

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF COMPUTER SCIENCE**  
**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
Program: Bachelor in Science (CS) <i>(Certificate / Diploma / Degree/Honors)</i>		Semester - VII	Session: 2024-2025
1	Course Code	CSSC-07T	
2	Course Title	Programming in Python	
3	Course Type	DSC (Discipline Specific Course)	
4	Prerequisite	<i>As per Program</i>	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: <ul style="list-style-type: none"> <li>• Define the structure and components of a Python program.</li> <li>• Demonstrate proficiency in handling of loops and creation of functions. Identify the methods to create and manipulate lists, tuples and dictionaries.</li> <li>• Discover the commonly used operations involving regular expressions and file system.</li> <li>• Use libraries to write python program.</li> <li>• Use various data structure of python.</li> <li>• Interpret the concepts of Object-Oriented Programming as used in Python.</li> </ul>	
6	Credit Value	3 Credits	<i>Credit = 15 Hours - Learning &amp; Observation</i>
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching–Learning Periods (01 Hr. per period) - 45 Periods (45 Hours)			
Unit	Topics (Course contents)		No. of Period
I	<b>Introduction to Python Programming:</b> What is a Program, Formal and Natural Languages, Why use Python, Uses of python, Strengths & Drawbacks, The Python Interpreter, Running Python, The IDLE User Interface, The Interactive Prompt, Script Mode, Dynamic Typing , Debugging. <b>Types, Operators, Expressions &amp; Statements:</b> Values and Types, Assignment Statement, Variable Names, Expressions & Statements, Order of Operations, String Operations, Comments.		10
II	<b>Conditionals:</b> Boolean Expressions, Logical operators, Conditional & Alternative Execution, Chained and Nested Conditions. <b>Iterations:</b> Reassignment, Updating Variables, The “for” and “while” statements, break. <b>Strings:</b> String is a sequence, len, Traversal with a for loop, String Slices, Searching, Looping and Counting, String Methods, the “in” operator, String Comparison.		10
III	<b>Lists, Tuples, and Dictionaries;</b> Basic list Operators, replacing, inserting, removing an element, searching and sorting lists, Accessing tuples, Operations, Working, Functions and Methods, dictionary literals, adding and removing keys, accessing and replacing values, Traversing Dictionaries.		10
IV	<b>Function, Files and Graphics:</b> Defining a function, calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables, <b>Files:</b> Files & Persistence, Reading and Writing, Filenames and Paths. <b>Graphics programming:</b> Drawing with turtle graphics, using turtle module, moving the turtle with any direction, moving turtle to any location, the color, bgcolor, circle and speed method of turtle, drawing with colors, drawing basic shapes using iterations. <b>Python Libraries:</b> Exploring python libraries like Panda, Numpy, TensorFlow, Scikit-Learn, Keras, PyTorch, SciPy etc.		15
<b>Keywords</b>	<i>List, Tuple, Dictionary, Panda, Numpy, TensorFlow, Scikit-Learn, Keras, PyTorch, SciPy.</i>		

Name and Signature of Convener & Members of CBoS:

Dr. H.S. Hora  
Chairman  
Sudhakar

Dr. Anurag  
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## PART-C: Learning Resources

Text Books, Reference Books and Others

### Text Books Recommended:

- T. Budd, Exploring Python, TMH, 1st Ed, 2011
- Allen Downey, Jeffrey Elkner, Chris Meyers, How to think like a computer scientist: Learning with Pyth, Freely available online. 2012

### Reference Books Recommended:

- Luca Massaron John Paul Mueller, Python for Data Science For Dummies, Wiley, 2ed, 2019
- Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition by O'Reilly, 2015
- Zed A. Shaw, Learn Python 3 the Hard Way (Addison-Wesley, 2016)

