

REAL ANALYSIS

1. Course Description

Programme: B.Sc

Max. Hours : 60

Course Code: U26/MAT/DSC/201

Hours per week : 04

Course Type: DSC- II

Max. Marks : 100

No. of credits: 4

2. Course Objectives

1. To offer a thorough introduction to the fundamental ideas of Real Analysis and explain their relevance to current Mathematical progress.
2. To demonstrate the applicability of Real Analysis in analyzing and solving domain-specific challenges within Computer Science, Engineering, Physics, Economics, and various other disciplines.

3. Course Outcomes

After the successful completion of the course, the student will be able to:

CO 1: Recall and explain the concepts of open sets, closed sets, and the convergence and divergence of sequences. (L I)

CO 2: Explain the concepts of convergence of series using various tests, including the limits and continuity of functions. (L II)

CO 3: Analyze the differentiability of real functions using Rolle's Theorem and the Mean Value Theorem. (L IV)

CO 4: Explain the conditions and algebra of integrability for real functions using the Fundamental Theorem of Calculus. (L II)

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4. Course Content

Module – I

15 Hours

Real Numbers:

Field Structure and Order Structure, Bounded and Unbounded Sets, Completeness in the Set of Real Numbers, Absolute value of a Real Number

Sections: 2, 3, 4, 5 of Chapter 1, Pg. No: 9 to 26

Open Sets, Closed Sets and Countable Sets:

Limit Points of a Set, Closed Sets- Countable and Uncountable Sets.

Sections: 2, 3, 4 of Chapter 2, Pg. No: 31 to 43.

Real Sequences:

Sequences, Limit Points of a Sequence, Convergent Sequences, Non-Convergent Sequences (Definitions), Cauchy 's General Principle of Convergence, Algebra of Sequences, Some Important Theorems, Monotonic Sequences.

Sections: 1, 2, 4, 5, 6, 7, 8, 9 of Chapter 3, Pg. No: 44 to 50, 52 to 98.

Module -II

15 Hours

Infinite Series:

Positive Term Series, Comparison Tests for Positive Term Series, Cauchy's Root Test, D'Alembert's Ratio Test, Logarithmic Test, Integral Test, Alternating Series (Leibnitz Test). **Sections: 2, 3, 4, 5, 7, 8, 10.1, 10.2 of Chapter 4, Pg. No:103 to 116, 119 to 124, 130 to 136.**

Functions of a Single Variable (I):

Limits, Continuous Functions, Functions Continuous on Closed Intervals.

Sec 1, 2, 3 of Chapter 5, Pg. No: 145 to 171

Module-III

15 Hours

Functions of a Single Variable (II):

The Derivative, Increasing and Decreasing Functions, Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Higher order derivatives.

Sections: 1, 3, 5, 6, 7, 8 of Chapter 6, Pg No: 177 to 180, 184 to 186, 188 to 208.

Module-IV

15 Hours

Riemann Integral:

Definition and Existence of the Integral, Refinement of Partitions, Darboux's Theorem, Conditions of Integrability, Integrability of the Sum and Difference of Integrable Functions, The Integral as a Limit of Sums, Some Integrable Functions, Integration and Differentiation, The Fundamental Theorem of Calculus.

Sections: 1, 2, 3, 4, 5, 6, 7, 8, 9 of Chapter 9, Pg. No: 263 to 287, 291-300.

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5. Reference Books:

1. S.C Malik and Savita Arora, Mathematical Analysis, Seventh Edition, New Age International Publishers.
2. Kenneth A Ross - Elementary Analysis: The theory of Calculus, Springer, Second Edition, 2013.
3. William F. Trench- Introduction to Real Analysis, Prentice Hall/ Pearson Education, First Edition, 2003.
4. Lee Larson - Introduction to Real Analysis I, University of Louisville (course notes), 2014.
5. Shanti Narayan & P. K Mittal – A course of Mathematical Analysis, S Chand & Company Ltd., Revised (29th Edition), 2005.
6. Brian S. Thomson, Judith B. Brucker & Andrew M. Bruckner – Elementary Real Analysis, Prentice Hall, First Edition 2001; Second Edition 2008.

6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local/Regional/National /Global Development Needs	Relevance
National	Understanding the integrability of real functions and the Fundamental Theorem of Calculus equips students with essential mathematical skills used in scientific research, engineering analysis, and data modelling, which are important for technological and scientific development.
Global	Real analysis is a versatile and fundamental branch of mathematics with applications spanning a wide range of disciplines. Its rigorous methods and concepts provide a solid framework for understanding and solving real-world problems in various scientific, engineering, and economic fields.

