in a one-dimensional infinite potential well (derivation), degeneracy in threedimensional case, particle in a finite potential well (qualitative), Transmission across a potential barrier, the tunnel effect (qualitative),One-dimensional simple harmonic oscillator - concept of zero - point energy.

References	
1	Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2	Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer
3	Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
4	Classical Mechanics, Takwale and Puranik-1989, Tata Mcgraw Hill, new Delhi
5	Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 2009.
6	Physics for Scientists and Engineers with Modern Physics, Serway and Jewett, 9th edition, Cengage Learning, 2014.
7	Quantum Physics, Berkeley Physics Course Vol. 4. E.H. Wichman, Tata McGraw-Hill Co., 2008.
8	Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, McGraw Hill, 2003.

9	P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill publication, ISBN: 9780070146174.
10	Ajoy Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Publication,ISBN 978-1-4020-2130-5.
11	Modern Physics; R.Murugeshan & K.Sivaprasath; S. Chand Publishing.
12	G Aruldhas, Quantum Mechanics, Phi Learning Private Ltd., ISBN: 97881203363.
13	Gupta, Kumar & Sharma, Quantum Mechanics, Jai Prakash Nath Publications.
14	Physics for Degree Students B.Sc., Third Year, C.L.Arora and P.S.Hemne, 1st edition, S.Chand & Company Pvt. Ltd., 2014.

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Course Title	**Classical Mechanics and Quantum Mechanics- I (Practical)**	**Practical Credits**	02
Course Code	PHY DSCP-5	**Contact Hours**	04 Hours
Formative Assessment	25 Marks	**Summative Assessment**	25 Marks
Practical Content			

PHY DSCP-5 - Classical Mechanics and Quantum Mechanics- I (Practical)

1. To determine 'g', the acceleration due to gravity, at a given place, from the L – T^2 graph, for a simple pendulum.
2. Studying the effect of mass of the bob on the time period of the simple pendulum.
3. Determine the acceleration of gravity is to use an Atwood's machine.
4. Study the conservation of energy and momentum using projectile motion.
5. Verification of the Principle of Conservation of Linear Momentum
6. Determination of Planck constant and work function of the material of the cathode using Photo-electric cell.
7. To study the spectral characteristics of a photo-voltaic cell (Solar cell).
8. Determination of electron charge ‘e’ by Millikan’s Oil drop experiment. To study the characteristics of solar cell.
9. To find the value of e/m for an electron by Thomson’s method using bar magnets.
10. To determine the value of e/m for an electron by magnetron method.

11. To study the tunnelling in Tunnel Diode using I-V characteristics.
12. Determination of quantum efficiency of Photodiode.
13. A code in C/C++/Scilab to find the first seven eigen states and eigen functions of Linear Harmonic Oscillator by solving the Schrödinger equation.
14. A code in C/C++/Scilab to plot and analyse the wavefunctions for particle in an infinite potential well.

References
B.Sc Practical Physics by C.L Arora.
B.Sc Practical Physics by Harnam Singh and P.S Hemne.
Practical Physics by G.S Squires.
Scilab Manual for CC-XI: Quantum Mechanics &Applications (32221501) by Dr Neetu Agrawal, Daulat Ram College of Delhi.
Scilab Textbook Companion for Quantum Mechanics by M. C. Jain.
Computational Quantum Mechanics using Scilab, BIT Mesra.
Advanced Practical Physics for Students by Worsnop B L and Flint H T.

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Program Name	BSc in Physics	**Semester**	V
Course Title	**Elements of Atomic, Molecular & Laser Physics (Theory)**		
Course Code	PHY DSCT-6	**No. of Credits**	04
Contact Hours	60 Hours	**Duration of SEA/Exam**	2 ½ Hours
Formative Assessment Marks	40	**Summative Assessment Marks**	60

5th Semester -PHY DSCT-6 - Elements of Atomic, Molecular & Laser Physics (Theory)

Unit1: Basic Atomic models Thomson's atomic model; Rutherford atomic model – Model, Theory of alpha particle scattering, Rutherford scattering formula; Bohr atomic model – postulates, Derivation of expression for radius, total energy of electron; Origin of the spectral lines; Spectral series of hydrogen atom; Effect of nuclear motion on atomic spectra - derivation; Ritz combination principle; Correspondence principle; Critical potentials – critical potential, excitation potential and ionisation potential; Atomic excitation and its types, Franck-Hertz

experiment; Sommerfeld's atomic model – model, Derivation of condition for allowed elliptical orbits.

Unit2: Vector atomic model and optical spectra Vector atom model – model fundamentals, spatial quantisation, spinning electron; Quantum numbers associated with vector atomic model; Coupling schemes – L-S and j-j schemes; Pauli's exclusion principle; Magnetic dipole moment due to orbital motion of electron – derivation; Magnetic dipole moment due to spin motion of electron; Lande g-factor and its calculation for different states; Stern-Gerlach experiment – Experimental arrangement and Principle; Fine structure of spectral lines with examples; Spin-orbit coupling/Spin-Orbit Interaction – qualitative; Optical spectra – spectral terms, spectral notations, selection rules, intensity rules; Fine structure of the sodium D-line; Zeeman effect: Types, Experimental study and classical theory of normal Zeeman effect, Zeeman shift expression (no derivation), examples; Stark effect: Experimental study, Types and examples.

Unit3: Molecular Physics Types of molecules based on their moment of inertia; Types of molecular motions and energies; Born-Oppenheimer approximation; Origin of molecular spectra; Nature of molecular spectra; Theory of rigid rotator – energy levels and spectrum, Qualitative discussion on Non- rigid rotator and centrifugal distortion; Theory of vibrating molecule as a simple harmonic oscillator – energy levels and spectrum; Electronic spectra of molecules – fluorescence and phosphorescence; Raman effect – Stoke's and anti-Stoke's lines, characteristics of Raman spectra, classical and quantum approaches, Experimental study of Raman effect; Applications of Raman effect

Unit4: Laser Physics Ordinary light versus laser light; Characteristics of laser light; Interaction of radiation with matter - Induced absorption, spontaneous emission and stimulated emission with mention of rate equations; Einstein's A and B coefficients – Derivation of relation between Einstein's coefficients and radiation energy density; Possibility of amplification of light; Population inversion; Methods of pumping; Metastable states; Requisites of laser – energy source, active medium and laser cavity; Difference between Three level and four level lasers with examples; Types of lasers with examples; Construction and Working principle of Ruby Laser and He-Ne Laser; Application of lasers (qualitative) in science & research, isotope separation,

communication, fusion, medicine, industry, war and space.

References	
1	Modern Physics, R. Murugeshan, Kiruthiga Sivaprakash, Revised Edition, 2009, S. Chand & Company Ltd.
2	Atomic & Molecular spectra: Laser, Raj Kumar, Revised Edition, 2008, Kedar Nath Ram Nath Publishers, Meerut.
3	Atomic Physics, S.N. Ghoshal, Revised Edition, 2013, S. Chand & Company Ltd.
4	Concepts of Atomic Physics, S.P. Kuila, First Edition, 2018, New Central Book Agency (P) Ltd.
5	Concepts of Modern Physics, Arthur Beiser, Seventh Edition, 2015, Shobhit Mahajan, S. Rai Choudhury, 2002, McGraw-Hill.
6	Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. McCash, Fourth Edition, 2008,
	Tata McGraw-Hill Publishers.
7	Elements of Spectroscopy – Atomic, Molecular and Laser Physics, Gupta, Kumar and Sharma, 2016, Pragati Publications.