### Online Resources:

- NPTEL URL link for Python Programming:  
[https://www.youtube.com/watch?v=coPsX7MKfc8&list=PLIdgECt554OVFKXRpo\\_kuI0XpUQKk0ycO](https://www.youtube.com/watch?v=coPsX7MKfc8&list=PLIdgECt554OVFKXRpo_kuI0XpUQKk0ycO)
- Complete NPTEL link for Basic Python Programming:  
[https://www.youtube.com/watch?v=Y3Ri2GdYfYg&list=PLqftY2uRk7oXvERQEGATSr-KzAh8WLW\\_D](https://www.youtube.com/watch?v=Y3Ri2GdYfYg&list=PLqftY2uRk7oXvERQEGATSr-KzAh8WLW_D)
- File Handling: [https://www.w3schools.com/python/python\\_file\\_handling.asp](https://www.w3schools.com/python/python_file_handling.asp)
- NumPy: <https://www.w3schools.com/python/numpy/default.asp>
- Pandas: <https://www.w3schools.com/python/pandas/default.asp>
- SciPy: <https://www.w3schools.com/python/scipy/index.php>
- Django: <https://www.w3schools.com/django/index.php>
- Matplotlib: [https://www.w3schools.com/python/matplotlib\\_intro.asp](https://www.w3schools.com/python/matplotlib_intro.asp)
- Machine Learning: [https://www.w3schools.com/python/python\\_ml\\_getting\\_started.asp](https://www.w3schools.com/python/python_ml_getting_started.asp)
- Python MySQL: [https://www.w3schools.com/python/python\\_mysql\\_getstarted.asp](https://www.w3schools.com/python/python_mysql_getstarted.asp)
- Topics related Python from SWAYAM/NPTEL
  - <https://www.youtube.com/channel/UCxulcR5XRauYn37yg-Fh6rA>
  - <https://www.youtube.com/channel/UCJAgwlniUkaShdmA5aAZdQw>
- Topics related Python from Tutorials
  - <https://www.javatpoint.com/python-tutorial>
  - <http://docs.python.org/3/tutorial/index.html>
  - <http://interactivepython.org/courselib/static/pythonds>
  - <http://www.ibiblio.org/g2swap/byteofpython/read/>
- Python for Beginners:
  - [https://www.w3schools.com/python/python\\_intro.asp](https://www.w3schools.com/python/python_intro.asp)
  - <https://www.python.org/about/gettingstarted/>
  - <https://www.javatpoint.com/python-tutorial>
  - <https://www.geeksforgeeks.org/python-programming-language/>

## PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10	
	Total Marks - 30	

End Semester Exam (ESE):	Two section – A & B
	Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks
	Section B: Descriptive answer type qts., 1 out of 2 from each unit-4x10=40 Marks

Name and Signature of Convener & Members of CBoS:

Dr. H.S. Flata  
Chairman

*Kiran*

*Shalini*

*Yash*

*Om*

*Arjun*

*Sunil*

*Dr. Devendra Thakur*

*Shruti*

*Dr. Jyoti*  
*Dr. Anurag*

*Dr. Anurag*  
*Dr. Anurag*

*Anjeeta Kujur*

*Dr. Anurag*

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF COMPUTER SCIENCE**  
**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
<b>Program:</b> Bachelor in Science (CS) <i>Certificate / Diploma / Degree</i>		<b>Semester - VII</b>	<b>Session:</b> 2024-2025
1	<b>Course Code</b>	CSSC-07P	
2	<b>Course Title</b>	Lab 7: Programming in Python	
3	<b>Course Type</b>	DSC	
4	<b>Prerequisite</b>	<i>As per program</i>	
5	<b>Course Learning Outcomes (CLO)</b>	At the end of this course, the students will be able to: <ul style="list-style-type: none"> <li>• Define the structure and components of a Python program.</li> <li>• Demonstrate proficiency in handling of loops and creation of functions. Identify the methods to create and manipulate lists, tuples and dictionaries.</li> <li>• Discover the commonly used operations involving regular expressions and file system.</li> <li>• Determine the need for scraping websites and working with CSV, JSON and other file formats.</li> <li>• Interpret the concepts of Object-Oriented Programming as used in Python.</li> </ul>	
6	<b>Credit Value</b>	<b>1 Credits</b>	<i>Credit =30 Hours Laboratory or Field Learning/Training</i>
7	<b>Total Marks</b>	<b>Max. Marks: 50</b>	<b>Min Passing Marks: 20</b>
<b>PART -B: Content of the Course</b>			
<b>Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)</b>			
<b>Module</b>	<b>Topics (Course contents)</b>		<b>No. of Period</b>
<b>List of Practical Experiments</b>	<p><b>Note:</b> This is tentative list; the teachers concern can add more program as per requirement.</p> <ol style="list-style-type: none"> <li>1. Python program to find the union of two lists.</li> <li>2. Python program to find the intersection of two lists.</li> <li>3. Using for loop, print a table of Celsius/Fahrenheit equivalences. Let c be the Celsius temperatures ranging from 0 to 100, for each value of c, print the corresponding Fahrenheit temperature.</li> <li>4. Using while loop, produce a table of sines, cosines and tangents. Make a variable x in range from 0 to 10 in steps of 0.2. For each value of x, print the value of sin(x), cos(x) and tan(x).</li> <li>5. Write a program that reads an integer value and prints —leap year! or —not a leap year!.</li> <li>6. Write a program that takes a positive integer n and then produces n lines of output shown as follows.                For example, enter a size: 5                *                **                ***                ****                *****</li> <li>7. Write a function that takes an integer <math>n</math> as input and calculates the value of <math>1 + 1/1! + 1/2! + 1/3! + \dots + 1/n</math></li> </ol>		<b>30</b>