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a) Components on Skill Development/Entrepreneurship Development/Employability.

SD/ED/EMP	Syllabus Content	Description of Activity
Skill Development	Module I, II, III & IV	Fundamentals of Real Analysis using Mathematical Software
Employability	Module I, II, III & IV	Real analysis helps in understanding optimization, modelling, and stability of economic systems used in financial analysis and forecasting.

7. Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Participative Learning	Presentations, Interactive Classroom games/Quiz
2.	Experiential Learning	Field Trips
3.	Problem Solving	Assignments, Research Projects

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8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

b) CO	Continuous Internal Assessments CIA - 40%	End Semester Examination- 60%
CO1	CIA-I - Written Exam	Written Exam
CO2	CIA-I(Written Exam)	
CO3	CIA-II (Skill Tests)	
CO4	CIA-II (Assignments)	

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c) Model Question Paper- End Semester Exam Theory

MODEL QUESTION PAPER
THEORY

Course Code: U26/MAT/DSC/201
No. Of Credits: 4

Max. Marks: 60
Max. Time: 2 Hrs

Note: This question paper consists of Section A and B. The answer to Section A & B must be written in the answer book given.

SECTION – A (Long Essay Type)

I. Answer ALL questions:

Marks: 4 x 10 =40M

1. (a) Prove that every bounded sequence with a unique limit point is convergent.

(b) Show that $\lim_{n \rightarrow \infty} \frac{3 + 2\sqrt{n}}{\sqrt{n}} = 2$.

OR

2. State and Prove Cauchy 's General Principle of Convergence.

3. (a) State and prove D' Alembert's Ratio Test.

(b) Test for the convergence of the series (a) $\sum_{n=0}^{\infty} \frac{1}{2n^2 + 1}$.

OR

4. (a) State and prove Cauchy's Root Test.

(b) If a function f is continuous on a closed interval $[a, b]$ then f attains its bounds at least once in $[a, b]$.

5. (a) State and prove Rolle's Theorem,

(b) Expand $f(x) = e^x$ using Maclaurin's theorem.

OR

6. (a) Prove Taylor's Theorem with Lagrange's form of remainder.

(b) Show that using Cauchy's Mean Value theorem $\frac{\sin \alpha - \sin \beta}{\cos \beta - \cos \alpha} = \cot \theta$, where

$$0 < \alpha < \theta < \beta < \pi/2.$$

7. (a) Prove that a necessary and sufficient condition for the integrability of a bounded function f is that for every $\epsilon > 0$ there corresponds $\delta > 0$ such that for every partition P of $[a, b]$ with norm $P < \delta$ is $U(P, f) - L(P, f) < \epsilon$.

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(b) Show that a constant function is integrable and $\int_a^b k dx = k(b - a)$.

OR

8. (a) State and prove the Fundamental Theorem of Calculus.

(b) Show that $\int_1^2 (3x + 1) dx = \frac{11}{2}$.

SECTION –B (Short Essay Type)

II. Answer any FOUR of the following questions:

Marks: 4 x 5=20M

9. Show that the sequence $S_n = \frac{1}{n+1} + \frac{1}{n+2} + \frac{1}{n+3} + \dots + \frac{1}{n+n}$ is convergent.

10. Show that the series $1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \dots$ is convergent.

11. Discuss the kind of discontinuity for the function f defined as

$$f(x) = \begin{cases} \frac{x-|x|}{x} & \text{when } x \neq 0 \\ 2 & \text{when } x = 0 \end{cases}$$

12. Determine whether the function f defined on \mathbb{R} by $f(x) = \begin{cases} x & \text{if } 0 \leq x \leq 1 \\ 1 & \text{if } x \geq 1 \end{cases}$

is differentiable.

13. Examine the validity of the hypothesis and conclusion of Lagrange's Mean Value Theorem for $f(x) = |x|$ on $[-1, 1]$.