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Course Title	**Elements of Atomic, Molecular & Laser Physics (Practical)**		**Practical Credits**	02
Course Code	**PHY DSCP-6**		**Contact Hours**	04 Hours
Formative Assessment	25 Marks	**Summative Assessment**		25 Marks
Practical Content				

PHY DSCP-6 - Elements of Atomic, Molecular & Laser Physics (Practical)

1. To determine Planck's constant using Photocell.
2. To determine Planck's constant using LED.
3. To determine wavelength of spectral lines of mercury source using spectrometer.
4. To determine the value of Rydberg's constant using diffraction grating and hydrogen discharge tube.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine fine structure constant using fine structure separation of sodium D-lines using a plane diffraction grating.
7. To determine the value of e/m by Magnetic focusing or Bar magnet.

8. To determine the ionization potential of mercury.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To determine the absorption lines in the rotational spectrum of Iodine vapour.
11. To determine the force constant and vibrational constant for the iodine molecule from its absorption spectrum.
12. To determine the wavelength of laser using diffraction by single slit/double slits.
13. To determine wavelength of He-Ne laser using plane diffraction grating.
14. To determine angular spread of He-Ne laser using plane diffraction grating.
15. Study of Raman scattering by CCl_4 using laser and spectrometer/CDS.

References
Practical Physics, D.C. Tayal, First Millennium Edition, 2000, Himalaya Publishing House.
B.Sc. Practical Physics, C.L. Arora, Revised Edition, 2007, S. Chand & Comp.Ltd.
An Advanced Course in Practical Physics, D. Chatopadhyaya, P.C. Rakshith, B. Saha, Revised Edition, 2002, New Central Book Agency Pvt. Ltd.
Physics through experiments, B. Saraf, 2013, Vikas Publications.

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Program Name	BSc in Physics	**Semester**	VI
Course Title	**Elements of Condensed Matter & Nuclear Physics**		
Course Code	**PHY DSCT-7**	**No. of Credits**	4
Contact Hours	60 Hours	**Duration of SEA/Exam**	2 ½ Hours
Formative Assessment Marks	40	**Summative Assessment Marks**	60

6th Semester PHY DSCT-7 - Elements of Condensed Matter & Nuclear Physics

Unit1: Crystal systems and X-rays: Crystal structure**:** Space Lattice, Lattice translational vectors, Basis of crystal structure, Types of unit cells, primitive, non-primitive cells. Seven crystal system, Coordination numbers, Miller Indices, Expression for inter planner spacing. **X Rays**: Production and properties of X rays, Coolidge tube, Continuous and characteristic X-ray spectra; Moseley's law. **X-Ray diffraction**, Scattering of X-rays, Bragg's law. **Crystal**

diffraction: Bragg's X-ray spectrometer- powder diffraction method, Intensity vs 2 plot (qualitative).

Free electron theory of metals: Classical free electron model (Drude-Lorentz model), expression for electrical and thermal conductivity, Weidman-Franz law, Failure of classical free electron theory; Quantum free electron theory, Fermi level and Fermi energy, Fermi-Dirac distribution function (expression for probability distribution F(E), statement only); Fermi Dirac distribution at T=0 and $E<E_f$, at T 0 and $E>E_f$, F(E) vs E plot at T = 0 and T 0. Density of states for free electrons (statement only, no derivation). Qualitative discussion of lattice vibration and concept of Phonons.; Specific heats of solids: Classical theory, Einstein's and Debye's theory of specific heats. Hall Effect in metals

Unit2: Magnetic Properties of Matter, Dielectrics and Superconductivity Magnetic Properties of Matter Review of basic formulae: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia, Para, and ferro magnetic materials; Langevin Classical Theory of dia – and Paramagnetism. Curie's law, Ferromagnetism and Ferromagnetic Domains (qualitative). Discussion of B-H Curve. Hysteresis and Energy Loss, Hard and Soft magnetic materials **Dielectrics**: Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), dielectric loss. Piezo electric effect, cause, examples and applications. **Superconductivity:** Definition, Experimental results – Zero resistivity and Critical temperature– The critical magnetic field – Meissner effect, Type I and type II superconductors.

Unit3: General Properties of Nuclei: Constituents of nucleus and their intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, main features of binding energy versus mass number curve, angular momentum, parity, magnetic moment, electric moments **Radioactivity decay:** Radioactivity: definition of radioactivity, half-life, mean life, radioactivity equilibrium **(**a) Alpha decay: basics of α-decay processes, theory of α emission (brief), Gamow factor, Geiger-Nuttall law. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays' emission & kinematics, internal conversion (Definition).

Unit4: Interaction of Nuclear Radiation with matter: Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, Energy loss due to ionization (quantitative description of Bethe Block formula), energy loss of electrons, introduction of Cerenkov radiation **Detector for Nuclear Radiations**: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility) qualitative only, Accelerators: Cyclotrons and Synchrotrons.

References

1. Solid State Physics-R. K. Puri and V.K. Babber., S.Chand publications,1st Edition(2004).
2. Fundamentals of Solid State Physics-B.S.Saxena,P.N. Saxena,Pragati prakashan Meerut(2017).
3. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
4. Nuclear Physics, Irving Kaplan, Narosa Publishing House
1. Introduction to solid State Physics, ***Charles Kittel***, VII edition, (**1996**)
5. Solid State Physics- **A J Dekker**, MacMillan India Ltd, (**2000**)
6. Essential of crystallography**, M A Wahab**, Narosa Publications (**2009)**
7. Solid State Physics-**S O Pillai**-New Age Int. Publishers (**2001**).
8. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
9. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
10. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
11. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute of Physics (IOP) Publishing, 2004).
12. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
13. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).

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Course Title	**Elements of Condensed Matter & Nuclear Physics (Practical)**	**Practical Credits**	02
Course Code	**PHY DSCP-7**	**Contact Hours**	04 Hours
Formative Assessment	25 Marks	**Summative Assessment**	25 Marks
Practical Content			

PHY DSCP-7 - Elements of Condensed Matter & Nuclear Physics (Practical)

1. Hall Effect in semiconductor: determination of mobility, Hall coefficient.
2. Energy gap of semiconductor (diode/transistor) by reverse saturation method
3. Thermistor energy gap
4. Fermi Energy of Copper
5. Analysis of X-ray diffraction spectra and calculation of lattice parameter.
6. Specific Heat of Solid by Electrical Method
7. Determination of Dielectric Constant of polar liquid.
8. Determination of dipole moment of organic liquid
9. B-H Curve Using CRO.
10. Determination of particle size from XRD pattern using Debye-Scherrer formula.
11. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method).
12. Measurement of susceptibility of paramagnetic solid (Gouy's Method) NUCLEAR PHYSICS
13. Study the characteristics of Geiger-Mùller Tube. Determine the threshold voltage, plateau region and operating voltage.
14. Study the absorption of beta particles in aluminium foils using GM counter. Determine mass attenuation coefficient of Aluminium foils.
15. Study the absorption of beta particles in thin copper foils using G M counter and determine mass attenuation coefficient.
16. Study the attenuation of gamma rays in lead foils using Cs-137 source and G M counter.
    a. Calculate mass attenuation coefficient of Lead for Gamma.
17. Determine the end point energy of Tl-204 source by studying the absorption of beta particles in aluminium foils.
18. Study the attenuation of absorption of gamma rays in polymeric materials using Cs-137 source and G M counter.
19. Simulation of nuclear decay using dice (Monte Carlo simulation)