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<b>PART- A: Introduction</b>		
Program: Bachelor in Science (CS) (Certificate / Diploma / Degree/Honors)		Semester - VII      Session: 2027-2028
1	Course Code	CSSE-05
2	Course Title	Computer Graphics
3	Course Type	DSE (Discipline Specific Elective)
4	Pre-requisite	As per program
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: <ul style="list-style-type: none"> <li>• Understand the basics of computer graphics, different graphics systems and applications of computer graphics.</li> <li>• Discuss various algorithms for scan conversion and filling of basic objects and their comparative analysis.</li> <li>• Use of geometric transformations on graphics objects and their application in composite form.</li> <li>• Extract scene with different clipping methods and its transformation to graphics display device.</li> <li>• Explore projections and visible surface detection techniques for display of 3D scene on 2D screen.</li> </ul>
6	Credit Value	4 Credits      Credit = 15 Hours - Learning & Observation
7	Total Marks	Max. Marks: 100      Min Passing Marks: 40

**PART -B: Content of the Course**

Total No. of Teaching-learning Periods(01 Hr. per period) – 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Period
I	<b>Basic elements of Computer Graphics:</b> Applications of Computer Graphics, Input Devices: Keyboard, Mouse, Trackball & Space ball, Joystick, Data Glove, Digitizers, Image Scanners, Touch panels, Light Pens systems. Output display devices: Refresh CRT, Raster-Scan display and Random-scan display technique, Color display techniques-Beam penetration method and Shadow-mask method, Direct view storage tubes, Emissive & Non-emissive flat-panel, Displays-Plasma panels, LED and LCD monitor.	15
II	<b>Fundamental Techniques in Graphics:</b> Line-drawing algorithms, DDA algorithm and Bresenham's Line drawing Algorithm, Midpoint Algorithm for Circle and Ellipse Generation, Curve generation. Attributes for output primitives: Area-filling Algorithms - Scan-line Polygon-fill.	15
III	<b>Geometrical Transformation:</b> 2D Transformation (translation, rotation, scaling, reflection and shearing), Homogeneous Coordinates and Matrix Representation of 2D Transformations, Successive and composite 2D Transformations, the Window-to-Viewport Transformations, Introduction to 3D Transformations Matrix.	15
IV	<b>Curves &amp; Surfaces:</b> Polygon Surfaces and polygon meshes, Quadratic and super quadrics surfaces, Spline curve and representation Definition of Bezier curve and its properties, Algorithms for Bezier curves and surfaces, Hermite curve.	15

Keywords: CRT, LED, LCD, DDA, 2D, 3D.

Name and Signature of Convener & Members:

Dr. H.S. Hota  
chairman

*Jindal*

*(Suman Kataria)*

*Shelley...*

*Bhal*

*...*

*ANJETA K...*



**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
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<b>PART- A: Introduction</b>			
Program: Bachelor of Computer Science (Certificate / Diploma / Degree/Honors)		Semester - VII	Session: 2027-2028
1	Course Code	CSSE-06T	
2	Course Title	Machine Learning	
3	Course Type	DSE (Discipline Specific Elective)	
4	Prerequisite	As per program	
5	Course Learning Outcomes (CLO)	<p>At the end of this course, the students will be able to:</p> <ul style="list-style-type: none"> <li>Gain a deep understanding of advanced AI and machine learning principles.</li> <li>Acquire skills for conducting a thorough literature review and formulating research problems.</li> <li>Learn to design and implement advanced AI and machine learning algorithms.</li> <li>Can understand and design generative AI techniques.</li> <li>Can apply AI and machine learning techniques to solve real-world problems.</li> </ul>	
6	Credit Value	3 Credits	Credit = 15 Hours - learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

**PART -B: Content of the Course**

Total No. of Teaching–Learning Periods (01 Hr. per period) - 45 Periods (45 Hours)		
Unit	Topics (Course contents)	No. of Period
I	<b>Introduction:</b> Concept of Machine Learning, Applications of Machine Learning, Key elements of Machine Learning, Supervised vs. Unsupervised Learning, Traditional programming Vs. Machine learning Statistical Learning: Bayesian Method, The Naïve Bayes Classifier.	13
II	<b>Linear Regression:</b> Prediction using Linear Regression, Gradient Descent, Linear Regression with one variable, Linear Regression with multiple variables, Polynomial Regression, Feature Selection and Feature Extraction. <b>Logistic Regression:</b> Classification using Logistic Regression, Logistic Regression vs. Linear Regression, Logistic Regression with one variable and with multiple variables.	11
III	<b>Regularization:</b> Regularization and its utility: The problem of Over fitting, Application of Regularization in Linear and Logistic Regression, Regularization and Bias/Variance. <b>Neural Networks:</b> Introduction, Model Representation, Gradient Descent vs. Perceptron Training, Stochastic Gradient Descent, Multilayer Perceptrons, Multiclass Representation, Back propagation Algorithms.	10
IV	<b>Deep Learning:</b> Introduction basics, various architectures of Deep learning: CNN, LSTM, Generative AI. <b>Machine learning tools:</b> Introduction of MATLAB, WEKA as machine learning tools, Using GUI of MATLAB and WEKA to develop Machine learning based models. Write programs to Implement machine learning models.	11

Keywords: Artificial Intelligence (AI), Linear Regression, Logistic Regression, Artificial Neural Network (ANN).