14. Prove that every continuous function is integrable.

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Question Paper format – Bloom's Taxonomy Level

SECTION A - INTERNAL CHOICE				4Q X 10 M = 40 M
Question Number	Module Covered	Question	CO	BTL (Bloom's Taxonomy Level)
1	Module I	(a) Prove that every bounded sequence with a unique limit point is convergent (b) Show that $\lim_{n \rightarrow \infty} \frac{3 + 2\sqrt{n}}{\sqrt{n}} = 2$	CO 1	Level I
2	Module I	State and Prove Cauchy's General Principle of Convergence.	CO 1	Level I
3	Module II	(a) State and prove D'Alembert's Ratio Test. (b) Test for the convergence of the series (a) $\sum_{n=0}^{\infty} \frac{1}{2n^2 + 1}$	CO 2	Level II
4	Module II	(a) State and prove Cauchy's Root Test. (b) If a function f is continuous on a closed interval [a, b], then f attains its bounds at least once in [a, b].	CO 2	Level II
5	Module III	(a) State and prove Rolle's Theorem. (b) Expand $f(x) = e^x$ using Maclaurin's theorem	CO 3	Level IV
6	Module III	(a) Prove Taylor's Theorem with Lagrange's form of remainder. (b) Show that using Cauchy's Mean Value theorem $\frac{\sin \alpha - \sin \beta}{\cos \beta - \cos \alpha} = \cot \theta$, where $0 < \alpha < \theta < \beta < \pi/2$.	CO 3	Level IV
7	Module IV	(a) Prove that a necessary and sufficient condition for the integrability of a bounded function f is that for every $\epsilon > 0$ there corresponds $\delta > 0$ such that for very partition P of [a, b] with norm P $< \delta$ is $U(P, f) - L(P, f) < \epsilon$. (b) Show that a constant function is integrable and $\int_a^b k dx = k(b - a)$.	CO 4	Level II
8	Module IV	(a) State and prove Fundamental theorem of Calculus. (b) Show that $\int_1^2 (3x + 1) dx = \frac{11}{2}$.	CO 4	Level II

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SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have ONE question from each module)				4Q X 5 M = 20 M	
9	Module I	Show that the sequence $S_n = \frac{1}{n+1} + \frac{1}{n+2} + \frac{1}{n+3} + \dots + \frac{1}{n+n}$ is convergent	CO 1	Level I	
10	Module I	Show that the series $1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \dots$ is convergent.	CO 1	Level I	
11	Module II	Discuss the kind of discontinuity for the function f defined as $f(x) = \begin{cases} x - x & \text{when } x \neq 0 \\ \frac{x}{2} & \text{when } x = 0 \end{cases}$	CO 2	Level II	
12	Module II	Determine whether the function f defined on \mathbb{R} by $f(x) = \begin{cases} x & \text{if } 0 \leq x \leq 1 \\ 1 & \text{if } x \geq 1 \end{cases}$ is differentiable	CO 2	Level II	
13	Module III	Examine the validity of the hypothesis and conclusion of Lagrange's Mean value theorem for $f(x) = x $ on $[-1, 1]$	CO 3	Level IV	
14	Module IV	Prove that every continuous function is integrable.	CO 4	Level II	

c. Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	CO Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	4x10=40	6 (By taking at least one question from each Module)	4x5=20
2	15	CO-2	2			
3	15	CO-3	2			
4	15	CO-4	2			

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9. CO-PO Mapping

CO	PO	Cognitive Level	Classroom sessions (hrs.)
1	1, 2	Remember	15
2	2, 7	Understand	15
3	1, 2	Analyze	15
4	1, 2	Discuss	15

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REAL ANALYSIS Practical Syllabus

1. Course Description

Programme: B.SC.

Course Code: U26/MAT/DSC/201/P

Course Type: DSC 2

No. of credits: 1

Max. Hours: 30

Hours per week: 02

Max. Marks : 50

2. Course Objectives:

1. Test the convergence or divergence of a given sequence/series.
2. Analyze the behaviour of functions with regard to continuity, differentiability and integrability.

3. Course Outcomes

After the successful completion of the course, the student will be able to:

CO1: Test the convergence or divergence of a given sequence.

CO2: Understand the convergence or divergence of a given series.

CO3: Analyze the behaviour of functions with regard to derivability.

CO4: Discuss the Riemann integrability of real functions.

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PRACTICAL SESSIONS

1. Limit of Sequences
2. Cauchy Sequences and Monotone Sequences
3. Infinite Series
4. Integral Tests and Alternating Series
5. Continuous functions
6. Derivatives
7. The Mean Value Theorems
8. Higher Order Derivatives.
9. Riemann Integrals-I
10. Riemann Integrals-II

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6. Model Question Paper – End Semester Exam Practical

REAL ANALYSIS

Programme : B.Sc.

Course Code : U26/MAT/DSC/201/P

Type of Course: DSC-II

Max. Marks: 50

No. of credits : 1

I. Answer any SIX of the Following

6x5=30M

1. Using the definition of limit show that $\lim_{n \rightarrow \infty} \frac{2n-3}{n+1} = 2$.

OR

2. Show that the sequence $\{S_n\}$, where $S_n = 1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n}$ cannot converge.
 3. Test for convergence of the series $\frac{1.2}{3^2.4^2} + \frac{3.4}{5^2.6^2} + \frac{5.6}{7^2.8^2} + \dots$.