20.	**References**
1	IGNOU : Practical Physics Manual

2	Saraf : Experiment in Physics, Vikas Publications
3	S.P. Singh : Advanced Practical Physics
4	Melissons : Experiments in Modern Physics
5	Misra and Misra, Physics Lab. Manual, South Asian publishers, (**2000**)
6	Gupta and Kumar, Practical physics, Pragati prakashan, (**1976**)

Program Name	BSc in Physics	**Semester**	VI
Course Title	**Electronic Instrumentation & Sensors (Theory)**		
Course Code:	**PHY DSCT-8**	**No. of Credits**	04
Contact Hours	60 Hours	**Duration of SEA/Exam**	2 ½ Hours
Formative Assessment Marks	40	**Summative Assessment Marks**	60

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6th Semester PHY DSCT-8 - Electronic Instrumentation & Sensors (Theory)

Unit1: Power supply AC power and its characteristics, Single phase and three phase, Need for DC power supply and its characteristics, line voltage and frequency, Rectifier bridge, Filters:

Capacitor and inductor filers, Lsection and π-section filters, ripple factor, electronic voltage regulators, stabilization factor, voltage regulation using ICs. **Basic electrical measuring instruments** Cathode ray oscilloscope- Block diagram, basic principle, electron beam, CRT features, signal display. Basic elements of digital storage oscilloscopes. Basic DC voltmeter for measuring potential difference, Extending Voltmeter range, AC voltmeter using rectifiers Basic DC ammeter, requirement of a shunt, Extending of ammeter ranges.

Unit2: Wave form generators and Filters Basic principle of standard AF signal generator: Fixed frequency and variable frequency, AF sine and square wave generator, basic Wein-bridge network and oscillator configuration, Triangular and saw tooth wave generators, circuitry and waveforms. Passive and active filters. Fundamental theorem of filters, Proof of the theorem by considering a symmetrical T-network. Types of filters, Circuitry and Cut-off frequency and frequency response of Passive (RC) and Active (op-amp based) filters: Low pass, high pass and band pass.

Unit3: Data Conversion and display Digital to Analog (D/A) and Analog to Digital (A/D) converters – A/D converter with preamplification and filtering. D/A converter - Variable resistor network, Ladder type (R-2R) D/A converter, Op-amp based D/A converter. Digital display systems and Indicators- Classification of displays, Light Emitting Diodes (LED) and Liquid Crystal Display (LCD) – Structure and working. Data Transmission systems – Advantages and disadvantages of digital transmission over analog transmission, Pulse amplitude modulation (PAM), Pulse time modulation (PTM) and Pulse width modulation (PWM)- General principles. Principle of Phase Sensitive Detection (PSD).

Unit4: Transducers and sensors Definition and types of transducers. Basic characteristics of an electrical transducer, factors governing the selection of a transducer, Resistive transducer-potentiometer, Strain gauge and types (general description), Resistance thermometer-platinum resistance thermometer. Thermistor. Inductive Transducer-general principles, Linear Variable Differential Transducer (LDVT)- principle and construction, Capacitive Transducer, Piezo-electric transducer, Photoelectric transducer, Photovoltaic cell, photo diode and phototransistor – principle and working.

References
1. Physics for Degree students (Third Year) – C.L. Arora and P.S. Hemne, S, Chand and Co. Pvt. Ltd. 2014 (For Unit-1, Power supplies) 2. Electronic Instrumentation, 3rd Edition, H.S. Kalsi, McGraw Hill Education India Pvt. Ltd. 2011 (For rest of the syllabus) 3. Instrumentation – Devices and Systems (2nd Edition)– C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill Education Pvt. Ltd. (Especially for circuitry and analysis of signal generators and filters)

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Course Title	**Electronic Instrumentation & Sensors (Practical)**	**Practical Credits**	02
Course Code	**PHY DSCP-8**	**Contact Hours**	04 Hours
Formative Assessment	25 Marks	**Summative Assessment**	25 Marks
Practical Content			

PHY DSCP-8 - Electronic Instrumentation & Sensors (Practical)

1. Construct a DC power supply using a bridge rectifier and a capacitor filter. Use a Zener diode or a 3-pin voltage regulator and study the load and line regulation characteristics. Measure ripple factor with and without filter and compare with theoretical values.
2. Calibration of a low range voltmeter using a potentiometer
3. Calibration of an ammeter using a potentiometer
4. Design and construct a Wien bridge oscillator (sine wave oscillator) using µA 741 op-amp. Choose the values of R and C for a sine wave frequency of 1 KHz. Vary the value of R and C to change the oscillation frequency.
5. Design and construct a square wave generator using μA 741 op-amp. Determine its frequency and compare with the theoretical value. Also measure the slew rate of the op-amp. If the 741 is replace by LM318, study how does the waveform compare with the previous one.

6. Study the frequency response of a first order op-amp low pass filter
7. Study the frequency response of a first order op-amp high pass filter
8. Study the characteristics of *pn*-junction of a solar cell and determine its efficiency.
9. Study the illumination intensity of a solar cell using a standard photo detector (e.g., lux meter).
10. Study the characteristics of a LED (variation of intensity of emitted light).
11. Study the characteristics of a thermistor (temperature coefficient of resistance)
12. Study the characteristics of a photo-diode
13. Determine the coupling coefficient of a piezo-electric crystal.
14. Study the amplitude modulation using a transistor.
15. Performance analysis of A/D and D/A converter using resistor ladder network and op-amp.

References

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. B.Sc. Practical Physics, C.L. Arora (Revised Edition), S. Chand and Co. Ltd. 2007
3. Practical Physics, D.C. Tayal, First Millennium Edition, Himalaya Publishing House, 2000

Syllabus for B.Sc., Mathematics, (2024-25 onwards)

SEMESTER–I

MATDCT-1.1: MATHEMATICS-I	
Teaching Hours: 4 hours/Week	**Credits: 04**
Total Teaching Hours: 60 Hours	**Max.Marks:100 (S.A–80+I.A.–20)**

Unit–I: Algebra-I

Matrices: Elementary row and column transformations (operations), equivalent matrices, and theorems (without proof) on it. Row- reduced echelon form, Normal form of a matrix, Rank of a matrix, Problems.

Homogeneous and Non – Homogeneous systems of m linear equations in n unknowns consistency criterion – criterion for uniqueness of solutions.

Eigenvalues and Eigenvectors of a square matrix of order 2 and 3, standard properties, Matrix polynomial, Cayley-Hamilton theorem (with proof). Finding $A^{-1}, A^{-2}, A^2, A^3,$ A^4 – related problems.

(15 hours)

Unit–II: Differential Calculus-I

Ordinary Differentiation: Successive Differentiation - n^{th} derivatives of the functions: e^{ax+b}, $(ax + b)^n$, $\log(ax + b)$, $\sin(ax + b)$, $\cos(ax + b)$, $e^{ax}\sin(bx+ c)$, $e^{ax}\cos(bx + c)$ – Problems. Leibnitz theorem (with proof) and its applications.