Name and Signature of Convener & Members:

Dr. H.S. Hota  
 Chairman

*(Signatures of Convener and Members)*

ANJEETA KUMAR

## **PART-C: Learning Resources**

### **Text Books, Reference Books and Others**

#### **Text Books Recommended:**

- Machine learning, Anuradha Srinivasaraghavan, Vincy Joseph, Wiley publication, India , 2019 edition.
- Introduction to Machine Learning with python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly.

#### **Reference Books Recommended:**

- Understanding machine learning: From theory to algorithms, shai shalev-shwartz, shai ben-david, Cambridge University press.
- Machine learning with python, Abhishek Vijayvargia, BPB publication.
- Machine learning using python, U Dinesh Kumar, Manaranjan Pradhan, Wiley publication.
- Deep learning, Ian Goodfellow , Yoshua Bengio, Aoran Courville, Adaptive computation and machine learning series.
- Machine learning, Tom M. Mitchell, McGraw Hill, Indian Edition.

#### **Online Resources:**

- Overview of Machine Learning:  
[https://www.youtube.com/watch?v=whSKA8aO6xQ&list=PLyqSpQzTE6M-SISTunGRBRiZk7opYBf\\_K&index=3](https://www.youtube.com/watch?v=whSKA8aO6xQ&list=PLyqSpQzTE6M-SISTunGRBRiZk7opYBf_K&index=3)
- Introduction to Artificial Intelligence:  
[https://www.youtube.com/watch?v=pKeVMlKfPrc&list=PLwdnzlV3ogoXaceHrrFVZCJkbm\\_laSHcH&index=2](https://www.youtube.com/watch?v=pKeVMlKfPrc&list=PLwdnzlV3ogoXaceHrrFVZCJkbm_laSHcH&index=2)
- Deep Learning specialization:  
<https://www.coursera.org/specializations/deep-learning>
- Learning Material for Deep Learning  
[https://onlinecourses.nptel.ac.in/noc24\\_cs114/preview](https://onlinecourses.nptel.ac.in/noc24_cs114/preview)
- Learning Material for Artificial Intelligence and Machine Learning  
[https://onlinecourses.nptel.ac.in/noc24\\_ce107/preview](https://onlinecourses.nptel.ac.in/noc24_ce107/preview)
- Learning Material for Machine Learning  
[https://onlinecourses.swayam2.ac.in/imb24\\_mg126/preview](https://onlinecourses.swayam2.ac.in/imb24_mg126/preview)
- learning Material for Artificial Intelligence  
[https://swayam-plus.swayam2.ac.in/course\\_detail?course\\_code=P\\_SMARTBRIDGE\\_01](https://swayam-plus.swayam2.ac.in/course_detail?course_code=P_SMARTBRIDGE_01)
- Learning Material for Machine Learning using Python  
<https://www.coursera.org/specializations/machine-learning-introduction>
- Learning Material for Artificial Intelligence  
<https://www.coursera.org/learn/ai-for-everyone>
- Learning Material for Machine Learning  
<https://coursera.org/specializations/machine-learning-introduction>
- Learning Material for deep Learning  
<https://coursera.org/specializations/deep-learning>

## **PART -D: Assessment and Evaluation**

### **Suggested Continuous Evaluation Methods:**

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks



**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF COMPUTER SCIENCE**  
**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
Program: Bachelor in Science (CS) (Certificate / Diploma / Degree)		Semester - VII	Session: 2024-2025
1	Course Code	CSSE-06P	
2	Course Title	Lab 08: Machine Learning	
3	Course Type	DSE (Discipline Specific Elective)	
4	Prerequisite	As per program	
5	Course Learning Outcomes (CLO)	At the end of course, Students will be able to: <ul style="list-style-type: none"> <li>• Understand complexity of Machine Learning algorithms and their limitations;</li> <li>• Applying common Machine Learning algorithms in practice and implementing their own.</li> <li>• Perform experiments in Machine Learning using real-world data.</li> <li>• Design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.</li> <li>• Understand modern notions in data analysis oriented computing.</li> </ul>	
6	Credit Value	1 Credits	Credit =30 Hours Laboratory or Field Learning/Training
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20
<b>PART -B: Content of the Course</b>			
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)			
Module	Topics (Course contents)		No. of Period
List of Practical Experiments	<ol style="list-style-type: none"> <li>1. Use command to compute the size of a matrix, size/length of a particular row/column, load data from a text file, store matrix data to a text file, finding out variables and their features in the current scope.</li> <li>2. Perform basic operations on matrices (like addition, subtraction, multiplication) and</li> <li>3. Display specific rows or columns of the matrix.</li> <li>4. Perform other matrix operations like converting matrix data to absolute values, taking the negative of matrix values, adding/removing rows/columns from a matrix, finding the maximum or minimum values in a matrix or in a row/column, and finding the sum of some/all elements in a matrix.</li> <li>5. Create various type of plots/charts like histograms, plot based on sine/cosine function based on data from a matrix. Further label different axes in a plot and data in a plot.</li> <li>6. Generate different subplots from a given plot and color plot data.</li> <li>7. Use conditional statements and different type of loops based on simple example/s.</li> <li>8. Perform vectorized implementation of simple matrix operation like finding the transpose of a matrix, adding, subtracting or multiplying two matrices.</li> <li>9. Implement Linear Regression problem. For example, based on a dataset comprising of existing set of prices and area/size of the houses, predict the estimated price of a given house.</li> <li>10. Based on multiple features/variables perform Linear Regression. For example, based on a number of additional features like number of bedrooms, servant room,</li> </ol>		30