OR

4. Show that the following series is convergent:

$$1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \dots$$

5. Investigate the continuity at the indicated point

$$f(x) = \begin{cases} \frac{x^3-8}{x^2-4} & \text{when } x \neq 2 \\ 3 & \text{when } x = 2 \end{cases} \text{ at } x=2.$$

OR

6. Discuss the derivability of the function $f(x) = \begin{cases} 1 & \text{when } 0 \leq x \leq 1 \\ x & \text{when } x > 1 \end{cases}$ at $x=1$.
 7. Examine the validity of the hypothesis and the conclusion of Rolle's theorem for $f(x) = (x-a)^m(x-b)^n$ where m and n are positive integers on $[a, b]$.

OR

8. Use Taylor's theorem to show that $\cos x \geq 1 - \frac{x^2}{2}$, for all real x .
 9. Show that a constant function k is integrable and $\int_a^b k dx = k(b-a)$.

OR

10. Compute $\int_{-1}^1 |x| dx$.

Prepared by	Checked & verified by	Approved by
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SEMESTER – II
DATA STRUCTURES

1. Course Description

Programme: B.Sc.
Course Code: U26/CSC/DSC/201
Course Type: DSC
No. of credits: 4

Max. Hours:60
Hours per week:4
Max. Marks: 100

2. Course Objectives

1. To provide the knowledge of basic data structures and their implementations.
2. To develop skills to apply appropriate data structures in problem solving.

3. Course Outcomes:

After the successful completion of the course, the student will be able to:

CO1: To *demonstrate* an *understanding* of basic data structures and solve problems of Sorting, searching. (LII & L III)

CO2: *Illustrate* linear data structure such as stacks, queues and their applications. (L III)

CO3: *Analyze* operations on linked lists and compare different linked list types(L IV)

CO4: To *describe* basic operations on trees and graphs and various graph traversal techniques. (L II)

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4. Course Content

MODULE I:

15 Hours

INTRODUCTION TO DATA STRUCTURES

Introduction to data structures, Types of data structures, Data structure Operations. Array: Array Traversal, Linear Search, Binary Search; Sorting using Non-Recursive Methods-Bubble Sort, Selection Sort and Insertion Sort; Sorting using Recursive methods- Merge Sort and Quick Sort.

MODULE II:

15 Hours

STACKS AND QUEUES

Stacks-Introduction, Stacks, stack operations, applications of stack,stack Implementation. Queues- Introduction, Queues-Basic Concept, Queue Operations,applications of Queue, Queue Implementation. Circular Queues.

MODULE III:

15 Hours

LINKED LIST

Introduction to Linked Lists- Basic Concept,Types of Linked Lists,Single Linked List Implementation, Linked List implementation of Stack, Linked List implementation of Queue, Doubly Linked List.

MODULE IV:

15 Hours

TREES AND GRAPHS

Trees- Introduction, Binary Tree, Binary Tree Representation, Binary Tree, Traversal, Binary Search Tree, Applications of Trees- Heap Sort. Introduction to Graphs- Types of Graphs,Graph Implementation- ArrayGraph Traversal-Depth First Search, Breadth First Search. Spanning Tree, Prim's Algorithm, Kruskal's Algorithm.

5. References:

1. Data Structures Using C ,byE.Bala Guruswamy, McGraw Hill Education,FirstEdition,2017
2. Data Structures, by G.S.Baluja, Dhanpat Rai & Co. (P) Limited, First Edition
3. The Ultimate C with Data Structures,Wiley India, by R. NAGESWARA RAO
4. Data Structures With C By Seymour Lipschutz ,Schaum's outline series.



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6.Syllabus Focus**a) Relevance to Local, Regional, National and Global Development Needs**

Local /Regional/National /Global Development Needs	Relevance
Global	This course helps students learn different Algorithms in data Structures


b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
SD	Module I, II	Understanding and applying various searching, sorting techniques. Implementing stacks and queues.
SD	Module III, IV	Practical implementation of linked lists, trees and graphs.