Partial Differentiation: Functions of two and three variables - First and higher order derivatives - Homogeneous functions – derivatives- Euler's theorem and its extension (with proof) - Total derivative and differential - Differentiation of implicit functions and composite functions – Problems - Jacobians – Properties of Jacobians and related problems.**(15 hours)**

Unit–III: Integral Calculus-I

Recapitulation of definite integrals and its properties. Reduction formulae for $\int \sin^n x\, dx$, $\int \cos^n x\, dx$, $\int \tan^n x\, dx$, $\int \cot^n x\, dx$, $\int \sec^n x\, dx$, $\int \operatorname{cosec}^n x\, dx$, $\int \sin^m x \cos^n x\, dx$, with definite limit - problems. Differentiation under integral sign by Leibnitz rule- problems.

Application of Integral Calculus: Computation of length of an arc, area of plane curves, surface area and volume of solids of revolution of standard curves in Cartesian and Polar forms.

(15 hours)

Unit–IV: Geometry -3D

Analytical Geometry of Three Dimensions: Analytical geometry of three-dimensional,

recapitulations of elements of three-dimensional geometry. Planes (intercept form, normal form and passing through three points with proof) distance from a point to a plane, angle between two planes, bisectors of angle between two planes and problems, standard equation of sphere and orthogonal spheres, standard equation of right circular cone and right circular cylinder and problems.

(15 hours)

TEXTBOOKS

1. Shanti Narayan and P K Mittal, *Textbook of Matrices*, 5th ed., New Delhi, S. Chand and Co. Pvt. Ltd., 2013.
2. N P Bali, *Differential Calculus*, India: Laxmi Publications (P) Ltd.., 2010.
3. Shanthi Narayan and P K Mittal, *Integral Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
4. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
5. S.P. Mahajan & Ajay Aggarwal, *Comprehensive Solid Geometry*, 1st ed.: Anmol Publications, 2000.
6. G. B. Thomas and R L Finney, *Calculus and analytical geometry,* Addison Wesley, *1995.*

REFERENCE BOOKS

1. B. S. Vatssa, *Theory of Matrices*, New Delhi: New Age International Publishers, 2005.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2014.
3. J Edwards, *An elementary treatise on differential calculus: with applications and numerous examples*, Reprint. Charleston, USA: BiblioBazaar, 2010.
4. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
5. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
6. Shanthi Narayan and P K Mittal, *Analytical Solid Geometry*. New Delhi: S. Chand and Co. Pvt. Ltd., 2014.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/
4. https://ndl.iitkgp.ac.in/
5. http://cec.nic.in/cec/
6. https://www.doabooks.org/

MATDCP-1.1: MATHEMATICS PRACTICAL -I	
Teaching Hours: 4 hours/Week	**Credits: 02**
Duration of Exam: 03 Hours	**Max.Marks:50 (S.A. – 40+I.A.–10)**

MATDCP-1.1: MATHEMATICS PRACTICAL-I

Mathematics Practical with Free/Libre and Open Source Software (FLOSS) tool for computer programs (i. e., Theory MATDCT-1.1 based Practical MATDCP-1.1)

1. Introduction to Python: Basic syntax, variable types, basic operators, numbers, strings, lists, tuples
2. Functions and input/output statements.
3. Some simple programs to understand the relational, conditional and logical operators.
   i) Compare two numbers (less than, greater than) using *if* statement
   ii) Sum of natural numbers using *while* loop
   iii) Finding the factors of a number using *for* loop.
   iv) To check the given number is prime or not (use *if... else* statement).
   v) Find the factorial of a number (use *if...if...else*).
   vi) Simple programs to illustrate *logical operators (and, or, not*)

   Note: Give the structure of a while...do loop to the students and illustrate with an example.
4. Computation of a Rank of a matrix by row reduced Echelon forms and normal forms.
5. Solving the system of homogeneous and non-homogeneous linear equations.
6. Find the eigenvalues and eigenvectors of a given matrix.
7. Computation of inverse of a matrix by using Cayley-Hamilton theorem.
8. Find the n^{th} derivatives of standard functions.
9. Find n^{th} derivative with Leibnitz rule.
10. Obtaining partial derivatives of some standard functions
11. Verification of Euler's theorem, its extension and Jacobian of functions.
12. Find the reduction formula with or without limits.
13. Evaluate the surface area of solids.
14. Evaluate the volume of solids of revolutions for standard curves.
15. Find the angle between the two planes.
16. Find the equation and plot sphere, cone and cylinder.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). All of the above experiments should be performed.

REFERENCE BOOKS

1. Sandeep Koranne, *Handbook of Open Source Tools,* Springer US, 2015.
2. Philip N. Klein, *Coding the Matrix: Linear Algebra through Computer Science Applications*, Newtonian Press, 2013.
3. Brian Heinold, *A Practical Introduction to Python Programming*, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.
4. J. C. Bautista, *Mathematics and Python Programming,* Lulu Press, Incorporated, 2014.
5. Eric Ayars, Computational Physics with Python, California State University, 2013.
6. John Kerl, Concrete abstract algebra in Python, 2013.

WEB RESOURCES:

1. http://www.univie.ac.at/future.media/moe/galerie.html
2. http://faculty.msmary.edu/heinold/python.html
3. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html
4. https://www.vlab.co.in/
5. https://fossee.in/
6. http://www.python.org

SEMESTER–II

MATDCT-2.1: MATHEMATICS-II	
Teaching Hours: 4 hours/Week	**Credits: 04**
Total Teaching Hours: 60Hours	**Max.Marks:100 (S.A.-80+I.A.–20)**

MATDCT-2.1: MATHEMATICS-II

Unit–I: Algebra-II

Groups: Binary operation, algebraic structure-problems on finding identity and inverse. Definitions of a group with examples and properties. Abelian group – problems on finite and infinite groups. Subgroups, center of groups, order of an element of a group and its related theorems, cyclic groups and its related theorems, coset decompositions, Lagrange's theorem and its consequences.

(15 hours)

Unit–II: Differential Calculus -II

Limits and continuity, differentiability and properties of continuous functions. Intermediate value theorem, Mean value theorems-Rolle 's Theorem, Lagrange's mean value theorem and Cauchy's mean value theorem with examples. Indeterminate forms and evaluation of limits using L'Hospital rule.

(15 hours)

Unit–III: Differential Calculus-III

Polar coordinates, angle between the radius vector and tangent, angle of intersection of two curves (polar forms), length of perpendicular form pole to the tangent, pedal equation, derivative of an arc in Cartesian parametric and polar forms, curvature of plane curve, radius of curvature formula in Cartesian, parametric polar and pedal forms, center of curvature evolutes, asymptotes, singular points and double points.

(15 hours)

Unit–IV: Integral Calculus II:

Line and Multiple integrals: Definition of line integral and its basic properties, examples on evaluation of line integrals. Definition of Double integrals and its related problems. Evaluation of double integrals by change of order of integration and by change of variables, computation of plane and surface areas, volume underneath a surface and volume revolution using double integrals. Definition of triple integral, basic properties and examples on evaluation, change of variable, volume as a triple integral.