- o [https://www.youtube.com/watch?v=pKeVMIkFpRe&list=PLwdnzlV3ogoXaceHrrFVZCJkbm\\_laSHcH&index=2](https://www.youtube.com/watch?v=pKeVMIkFpRe&list=PLwdnzlV3ogoXaceHrrFVZCJkbm_laSHcH&index=2)
- o [http://www.hpc.iitkgp.ac.in/pdfs/AI\\_HPC.pdf](http://www.hpc.iitkgp.ac.in/pdfs/AI_HPC.pdf)
- o [https://www.tensorflow.org/resources/learn-ml?gclid=CjwKCAjw\\_ISWBhBkEiwAdqxb9hljIi5hngF0Cq2Fgy\\_JEWiD\\_uZbxtetr\\_BFUF\\_QztAELk8d2q3P\\_BoCodMQAvD\\_BwE](https://www.tensorflow.org/resources/learn-ml?gclid=CjwKCAjw_ISWBhBkEiwAdqxb9hljIi5hngF0Cq2Fgy_JEWiD_uZbxtetr_BFUF_QztAELk8d2q3P_BoCodMQAvD_BwE)
- o <https://www.cdx.org/professional-certificate/deep-learning>

### PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 & 10 Assignment/Seminar +Attendance - 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment A. Performed the Task based on lab. work - 20 Marks B. Spotting based on tools & technology (written) - 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS:

Dr. H.S. Pota  
 Chairman

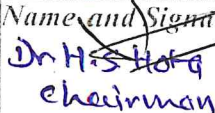

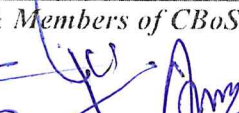
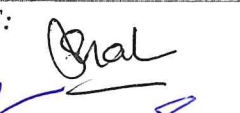


[Signatures of other members]

Anjeeta Kujur





**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF COMPUTER SCIENCE**  
**COURSE CURRICULUM**

<b>PART- A: Introduction</b>			
Program: Bachelor in Science (CS) (Certificate / Diploma / Degree/Honors)		Semester -VII	Session: 2024-2025
1	Course Code	CSSE-08	
2	Course Title	Theory of Computation	
3	Course Type	DSE (Discipline Specific Elective)	
4	Prerequisite	As per program	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: <ul style="list-style-type: none"> <li>• Understanding of the core concepts in automata theory and formal languages.</li> <li>• Understanding and analyzing the fundamentals of compiler designing.</li> <li>• Design grammars and automata (recognizers) for different language classes.</li> <li>• Design the pushdown automata.</li> <li>• Design the Turing machine.</li> </ul>	
6	Credit Value	4 Credits	Credit = 15 Hours - Learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40
<b>PART -B: Content of the Course</b>			
Total No. of Teaching–Learning Periods (01 Hr. per period) – 60 Periods (60 Hours)			
Unit	Topics (Course contents)		No. of Period
I	<b>Introduction to automata:</b> Definition and types of automata; Finite Automata, Pushdown Automata, Turing Machine, introduction to Grammar and languages according to the types of automata. <b>Finite Automata:</b> Introduction to Finite State Automata (FSA): Formal definition, simpler notations (state transition diagram, transition table). Types of FSA: Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Finite Automata with Epsilon Transitions, Elimination of Epsilon transitions, Conversion of NFA to DFA, Equivalence of NFA and DFA. Applications of Finite Automata, Minimization of Deterministic Finite Automata. Mealy machine, Moore machine.		15
II	<b>REGULAR EXPRESSIONS (RE):</b> Introduction to RE, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. <b>REGULAR GRAMMARS:</b> Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.		15
III	<b>CONTEXT FREE GRAMMAR (CFG):</b> Introduction to CFG's, Properties of CFG's, Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG, Minimization of CFG, Chomsky Normal Form (CNF), Greibach Normal Form (GNF), Pumping Lemma for CFLs. <b>PUSHDOWN AUTOMATA:</b> Introduction of PDA and its model, types of PDA, Languages accepted by the PDA, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA.		15
IV	<b>TURING MACHINES (TM):</b> Formal definition and model of Turing Machine, Types of TMs, Languages of a TM, TM as acceptors, Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA).		15
Keywords	Finite Automata, Regular Expression, Regular Grammar, Context Free Grammar, Turing Machine.		
Name and Signature of Convener & Members of CBoS:			
<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <p>Dr. H. S. Hota Chairman</p>  </div> <div style="text-align: center;"> <p>Dr. Anil Kumar</p>  </div> <div style="text-align: center;"> <p>Dr. Anurag</p>  </div> <div style="text-align: center;"> <p>Dr. Anurag</p>  </div> <div style="text-align: center;"> <p>Dr. Anurag</p>  </div> <div style="text-align: center;"> <p>Dr. Anurag</p>  </div> </div>			

ANJETA KUMAR

## PART-C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended:

- John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), Introduction to Automata Theory Languages and Computation, 3rd edition, Pearson Education, India.
- K. L. P Mishra, N. Chandrasekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.