7.Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Group Discussion	Participative Learning Group Discussion
2.	Interactive Classroom games	Experiential Learning
3.	Problem solving	Case studies


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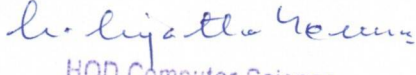
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8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination- 60%
CO1	CIA-1 Quiz test or subjective	Written Exam
CO2	CIA-1 Written exam	
CO3	CIA-2 Written Assignment	
CO4	CIA-2 Presentation	


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b) Model Question Paper- End Semester Exam

DATA STRUCTURES

Course Code: U26/CSC/DSC/201

Max.Marks:60

Credits:4

Time: 2 hrs

SECTION - A (Long Essay Type)

I. Answer ALL questions

Marks: 4 x 10 =40

1. a) Write a program to implement selection sort.
b) Trace the following list using selection sort 23 12 35 19 41 38
OR
2. Write a program to implement merge sort.
3. Explain applications of stacks.
OR
4. Explain the concept of Stack. Write a program to implement a stack using arrays.
5. Explain single linked lists. Write a program to insert at the beginning and end and display the elements of a single linked list
OR
6. Write a program to perform the linked queue operations.
7. Explain binary trees. List and explain the various tree traversals with an example.
OR
8. Explain Spanning Tree. Explain with example any one minimum Spanning Tree Algorithm.

SECTION - B (Short Essay Type)

II. Answer any Four

4x 5=20 M

9. Write a program to sort the elements using bubble sort.
10. Explain doubly linked list.
11. Explain Binary Search with example.
12. Write the node structure for a single linked list.
13. Explain Circular Queue.
14. Explain Breadth First Search with examples.

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Question Paper format – Blooms Taxonomy Level

SECTION A - INTERNAL CHOICE			4Q X 10 M = 40 M	
Question No	Module Covered	Question	CO	BTL (Blooms Taxonomy Level)
1	Module 1	a) Write a program to implement selection sort. b) Trace the following list using selection sort 23 12 35 19 41 38	CO 1	Level II & III
2	Module 1	Write a program to implement merge sort.	CO 1	Level II & III
3	Module 2	Explain applications of stacks.	CO 2	Level III
4	Module 2	Explain the concept of Stack. Write a program to implement a stack using arrays.	CO 2	Level III
5	Module 3	Explain single linked lists. Write a program to insert at the beginning and end and display the elements of a single linked list	CO 3	Level IV
6	Module 3	Explain Queue. Write a program to perform the linked queue operations.	CO 3	Level IV
7	Module 4	Explain binary trees. List and explain the various tree traversals with an example.	CO 4	Level II
8	Module 4	Explain Spanning Tree. Explain with example any one minimum Spanning Tree Algorithm.	CO 4	Level II
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have ONE question from each module)			4Q X 5 M = 20 M	
9	Module 1	Write a program to sort the elements using bubble sort.	CO 1	Level II & III
10	Module 3	Explain doubly linked list.	CO 3	Level IV
11	Module 1	Explain Binary Search with example.	CO 1	Level II & III
12	Module 3	Write the node structure for a single linked list.	CO 3	Level IV
13	Module 2	Explain Circular Queue	CO 2	Level III
14	Module 4	Explain Breadth First Search with examples.	CO 4	Level II

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c) Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15 hrs	CO-1	2	4x10=40	6 (By taking at least one question from each Module)	4x5=20
2	15 hrs	CO-2	2			
3	15 hrs	CO-3	2			
4	15 hrs	CO-4	2			

9. CO-PO Mapping

CO	PO	Cognitive Level	Class room sessions(hrs.)
1	1	Analyze	15
2	2	Understand	15
3	1	Remember	15
4	2	Understand	15


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DATA STRUCTURES
Practical Syllabus

1. Course Description

Programme: B.Sc.
Course Code: U26/CSC/DSC/201/P
Course Type: DSC
No. of credits: 1

Max. Hours: 30
Hours per week: 2
Max. Marks: 50

2. Course Objective:

To introduce the fundamental concepts of data structures through C language

3. Course Outcomes:

CO1: To understand searching and sorting techniques using coding exercise
CO2: Apply the principles of stacks, queues and linked lists

4. Course Content:

1. Program to implement linear search.
2. Program to implement Binary search.
3. Program to implement Bubble sort.
4. Program to implement Selection sort.
5. Program to implement Insertion sort.
6. Program to implement Merge sort.
7. Program to implement Quick sort.
8. Program to implement Stack using arrays.
9. Program to implement Queue using arrays.
10. Program to implement Single Linked List.
11. Program to implement Stack using Linked List.
12. Program to implement Queue using Linked List.
13. Program to implement Double Linked List.
14. Program to implement Recursive Binary tree traversals

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CBCS 2026

PRACTICAL MODEL PAPER

Programme: B.Sc.
Course Code: U26/CSC/DSC/201/P
Type of Course: DSC
No. of credits: 1




Max. Marks: 50
Time :2 hours


I. Answer the following questions


1. Write a C Program to implement Selection Sort.
2. Write a program to implement operation of Queue
3. Write a C Program to implement Stack using linked lists.