(15 hours)

TEXT BOOKS

1. N. S. Gopala Krishnan, *University Algebra*, New Age Intn.l Pvt Ltd, New Delhi 2015.
2. Vijay K. Khanna and S. K. Bhambri, *A Course in Abstract Algebra*, Vikas Publications. 5 Edition, 2022.
3. Shanthi Narayan and P. K. Mittal, *Differential Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2014.
4. Shanthi Narayan and P. K. Mittal*, Integral Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
5. M. D. Raisinghania, *Vector Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
6. G. B. Thomas and R. L. Finney, *Calculus*, Pearson Education, 2010.

REFERENCE BOOKS

1. I. N. Herstein, Topics in Algebra, 4th ed. New Delhi, Vikas Pub. House Pvt. Ltd., 1991.
2. J. Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
3. N P Bali, *Differential Calculus*, India: Laxmi Publications (P) Ltd.., 2010.
4. S. Narayanan & T. K. Manicavachogam Pillay, *Calculus*.: S. Viswanathan Pvt. Ltd., Vol. I & II, 1996.
5. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
6. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/
4. https://ndl.iitkgp.ac.in/
5. http://cec.nic.in/cec/

6. https://www.doabooks.org/

MATDCP-2.1: MATHEMATICS PRACTICAL -II	
Teaching Hours: 4 Hours/Week	**Credits: 02**
Duration of Exam: 03 Hours	**Max.Marks:50 (S.A. – 40+I.A.–10)**

MATDCP-2.1: MATHEMATICS PRACTICAL-II

Mathematics Practical with Free and Open Source Software (FOSS) tool for computer programs (i. e., Theory MATDCT-2.1 based Practical MATDCP-2.1)

1. Verify whether given operator is binary or not.
2. To find identity and inverse element of a group
3. To construct the Cayley's table and test abelian for a given finite set.
4. Program to find all possible cosets of the given finite group.
5. Program to find generators and corresponding possible subgroups of a cyclic group.
6. Program to illustrate limits, continuity and differentiability of a given function
7. Program to verify Rolle's, Lagrange's and Cauchy's mean value theorems.
8. Evaluation of limits by L'Hospital rule.
9. Finding the angle between the radius vector and tangent.
10. Finding the angle between two curves.
11. Finding the radius of curvature of the given curves.
12. Plotting of standard Cartesian, polar and parametric curves.
13. Program to evaluate the line integral, double integral and triple integral with constant limits.
14. Program to evaluate the line integral, double integral and triple integral with variable limits.

Note: The above list may be changed annually with the approval of the BOS in (Mathematics). All of the above experiments should be performed.

REFERENCE BOOKS

1. Sandeep Koranne, *Handbook of Open Source Tools,* Springer US, 2015.
2. Philip N. Klein, *Coding the Matrix: Linear Algebra through Computer Science Applications*, Newtonian Press, 2013.
3. Brian Heinold, *A Practical Introduction to Python Programming*, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.
4. J. C. Bautista, *Mathematics and Python Programming,* Lulu Press, Incorporated, 2014.
5. Hans Peter Langtangen, *A primer on Scientific programming with Python*, Springer, 2009.
6. John Kerl, Concrete abstract algebra in Python, 2013.

WEB RESOURCES:

1. http://www.univie.ac.at/future.media/moe/galerie.html
2. http://faculty.msmary.edu/heinold/python.html
3. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html
4. https://www.vlab.co.in/
5. https://fossee.in/
6. http://www.python.org

Syllabus for B.Sc., (Basic/ Honors) with Mathematics as Major & Minor Subject

SEMESTER – I

MATDSCT 1.1: Algebra - I and Calculus - I	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Unit-I: Matrix

Elementary row and column transformations (operations). Equivalent matrices, theorems on it.Row-reduced echelon form of a matrix. Rank of matrix, Problems.Homogeneous and non-homogeneous system of m linear equations in n unknowns consistency criterion-criterion for uniqueness of solutions. Eigen values and Eigen vectors of square matrix of order 2 and 3 standard properties, Matrix polynomial, Cayley-Hamilton theorem (with proof). Find A^{-1}, A^{-2} and A^2, A^3, A^4.

14 Hours

Unit-II: Differential Calculus-I

Limits, Continuity, Differentiability and properties. Properties of continuous functions. Intermediate value theorem, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurin's series (without proof), Indeterminate forms and evaluation of limits using L'Hospital rule**.** **14 Hours**

Unit-III: Polar Co-ordinates

Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-

radius of curvature formula in Cartesian, parametric, polar, and pedal forms- center of curvatureand asymptotes**.** **14 Hours**

Unit-IV: Successive Differentiation

nth Derivatives of Standard functions e^{ax+b} , $(ax+b)^n$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$,$e^{ax}\cos(bx+c)$,Leibnitz theorem and its applications. Extended polar co-ordinates -Singular and Multiple points.Tracing of curves (standardcurves).

14 Hours

Reference Books:

1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited, 1986.
2. Theory of Matrices - B S Vatsa, New Age International Publishers, 2005.
3. Matrices - A R Vasista, Krishna Prakashana Mandir, 2003.
4. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi, 2005.
5. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
6. Calculus – Lipman Bers, Holt, Rinehart & Winston, 1969.
7. Calculus - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II, 1996.
8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw Hill., 2008.
9. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company, 2018
10. Text Book of B.Sc . Mathematics G B Gururajachar, Academic Excellence series, 2019

Web Resources:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/

MATDSCP 1.1: Practical's on Algebra - I and Calculus – I	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**

Practical/Lab Work to be performed in Computer Lab

Suggested Software's: Maxima/Python.

1. Introduction to Python/Maxima.
2. Commands in Python/ Maxima.
3. Simple programs in Python/ Maxima
4. Matrices –Algebra of matrices.
5. Computation of rank of matrix.
6. Solving the system of homogeneous and non-homogeneous linear algebraic equations.
7. Computation of inverse of matrix using Cayley-Hamilton theorems.
8. Finding the angle between the radius vector and tangent and angle between two curves.
9. Finding the radius of curvature of the given curve.
10. Verification of mean value theorems.
11. Find the Taylor's and Maclaurin's expansion of the given function.
12. Indeterminate forms and evaluation of limits using L-Hospital Rule.
13. Finding the n^{th}derivative.
14. Tracing of standard curves.

SEMESTER – II

MATDSCT 2.1: Algebra - II and Calculus - II	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100** **(S.A.-60 + I.A. – 40)**

Unit-I: Groups

Definition of a group with examples and properties. Subgroups, center of groups, order of an element of a group and its related theorems, cyclic groups, Coset decomposition, Factor groups, Lagrange's theorem and its consequences. Fundamental of Congruence, Fermat's theorem and Euler's ϕfunction.

14 hours

Unit-II: Partial Derivatives

Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.

14 hours

Unit-III: Integral Calculus-I

Reduction formulae for $\int \sin^n x\, dx$, $\int \cos^n x\, dx$, $\int \tan^n x\, dx$, $\int \cot^n x\, dx$, $\int \sec^n x\, dx$, $\int \operatorname{cosec}^n x\, dx$, $\int \sin^m x \cos^n x\, dx$ with define limit –Problems. Application of integral Calculus: Computation of length of arc, plane area and surface area and volume of solids of revolutions for standard curves in Cartesian and polar forms.