#### Reference Books Recommended:

- A.M. Padma Reddy, Finite Automata and Formal languages, Pearson Education India
- Michael Sipser, Third Edition, Introduction to the Theory of Computation, Cengage Learning.

#### Online Resources:

- NPTEL YouTube Channel: Lectures on Theory of Computation  
<https://youtube.com/playlist?list=PLbMVogVj5nJSd25WnSU144ZyGmsqjuKr3&si=EvuSjnOTT1oTHjn>
- NPTEL YouTube Channel: Lectures on Theory of Automata, Formal Languages and Computation  
<https://youtube.com/playlist?list=PL85CF9F4A047C7BF7&si=SBm-gIkmkjOBDscB>
- NPTEL YouTube Channel: Lectures on Theory of Computation and Automata  
<https://youtube.com/playlist?list=PL3-wYxbt4yCgBHUpwXDTLos3JStccGfax&si=TbYH91hmlOrtUEN>
- SWAYAM YouTube Channel: Introduction to Automata, Languages and Computations  
[https://youtube.com/playlist?list=PLbRMhDVUMngcwWkzVTm\\_kFH6JW4JcTAUM&si=RbTG3WZ0Jf6Zx\\_pu](https://youtube.com/playlist?list=PLbRMhDVUMngcwWkzVTm_kFH6JW4JcTAUM&si=RbTG3WZ0Jf6Zx_pu)

## PART -D: Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - 10 Total Marks - 30	
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1 out of 2 from each unit-4x10=40 Marks	
Name and Signature of Convener & Members of CBoS:		
<p>Dr. H.S. Hota Chairman</p> <p>Smit</p> <p>(Suresh Thakur)</p> <p>Shreerishy Anil</p> <p>Anurag Kumar</p> <p>Prad</p> <p>ANJETA KURUR</p>		

# FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

## DEPARTMENT OF MATHEMATICS

### COURSE CURRICULUM

<b>Part A: Introduction</b>			
	<b>Program: Bachelor in Science ( Honors/Honors with Research)</b>	<b>Semester - VII</b>	<b>Session:2024-2025</b>
1	Course Code	<b>MASC-07</b>	
2	Course Title	Advanced Real Analysis	
3	Course Type	<b>Discipline Specific Course (DSC)</b>	
4	Pre-requisite(if any)	Knowledge of basic real analysis, sequence, series	
5	Course Learning Outcome (CLO)	<p><b>At the end of the course, the students will be able to :</b></p> <ul style="list-style-type: none"> <li>➤ Understand the concept of sequences and series of functions, power series apply the test for their convergence, divergence and apply Abel's and Tauber's theorems.</li> <li>➤ Understand the concept of functions of several variables and properties of sets of vectors in <math>R^n</math>, maxima and minima of real valued functions from <math>R</math> to <math>R</math> and from <math>R^n</math> to <math>R</math>, concept of Integration theory that is closely related to the theory of Euclidean spaces and derivatives of functions of several variables.</li> <li>➤ Understand the concept of Riemann-Stieltjes integral and apply it to evaluate definite integrals arising in different fields of science and engineering.</li> </ul>	
6	Credit Value	<b>4 C</b>	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

### Part B: Content of the Course

**Total no of teaching – learning period =60 Periods (60 Hours)**

UNIT	Topics	No of Periods
I	<p><b>The Riemann –Stieltjes Integral:</b>                      Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, Uniform convergence and Riemann-Stieltjes integration, Rectifiable curves.</p>	15
II	<p><b>Sequence and Series of Functions:</b>                      Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration, Weierstrass approximation theorem.</p>	15
III	<p><b>Functions of Several Variables:</b>                      Linear transformations, Derivatives in an open subset of <math>R^n</math>, Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem.</p>	15

*Dr. S. Dasgupta*  
*(Dr. P. K. Sahu)*

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IV	<b>Jacobians, extremum problems and Power Series:</b> Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals. Uniqueness theorem for power series, Abel's theorem, Taylor's theorem Tauber's theorems	15
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**Part C - Learning Resource**

Text Books, Reference Books, Other Resources

**Text Books Recommended-**

1. Principle of Mathematical Analysis By Walter Rudin(3rd edition) McGrawHill, 1976, International student edition.
2. Real Analysis By H.L.Roydon, Macmillan Pub.Co.Inc.4th Edition, New York .1962.