OR

4. Write a C Program to implement Binary tree traversals.

Prepared by	Checked &verified by	Approved by
 Ms. Jenifer Teaching faculty	 Dr. Sr. Sujatha Yeruva HoD	 Prof. Uma Joseph Principal


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Panel of Examiners

S.No.	B.Sc- Course Title	Examiner	Designation Place of Work	Contact No.
1.	Semester I	Dr. Teresa	Loyola Academy Secunderabad	9949099350
		Dr. Sunitha	Kasturba Gandhi Degree and PG College for Women	9676056078
		Ms T. Vamshi Mohana	RBVRR College, Narayanguda, Hyderabad	9849338286
		Mr. Subash Chander	Nizams College, Hyderabad	9505656130
2.	Semester II	Mr Mahesh	Jagruti College	8008677784
		Mr. Ramana	Bhavan's College, Sainikpuri	9949693094
		Ms. Jacintha	Loyola Academy	9908082486
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SEMESTER – II
THERMAL PHYSICS

1. Course Description

Programme: B. Sc

Course Code: U26/ PHY/ DSC/201

Type of Course: DSC-2

No. of Credits: 4

Max. Hours: 60

Hours per week: 4

Max. Marks: 100

2. Course Objectives

1. To study fundamentals of thermodynamics.
2. To study statistical behaviour of many particle systems.

3. Course Outcomes

After the successful completion of the course, the student will be able to:

- CO1: Understand molecular speed distributions, transport phenomena, and the role of entropy in physical processes and energy transfer. (L II)
- CO2: Examine the interrelationship between thermodynamic functions and ability to use such relationship to solve practical problems. (L IV)
- CO3: Understand the different laws of thermal radiation and their significance in describing energy distribution in the spectrum. (L II)
- CO4: Apply statistical distribution laws to describe the behaviour of particles in classical and quantum systems. (L III)

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4. Course content**MODULE-I****15 Hours****Kinetic theory of gases:**

Introduction – Deduction of Maxwell's law of distribution of molecular speeds, Transport Phenomena – Viscosity of gases – thermal conductivity – diffusion of gases.

Thermodynamics:

Basics of thermodynamics-Kelvin's and Clausius statements – Thermodynamic scale of temperature – Entropy, physical significance – Change in entropy in reversible and irreversible processes – Entropy and disorder – Entropy of universe – Temperature-Entropy (T-S) diagram – Change of entropy of a perfect gas-change of entropy when ice changes into steam. Application of Entropy in waste management.

MODULE-II**15 Hours****Thermodynamic potential and Maxwell's equations**


Thermodynamic potentials – Derivation of Maxwell's thermodynamic relations – Clausius-Clayperon's equation – Derivation for ratio of specific heats – Derivation for difference of two specific heats for perfect gas.


Low temperature Physics:

Joule Kelvin effect – liquefaction of gas using porous plug experiment. Joule expansion– Distinction between adiabatic and Joule Thomson expansion – Expression for Joule Thomson cooling– Adiabatic demagnetization – Production of low temperatures – Principle of refrigeration, vapour compression type.

MODULE-III**15 Hours****Quantum Theory of Radiation:**

Black body-Ferry's black body – distribution of energy in the spectrum of Black body – Wein's displacement law, Wein's law, Rayleigh-Jean's law – Quantum theory of radiation - Planck's law – deduction of Wein's distribution law, Rayleigh-Jeans law, Stefan's law from Planck's law. Measurement of radiation using pyrometers – Disappearing filament optical pyrometer – experimental determination – Angstrom pyroheliometer - determination of solar constant, effective temperature of sun.


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MODULE-IV**15 Hours****Statistical Mechanics:**

Introduction, concept of probability, postulates of statistical mechanics. Phase space, classical and quantum statistics and their differences, Maxwell- Boltzmann's distribution law -Molecular energies in an ideal gas. Bose-Einstein Distribution law- application to Photon energy, Fermi-Dirac Distribution law- free electron gas, comparison of three distribution laws.