14 hours

Unit-IV: Integral Calculus-II

Line integral: Definition of line integral and basic properties, examples on evaluation of line integrals. Double integral: Definition of Double integrals and basic properties, examples on evaluation of double integrals. Triple Integrals: Definition of triple integrals and basic properties, examples on evaluation of triple integral.

14 hours

Reference Books:

1. Topics in Algebra, I N Herstein, Wiley Eastern Ltd., New Delhi, 1991.
2. Higher algebra, Bernard & Child, Arihant, 1959.
3. Modern Algebra, Sharma and Vasista, Krishna Prakashan Mandir, Meerut, U.P., 2013.
4. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi, 1962.
5. Integral Calculus, Shanti Narayan and P K Mittal, S. Chand and Co. Pvt. Ltd., 2013.
6. Schaum's Outline Series, Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw Hill., 2008.
7. A Course in Abstract Algebra, Vijay K Khanna and S K Bhambri, Vikas Publications.
8. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company, 2018
9. Text Book of B.Sc . Mathematics G B Gururajachar, Academic Excellence series, 2019

Web Resources:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/

PRACTICAL

MATDSCP 2.1: On Algebra -II and Calculus – II	
Practical Hours : 4 Hours/Week	**Credits: 2**

Total Practical Hours: 56 Hours	Max. Marks: 50 (S.A.-25 + I.A. – 25)

Practical/Lab Work to be performed in Computer Lab

Suggested Software's: Maxima/Python.

1. Program to construct Cayley's table and test abelian for given finite set.
2. Program to find all possible cosets of the given finite group.
3. Program to find generators and corresponding possible subgroups of a cyclic group.
4. Programs to verification of Lagrange's theorem with suitable examples.
5. Program to verify the Euler's ϕfunction for a given finite group.
6. Program to verify the Euler's theorem and its extension.
7. Program to find Jacobian.
8. Programs to construct series using Maclaurin's expansion for functions of two variables.
9. Program to verify the given Reduction formula with or without limits.
10. Program to evaluate the Surface area, volume of solid of revolutions for standard curves
11. Program to evaluate the line integrals with constant and variable limits.
12. Program to evaluate the Double integrals with constant and variable limits.
13. Program to evaluate the Triple integrals with constant and variable limits.

SEMESTER–III

MATDSCT 3.1: Ordinary Differential Equations and RealAnalysis–I	
Teaching Hours: 4Hours/Week	**Credits:4**
Total Teaching Hours: 56Hours	**Max. Marks:100 (SEE−60+I.A.−40)**

Ordinary Differential Equations:

Unit I: Recapitulation of Differential Equations of first order and first degree, Exact Differential equations, Necessary and sufficient condition for the equations to be exact. Differential equations of the first order and higher degree: Equations solvable for p, x, y. Clairaut's equation and singular solution. Orthogonal trajectories of Cartesian and polar curves. **14hrs**

Unit II: Linear differential equations of the n^{th} order with constant coefficients. Complementary function, Particular Integrals when the RHS is of the form e^{a} , $sin(ax + b)$,$cos(ax + b)$, x^{n} , e^{ax} V and $x\,V$, where V is a function of x. Cauchy – Euler equations, Method of variation of parameters. Second order ordinary linear differential equations with variable coefficients: (i) When a part of complementary function (CF) is

given,(ii) Change of dependent variable, (iii) Change of independent variable, and (iv) Method of variation of parameters. Total and Simultaneous differential equations. **14hrs**

Real Analysis – I:

Unit III: Sequences: Sequences of real numbers, Supremum and infimum of a sequences, Bounded sequences, Limit of a sequence, convergent, diverge and oscillatory sequences. Algebra of convergent sequences. Monotonic sequences and its properties. Nature of standard sequences. Cauchy's general principle for convergence of a sequence.
14Hrs

Unit IV: Infinite Series: Definition of convergent, divergent and oscillatory
series. Series ofnon-negative terms. Geometric series, P-series (Harmonic series).
Comparison tests for positive term series. D'Alembert's ratio test, Raabe's test,
Cauchy's Root test. Alternating series. Leibnitz's theorem. Absolute convergence
and conditional convergence of a series. Summation of series: Binomial, exponential and logarithmic.
14hrs

Reference Books:

1. M. D. Raisinghania, Ordinary Differential Equations & Partial Differential Equations,
   S. Chand & Company, New Delhi, 2013.
2. J. Sinha Roy and S. Padhy: A course of Ordinary and
   Partial Differential Equation,Kalyani Publishers, New
   Delhi, 2018.
3. D. Murray and Daniel Alexander, Introductory Course in
   Differential Equations, OrientBlackswan, India, 1967.
4. W. T. Reid, Ordinary Differential Equations, John Wiley, New Delhi, 2010.
5. M. L. Khanna, Differential Equations, Jai Prakash Nath & Co. Meerut, 1997.
6. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
7. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis,
   3rdEd., John Wiley andSons (Asia) Pvt. Ltd., Singapore, 2000.
8. Gerald G. Bilodeau, Paul R. Thie, G. E. Keough, An
   Introduction to Analysis, 2ndEd.,Jones & Bartlett, 2010.
9. K. A. Ross, Elementary Analysis: The Theory of Calculus (2nd Ed),
   Springer, 2013.

Web Resources:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics http://ocw.mit.edu/courses/mathematics/

PRACTICAL

MATDSCP3.1: Practical's on Ordinary Differential Equations and Real Analysis–I	
Teaching Hours:4Hours/Week	**Credits:2**
Total Teaching Hours:56Hours	**Max.Marks:50 (SEE-25+I.A.–25)**

Practical's/Lab Work to be performed in Computer Lab:

Use open- source software (FOSS) to executive the practical problems.
Maxima/Scilab/MatLab/Mathematica/Python).

1. Fundamentals of Ordinary differential equations and Real analysis using FOSS.
2. Test for exactness of differential equation and solving.
3. Plot orthogonal trajectories for Cartesian and polar curves.
4. Solutions of differential equations that are solvable for x, y, p.
5. To find the singular solution by using Clairaut's form.
6. Finding the complimentary function of linear homogeneous differential equations withconstant coefficients.
7. Finding the particular integral of linear homogeneous differential equations withconstant coefficients.
8. Solution of second order ordinary linear differential equations with variable coefficientsby the method of variation of parameters.
9. Test the convergence of sequences
10. Test the convergence of series using partial sums.
11. Test the convergence of series by using D'Alembert's ratio Test
12. Test the convergence of series by using Raabe's Test
13. Convergence of alternating series using Leibnitz's theorem.
14. Summation of series.