**References Books Recommended-**

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.
2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York,1975.
3. A.J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co.,Inc.,1968.
4. E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969.
5. I.P. Natanson, Theory of Functions of a Real Variable. Vol. 1, Frederick Ungar Publishing Co., 1961.
- 6.A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., New York, 1970.
7. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.
- 8..Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing Co.Ltd. NewDelhi,1966.

**E-resources:**

- <https://onlinecourses.nptel.ac.in>
- <https://epqp.inflibnet.aci.in>
- <https://swayam.gov.in>
- <https://www.mooc.org>

**Part D: Assessment and Evaluation**

**Suggested Continuous Evaluation Methods:**

<b>Maximum Marks:</b>	<b>100 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>
<b>End Semester Examination (ESE):</b>	<b>70 Marks</b>

<b>Continuous Internal Assessment (CIA)</b> (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
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<b>End Semester Examination (ESE)</b>	<b>Two Section-A&amp;B</b> Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks
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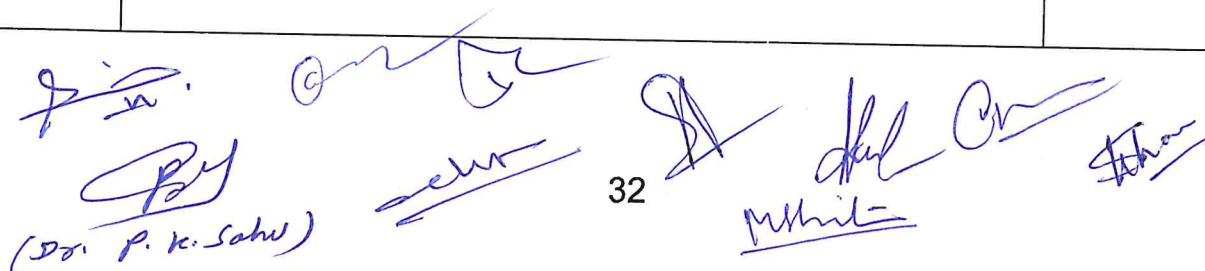
**Name and signature of convener & members of CBOS-**


  
 (Dr. P. K. Sahu)

**FOUR YEAR UNDERGRADUATE PROGRAM(2024-28)**  
**DEPARTMENT OF MATHEMATICS**  
**COURSE CURRICULUM**

<b>Part A: Introduction</b>			
<b>Program: Bachelor in Science (Honors/Honors with Research)</b>		<b>Semester - VII</b>	<b>Session:2024-2025</b>
1	Course Code	<b>MASE-05</b>	
2	Course Title	<b>Integral Transforms</b>	
3	Course Type	<b>Discipline Specific Elective (DSE)</b>	
4	Pre-requisite ( if any)	Basic idea of differentiation and integration	
5	Course Learning Outcome (CLO)	<b>This Course will enable the students to:</b> <ul style="list-style-type: none"> <li>➤ Know about piece wise continuous functions,Dirac delta function,Laplace transforms and its properties.</li> <li>➤ Solve ordinary differential equations using Laplace transforms.</li> <li>➤ Explain Parseval's identity,Plancherel's theorem and applications of Fourier transforms to boundary value problems.</li> </ul>	
6	Credit Value	4C	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks : 40

<b>Part B: Content of the Course</b>		
<b>Total no of teaching – learning period =60 Periods (60 Hours)</b>		
<b>Unit</b>	<b>Topics</b>	<b>No. of Periods</b>
I	<b>LaplaceTransforms:</b> Integral transform, Kernel of an integral transform, Reduction of integral transform intoLaplace transform, Linearity, Existence theorem, Laplace transforms of derivatives andintegrals, Shifting theorems, Change of scale property, Laplace transforms of periodicfunctions,Dirac'sdeltafunction.	15
II	<b>Laplace Transforms (Continued) and Applications:</b> Differentiation and integration of transforms, Convolution theorem, Integral equations, Inverse Laplace transform, Lerch's theorem, Linearity property of inverse Laplace transform, Translations theorems of inverse Laplace transform, Inverse transform of derivatives, Applications of Laplace transform in obtaining solutions of ordinary differential equations and integral equations.	15
III	<b>FourierTransforms:</b> Fourier and inverse Fourier transforms, Fourier sine and cosine transforms, Inverse Fouriersine and cosine transforms, Linearity property, Change of scale property, Shifting property, Modulation theorem, Relation between Fourier and Laplace transforms.	15



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IV	<b>Solution of Equations by Fourier Transforms :</b> Solution of integral equation by Fourier sine and cosine transforms, Convolution theorem for Fourier transform, Parseval's identity for Fourier transform, Plancherel's theorem, Fourier transform of derivatives, Applications of infinite Fourier transforms to boundary value problems, Finite Fourier transform, Inversion formula for finite Fourier transforms.	15
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**Part C - Learning Resource**