5. Reference Books

1. **Fundamentals of Physics.** Halliday/Resnick/Walker.C. *Wiley India Edition 2007.*
2. **University Physics** – Sears & Zemansky, Pearson, 2019
3. **Heat Thermodynamics and Statistical Physics**-Brijlal, N.subrahmanyam, P.S.Hemne
4. **Second Year Physics** –*Telugu Academy.*
5. **Modern Physics** by R. Murugesan and Kiruthiga Siva Prasath (for statistical Mechanics)
S.Chand & Co
6. **Heat and Thermodynamics** by Mark W.Zemansky 5th edition McGraw – Hill
7. Berkeley Physics Course. Volume-5. **Statistical Physics** by F. Reif. The McGraw-Hill companies.
8. **An Introduction to Thermal Physics** by Daniel V. Schroeder. Pearson Education Low Price Edition.
9. **Thermodynamics** by R. C. Srivastava, Subit K. Saha & Abhay K. Jain Eastern Economy Edition.
10. **Modern Engineering Physics** by A.S. Vasudeva. S. Chand & Co. Publications.
11. B.B. Laud “**Introduction to statistical Mechanics**” (Macmillan 1981).

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6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local/Regional/National/Global Development Needs	Relevance
National	Thermal physics is foundational to address a wide range of national development needs, including energy sustainability and environmental protection.
Global	Applications span multiple sectors and are instrumental in driving innovation.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Skill Development	Module II & III	Hands - on Practicals
Employability	Module IV	Understanding probability distributions helps in modelling real world data.

7. Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Participative Learning	<ul style="list-style-type: none"> • Presentations and Group discussions • Reading and gathering information from library
2.	Experiential Learning	<ul style="list-style-type: none"> • Preparing models
3.	Problem solving	<ul style="list-style-type: none"> • Research Projects • Reviewing research articles

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8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA -40%	End Semester Examination-60%
CO1	CIA 2 – Test 1: MCQ's, Quiz test or subjective	Written Exam
CO2	CIA 1 - Subjective	
CO3		
CO4	CIA 2 – Test 2: MCQ's / Presentation / Seminar topics	

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b) Model Question Paper – End Semester Exam Theory

THERMAL PHYSICS

Course Code: U26/ PHY/ DSC/201

MAX MARKS: 60

Credits: 4

TIME: 2 hours

Note: This question paper consists of Section A and B. The answer to Section A & B must be written in the answer book given.

Section A (Long Essay Type)

I. Answer all Questions

Marks: 4 x 10 = 40

1. Discuss transport phenomena in gases? Derive an expression for the coefficient of viscosity of a gas on the basis of kinetic theory of gases.

OR

2. Describe temperature–entropy diagram? What are its uses? Derive an equation for change in entropy in case of perfect gas.

3. Define four thermodynamic potentials. Obtain Maxwell's thermodynamic equations using these potentials.

OR

4. Describe Joule-Thomson effect? Derive an expression for Joule-Thomson cooling.

5. Explain the principle of pyrometer? Describe the construction and working of an optical pyrometer.

OR

6. Derive Planck's formula for the distribution of energy in a black body radiation.

7. Derive Bose Einstein distribution law and apply it to a photon gas to obtain the energy distribution.

OR

8. Derive Maxwell's distribution law for molecules of an ideal gas.

Section B (Short Essay Type)II. Write short notes on any **FOUR** of the following:

Marks: 4 x 5 = 20

9. Define entropy? Show that entropy increases in an irreversible cycle.

10. Explain Kelvin scale of temperature.

11. Derive Clausius-Clapeyron's equation from Maxwell's equation.

12. Explain the principle of refrigeration.

13. Compute the temperature of the sun if a body at 1000 K emits maximum energy at a wavelength of $20,000 \text{ \AA}$ and if the sun emits maximum energy at a wavelength 5500 \AA .

14. What do you mean by statistical equilibrium?

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Question Paper format – Blooms Taxonomy Level

SECTION A - INTERNAL CHOICE				4Q X 10 M = 40 M
Question Number	Module Covered	Question	CO	BTL (Blooms Taxonomy Level)
1	Module 1	Discuss transport phenomena in gases? Derive an expression for the coefficient of viscosity of a gas on the basis of kinetic theory of gases.	CO 1	Level II & IV
2	Module 1	Describe temperature–entropy diagram? What are its uses? Derive an equation for change in entropy in case of perfect gas.	CO 1	Level I & II
3	Module 2	Define four thermodynamic potentials. Obtain Maxwell's thermodynamic equations using these potentials.	CO 2	Level I & II
4	Module 2	Describe Joule-Thomson effect? Derive an expression for Joule-Thomson cooling.	CO 2	Level II
5	Module 3	Explain the principle of pyrometer? Describe the construction and working of an optical pyrometer.	CO 3	Level I & II
6	Module 3	Derive Planck's formula for the distribution of energy in a black body radiation.	CO 3	Level IV
7	Module 4	Derive Bose Einstein distribution law and apply it to a photon gas to obtain the energy distribution.	CO 4	Level II
8	Module 4	Derive Maxwell's distribution law for molecules of an ideal gas.	CO 4	Level IV
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have ONE question from each module)				4Q X 5 M = 20 M
9	Module 1	Define entropy? Show that entropy increases in an irreversible cycle.	CO 1	Level I
10	Module 2	Explain Kelvin scale of temperature.	CO 1	Level I
11	Module 2	Derive Clausius-Clapeyron's equation from Maxwell's equation.	CO 2	Level IV
12	Module 3	Explain the principle of refrigeration.	CO 3	Level II