SEMESTER–IV

MATDSCT4.1:Partial Differential Equations and Integral Transforms	
Teaching Hours: 4Hours/Week	**Credits:4**

Total Teaching Hours:56Hours	Max.Marks:100 (SEE – 60+I.A.–40)

Partial Differential Equations:

Unit I: Basic concepts–Formation of a partial differential equations by elimination of arbitrary constants and functions, Solution of partial differential equations: Lagrange's linear equations of the form Pp + Qq = R , Standard types of first order non-linear partial differential equations, Charpit's method.
14Hrs

Unit II: Homogeneous and non-homogeneous linear partial differential equations with constant coefficients, Partial differential equations of the second order. Classification of second-order partial differential equations, canonical forms. Solutions of the Heat equation and Wave equation (using Fourier series).
14 Hrs

Integral Transforms:

UnitIII: Laplace Transforms: Definition**,** Basic Properties. Laplace transforms of some standard functions. Laplace transform of Periodic functions. Laplace transform of derivative and integral of a function. Heaviside function. Dirac-delta function. Convolution theorem. Inverse Laplace transforms and its properties. Solution of differential equationsby using Laplace transforms**.,**
14Hrs

Unit IV: Fourier Series and Transforms: Periodic functions. Fourier Coefficients. Fourier series of functions with period 2 and period 2L. Fourier series of even and odd functions. Half range Cosine and Sine series. Fourier Transforms - Finite Fourier Cosine and Sine transform. Transforms of derivates**.**

14Hrs

Reference Books:

1. D. A. Murray, Introductory Course in Differential Equations, Franklin Classics Pub.,2018
2. H. T. H. Piaggio, Elementary Treatise on Differential Equations and their Applications,CBS Publisher & Distributors, Delhi, 1985.
3. G. F. Simmons, Differential Equations, Tata McGraw Hill Publishing Company, 1974
4. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2007.
5. M. D. Raisinghania, Ordinary Differential Equations & Partial Differential Equations,20th Ed., S. Chand & Company, New Delhi, 2013.
6. K. Sankara Rao, Introduction to Partial Differential Equations: PHI, 3rd Edition, 2015.

7. I. N. Sneddean, Elements of Partial differential equations, McGraw- Hill InternationalEditions, 1986.
8. Murray R. Spiegall,, Laplace Transforms, Schaum's Series,1965.
9. J. K. Goyal and K. P. Gupta, Laplace Transform, Pragati Prakashan Meerut, 30th Ed., 2017.
10. Sudhir Kumar, Integral Transform Methods in Science and Engineering, CBSEngineering Series, 2017.
11. Murray R. Spiegel, Fourier Analysis, Schaum's Series, 1974.
12. Earl David Rainville and Philip Edward Bedient–A short course in DifferentialEquations, Prentice Hall College Div, 6thEdition, 1974.
13. Sathya Prakash, Mathematical Physics, Sultan Chand & Sons, New Delhi, 2021.

Web Resources:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathem

atics http://ocw.mit.edu/courses/mathematics/

PRACTICALS

MATDSCP4.1:Practical's on Partial Differential Equations and Integral Transforms	
Practical Hours:4Hours/Week	**Credits: 2**
Total Teaching Hours:56Hours	**Max.Marks:50 (S.A.-25+I.A.–25)**

Programs using Scilab/Maxima/Python:

1. Elements of Partial differential equations and Integral transforms using FOSS.
2. Solutions of Linear Partial differential equations of Type-1 and Type-2.
3. Solutions of Linear Partial differential equations of Type-3 and Type-4.
4. Solution of Partial differential equation using Char pit's method.
5. Finding the complimentary function of second order homogenous partial differential equationwith constant coefficients.
6. Finding the particular integral of second order homogenous partial differential equation withconstant coefficients.
7. Solutions to Heat and Wave equations using Fourier series method
8. Finding the Laplace transform of some standard functions.
9. Finding the inverse Laplace transform of some simple functions.
10. Verification of Convolution Theorem.
11. To solve ordinary linear differential equation using Laplace transform.
12. To find the Fourier series of some simple functions with period 2 and 2L.

13. To find Cosine Fourier transforms
14. To find Sine Fourier transforms

SEMESTER–V

MATDSCT5.1: Real Analysis-II and Complex Analysis	
Teaching Hours:4Hours/Week	**Credits:4**
Total Teaching Hours:60Hours	**Max.Marks:100 (S.A.-60+I.A.–40)**

MATDSCT5.1: REAL ANALYSIS-II AND COMPLEX ANALYSIS

Unit–I: Riemann Integration

Definition and examples for partition of an interval, refinement of a partition and common refinement. Riemann Darboux Sums-Upper and lower (Darboux) sum-definition, properties and problems.

Riemann Integral – Upper and Lower integrals (definition & problems), Darboux's theorem and Criterion for Integrability, Integrability of sum, difference, product, quotient, and modulus of integrable functions. Integral as a limit of sum (Riemann sum)-Problems. Some integrable functions Integrability of continuous functions, monotonic functions, bounded function with finite number of discontinuity.

15 Hours

Unit –II: Improper Integrals

Improper Integrals – **Improper** integrals of the first, second and third kind with examples. Improper integral as the limit of the proper integral.

Beta-Gamma Functions – Definitions, Properties and examples, relations between beta and gamma functions, standard theorems, applications of definite integrals, duplication formula and its applications.

15 Hours

Unit – III: Complex numbers and functions of complex variables

Complex numbers-Cartesian and Polar form-Geometrical representation- Complex-Plane-Euler's formula.

Functions of a Complex variable-limit, Continuity and Differentiability of a Complex function. Analytic function, Cauchy-Riemann equations in Cartesian form with proof and related problems.

Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given-Milne Thomson method.

15 Hours

Unit –IV: Complex Integration and Transformations:

Complex Integration: – Definition, Line integral, properties and problems. Cauchy's Integral theorem-proof using Green's theorem-direct consequences. Cauchy's Integral formula with proof-Cauchy's generalized formula for the derivatives with proof and applications for evaluation of simple line integrals-Cuchy's inequality with proof-Liouville's theorem with proof.

Fundamental theorem of algebra with proof.

Transformations: Linear Transformation-Definitions-Bilinear transformations- Cross- ratio of four points-Cross-ratio preserving property-Preservation of the family of straight lines and circles-Conformal Mappings-Discussion of the transformations. –

15 Hours

REFERENCE BOOKS:

1. S. C. Malik and Savita Arora, Mathematical Analysis, 6th ed.: New Age Intl. Ltd. 2021.
2. Robert G. Bartle and Donald R. Sherbert, Introduction to Real Analysis, , Wiley, 2021.
3. Ajit Kumr and S. Kumaresan, A Basic Course in Real Analysis, Taylor and Francis Group, 2014.
4. N. P. Bali, Real Analysis, Golden Math Series, Laxmi Pub. Pvt. Ltd , New Delhi, 2013.
5. Walter Rudin, Principles of Mathematical Analysis, 3rd Ed. McGraw Hill Ed. 2017.
6. L. V. Ahlfors, Complex Analysis, 3rd, McGraw Hill Education, 1978.
7. Bruce P. Palka, Introduction to the Theory of Function of a Complex Variable, Springer, 2012.
8. Serge Lang, Complex Analysis, 4th ed. Springer, 2003.
9. Shanthi Narayan and M.D. Raisinghania, Elements of Real Analysis, 14th ed. S. Chand Publishers, 2013.
10. Shanthi Narayan and P. K. Mittal, Theory of Functions of a Complex Variable, 2nd ed. S. Chand Publishers, 2005.
11. S. Ponnuswamy, Foundations of Complex Analysis, 2nd ed., Narosa, 2011.
12. J. W. Brown & R. V. Churchil, Complex Variables and Applications, 8th ed, McGraw Hill Companies, 2017.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/

MATDSCP 5.1: **PRACTICAL'S ON REAL ANALYSIS-II AND COMPLEX ANALYSIS**	
Practical Hours: 4 Hours/Week	**Credits: 2**
Total Practical Hours: 60 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's:
wxMaxima/Scilab /Python/R/Maple/Sage…etc.

Suggested Programs:

1. Fundamental elements of Real Analysis-II and Complex Analysis using FOSS.
2. Program to check whether a given set of real numbers attains supremum or infimum.

3. Program to find upper and lower Riemann sums with respect to given partition
4. Program to test the Riemann Integrability.
5. Program to evaluate Riemann integral as a limit of sum.
6. Evaluation of the integrals using Gamma function.
7. Evaluation of the integrals using Beta function.
8. Verification of Cauchy – Riemann equations (Cartesian form) or test for analyticity.
9. Program to check whether a function is harmonic or not.
10. Program to construct analytic functions (through Milne–Thompson method).
11. Verification of problems on Cauchy's Integral theorem
12. To find the Cross ratio of four points in complex transform.

MATDSCT 5.2: VECTOR CALCULUS AND GROUP THEORY	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

MATDSCT5.2: Vector Calculus and Group Theory

Unit – I: Vector Algebra

Vector Algebra: Multiple product – scalar triple product, vector triple product, geometrical interpretation, related problems, vector function of a scalar variable – interpretation as a space curve, derivative, tangent, normal and binormal vectors to a space curve.

Scalar field: Gradient of a scalar field, geometrical meaning, directional derivative, unit normal to the surfaces - tangent plane and normal to the surface.

Vector field: Divergence and curl of a vector field, solenoidal and irrotational fields, Laplacian of a scalar field, Vector identities.

15 Hours

Unit – II: Vector Integration

Vector Integration – Definition and basic properties, vector line integral, surface integral and volume integral; **Green's theorem in the plane** – Proof and related problems, **Gauss' Divergence theorem** – Proof and related problems, **Stokes' theorem** – Proof and related problems.

15 Hours

Unit-III: Calculus of Variations

Variation of a function – variation of the corresponding functional – extremal of a functional – variational problem – Euler's equation and its particular forms – Examples – standard problems like geodesics, minimal surface of revolution, hanging chain, Brachistochrone problem –Isoperimetric problems.

15Hours

Unit-IV: Group Theory

Recapitulation of Elements of Group theory (i.e., Groups, subgroups, cyclic groups, cosets). Normal subgroups-examples and problems – Quotient group.

Homomorphism and Isomorphism of groups-Kernel and image of a homomorphism-Normality of the Kernel-Fundamental theorem of homomorphism- properties related to isomorphism-Permutation group-Cayley's theorem.

15 Hours

REFERENCE BOOKS:

1. M. D. Raisinghania, Vector Calculus, S. Chand Co. Pvt.Ltd., 2013.
2. M. Spiegel, Vector Analysis, 2nd Ed., Schaum's Outline Series, Mc-Graw Hill Pub. House Edition, 2017.
3. C. E. Weatherburn, Elementary Vector Analysis, Alpha ed., 2019.
4. Shanthi Narayan and P. K. Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
5. B. S. Grewal, Higher Engineering Mathematics, 42nd ed. Khanna Publishers, 2017.
6. A. S. Gupta, Calculus of Variations, Prentice Hall of India, New Delhi, 2011.
7. Oskar Bolza, Lectures on the Calculus of Variations, Dover Pub. New York, 2018.
8. R. K. Sharma, Calculus of Variations, Medtech, 2017.
9. P. N. Wartikar and J. N. Wartikar, A Textbook of Applied Mathematics, Vol. II, Pune Vidyarthi Griha Prakashan, 2008.
10. I. N. Herstein, Topics in Algebra, 4th ed. New Delhi, India: Vikas Publ. House Pvt, Ltd., 1991.
11. B. Boumslag and B. Chandler, Schaum's outline series on groups, 1968.
12. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/

MATDSCP5.2: PRACTICAL'S ON VECTOR CALCULUS AND GROUP THEORY	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's:
wxMaxima/Scilab /Python/R/Maple/Sage…etc.

Suggested Programs:

1. Fundamental elements of Vector Calculus, Calculus of variations and Group Theory using FOSS tool.
2. Program to verify the multiple products of vectors – Scalar and Cross product.
3. Program to verify y the vector differentiation and finding unit tangent.
4. Program to find the gradient and Laplacian of a scalar function.
5. Program to find the divergence and curl of a vector function.
6. Program to evaluate a vector line integral, a surface integral and a volume integral.
7. Program to verify Green's theorem, the Gauss' Divergence theorem and the Stokes' theorem.
8. Examples on Euler's equation in particular form and full form.
9. Examples on minimum surface of revolution, Brachistochrone problem and Isoperimetric problems.
10. Program to verify whether given set is a group with respect to binary operations, find an identity and inverse elements of a group, and find the index of a subgroup of a group.
11. Program to verification of normality of a given subgroup.
12. Examples on homomorphism and isomorphism of groups.

SEMESTER–VI

(2023-24 onwards)

MATDSCT 6.1: RING THEORY AND LINEAR ALGEBRA	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

MATDSCT 6.1: Ring Theory and Linear Algebra

Unit I: Ring Theory

Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield. Ideal, ideal generate by a subset of a ring, factor rings, operations on ideals, principal, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. Ring isomorphism and its properties.

15 Hours

Unit – II: Vector Spaces

Vector Spaces: Definition, example and properties of vector space.

Subspaces: Examples, criterion for a sub- set to be a subspace and some properties.

Basis and dimension: Linear Combination-Linear span, Linear dependence and Linear independence, basic properties of linear dependence and independence, techniques of determining linear dependence and independence in various vector spaces and related

problems. Co-ordinates, ordered basis, some basic properties of basis and dimension and subspace spanned by given set of vectors.

15 Hours

Unit–III: Linear Transformations

Definition, examples, equivalent criteria, some basic properties, and matrix representation and change of basis and effect on associated matrix, similar matrices. Null space, Range space, proof of Rank– Nullity theorem and related problems.

15 Hours

Unit–IV: Isomorphism, Eigen values and Eigen vectors.

Isomorphism and Automorphism: Examples, order of automorphism and Fundamental theorem of homomorphism.

Eigen values and Eigen vectors: Computation of Eigen values, algebraic multiplicity, some basic properties of eigenvalues, determination of eigen vectors and eigen space and geometric multiplicity.

15 Hours

REFERENCE BOOKS:

1. I. N. Herstein, Topics in Algebra, 4th Ed. New Delhi, India: Vikas Publ. House Pvt, Ltd., 1991.
2. A. R. Vasishtha, Modern Algebra, 16th Ed., Krishna Prakshan Mandir, 2010.

3. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence, Linear Algebra. 4th Ed., Prentice-Hall of India Pvt. Ltd, 2003.
4. Kenneth Hoffman & Ray Kunze, Linear Algebra, 2nd Ed., Prentice Hall India Leaning Private Ltd., 2015.
5. Gilbert Strang, Linear Algebra and its applications, 2nd ed., Elsevier, 2015.
6. Vivek Sahai & Vikas Bist, Linear Algebra, 2nd Ed., Narosa Publishing House, 2013.
7. Serge Lang, Introduction to Linear Algebra (2nd ed.), Springer India, 2005.
8. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
9. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
10. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/