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13	Module 4	What will be the temperature of the sun if a body at 1000 k emits maximum energy at a wavelength of $20,000\text{\AA}$ and if the sun emits maximum energy at a wavelength 5500\AA .	CO 4	Level I
14	Module 4	What do you mean by statistical equilibrium?	CO 4	Level II

c) Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	CO Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	4x10=40	6 (By taking at least one question from each Module)	4x5= 20
2	15	CO-2	2			
3	15	CO-3	2			
4	15	CO-4	2			

9. CO-PO Mapping

CO	PO	Cognitive Level	Classroom sessions (hrs)
1	1, 2	Evaluate	15
2	1, 2	Understand	15
3	1, 7	Remember	15
4	1, 2	Analyze	15

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THERMAL PHYSICS

Practical Syllabus

1. Course Description

Programme: B. Sc
Course Code: U26/ PHY/ DSC/201/P
Type of Course: DSC-2
No. of Credits: 1

Max. Hours: 30
Hours per week: 2
Max. Marks: 50

2. Course Objectives

1. To impart knowledge of thermodynamics to suggest solutions for thermodynamic problems.
2. To apply the Laws of thermodynamics to analyse thermodynamic processes/cycles

3. Course Outcomes

After the successful completion of the course, the student will be able to:

CO1: Apply thermodynamic laws to steam processes.

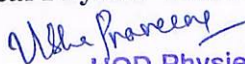
CO2: Prepare the technical report on the experiments carried.


4. Course Content

1. Co-efficient of thermal conductivity of a bad conductor by Lee's method.
2. Measurement of Stefan's constant.
3. Specific heat of a liquid using Joule's calorimeter.
4. Heating efficiency of electrical kettle with varying voltages.
5. Cooling Curve of a metallic body.
6. Resistance thermometer- To Determine temperature coefficient of resistance
7. Thermal expansion of solids.
8. Study of conversion of mechanical energy to heat.
9. Determine the Specific heat of a solid (graphite rod)
10. Simulations for T-S diagram

5. Reference Books

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (Vani Publishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. "Practical Physics" R.K Shukla, Anchal Srivastava


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5. Model Question Paper – End Semester Exam Practical




THERMAL PHYSICS


Programme : B.Sc.
 Course Code : U26/PHY/DSC/201/P
 Type of Course: DSC-2
 No. of credits : 1


Time: 2 hrs
 Max. Marks: 50

Answer any ONE of the Following

1. Determine Co-efficient of thermal conductivity of a bad conductor by Lee's method.
2. Determine Stefan's constant.
3. Determine specific heat of a liquid by using Joule's calorimeter.
4. Calculate the heating efficiency of an electric kettle with varying voltages.
5. Determine the temperature coefficient of resistance by using resistance Thermometer.
6. Determine the coefficient of linear expansion of the given solids.
7. Determine the Specific heat of a solid (graphite rod).
8. Simulate a T-S diagram taking any two temperatures in to consideration.

Prepared by	Checked & verified by	Approved by
 Dr. K. Devy Teaching Faculty	 Dr. Usha Praveena HoD	 Prof. Uma Joseph Principal


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Panel of Examiners

Semester/ Course Title	Examiner	Designation Place of Work	Years of Experience	Contact No.	Email Id.
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	A.Rajani Malathi Asst. Prof.	Telangana Mahila Viswavidyalayam	07	7416281854	rajanimalathi27@gmail.com
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	Dr. K Madhavi Asst. Prof.	Telangana Mahila Viswavidyalayam	21	9989335466	manthenamadhavi.k@gmail.com
	K. Annapuna HOD	Sri Sai Degree & PG College, DSNR	18	9866517564	n_annapurna@yahoo.com
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	Dr.Vamsi Priya Asst. Prof.	Telangana Mahila Viswavidyalayam	12	7981368819	Vamsipriyav.priya@gmail.com
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