**Text Books, Reference Books, Other Resources**

**Text Books Recommended-**

1. James Ward Brown & Ruel V. Churchill. *Fourier Series and Boundary Value Problems*. McGraw-Hill Education. 2011
2. Charles K. Chui. *An Introduction to Wavelets*. Academic Press 1992

**Reference Books Recommended-**

3. Erwin Kreyszig. *Advanced Engineering Mathematics* (10<sup>th</sup> edition). Wiley. 2011
4. Walter Rudin. *Fourier Analysis on Groups*. Dover Publications. 2017
5. A. Zygmund. *Trigonometric Series* (3<sup>rd</sup> edition). Cambridge University Press. 2002

**E-Recourses:**

<https://onlinecourses.nptel.ac.in>  
<https://epqp.inflibnet.aci.in>  
<https://swayam.gov.in>  
<https://www.mooc.org>

**Part D: Assessment and Evaluation**

**Suggested Continuous Evaluation Methods:**

<b>Maximum Marks:</b>	<b>100 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>
<b>End Semester Examination (ESE):</b>	<b>70 Marks</b>

<b>Continuous Internal Assessment (CIA)</b> (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
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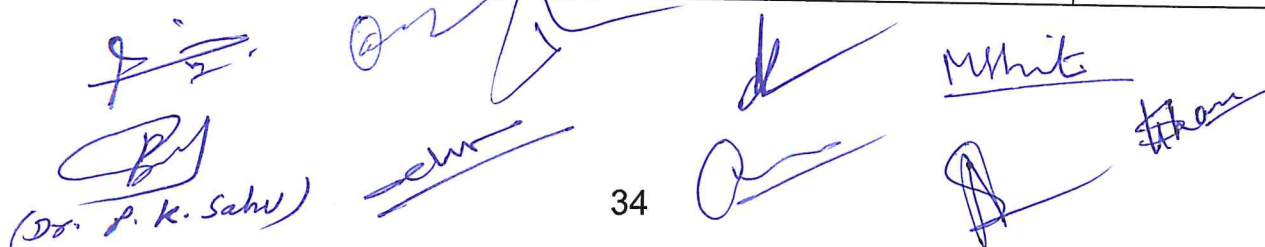
<b>End Semester Examination (ESE)</b>	<b>Two Section-A&amp;B</b> Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks
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**Name and signature of convener & members of CBOS-**

Dr. S. Dashputra  
 Dr. P. K. Sahu  
 Dr. Anjan Kumar Mishra  
 Dr. ...  
 Dr. ...  
 Dr. ...

**FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)**  
**DEPARTMENT OF MATHEMATICS**  
**COURSE CURRICULUM**

<b>Part A: Introduction</b>			
<b>Program: Bachelor in Science ( Honors/Honors with Research)</b>		<b>Semester - VII</b>	<b>Session:2024-2025</b>
1	Course Code	<b>MASE-06</b>	
2	Course Title	<b>Topology</b>	
3	Course Type	<b>Discipline Specific Elective (DSE)</b>	
4	Pre requisite(if any)	Knowledge of basic ideas of set theory and analysis including metric spaces.	
5	Course Learning Outcome (CLO)	<p style="text-align: center;"><b>This Course will enable the students to:</b></p> <ul style="list-style-type: none"> <li>➤ Understand the concept of countable and uncountable sets and its properties. Understand the concept of topological spaces and its examples, bases, sub-bases, subspaces and relative topology.</li> <li>➤ Understand the concept of countable, separable spaces and separation axioms with their characterizations and basic properties.</li> <li>➤ Understand the concept and properties of compactness, continuous functions.</li> <li>➤ Understand the concept and properties of countable compactness in metric spaces.</li> <li>➤ Understand the concept and properties of connectedness, continuous functions.</li> </ul>	
6	Credit Value	<b>4C</b>	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks : 40
<b>Part B: Content of the Course</b>			
<b>Total no of teaching – learning period =60 Periods (60 Hours)</b>			
Unit	Topics		No. of Periods
I	<b>Topological Space :</b> Cardinal numbers and its arithmetic. Definition and examples of topological spaces. Neighbourhood Systems, Limit point. Derived sets and closed sets; Interior, Exterior and Frontier points ,Bases and sub-bases.. Alternate methods of defining a topology in terms of Kuratowski Closure Operator , Subspaces and relative topology.		<b>15</b>
II	<b>Continuous function of Topological space:</b> Continuous functions and homeomorphism. First and Second Countable spaces. Lindelof's theorems. Separable spaces. Second countability and separability.		<b>15</b>
III	<b>Compactness and Connectedness:</b> Compactness. Continuous functions and compact sets. Basic properties of Compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local compactness, Connected spaces, Connectedness on the real line.Components, Locally connected spaces. Totally connected spaces.		<b>15</b>



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IV	<b>Separation axioms:</b> Separation axioms; T <sub>0</sub> , T <sub>1</sub> , T <sub>2</sub> , T <sub>3</sub> , T <sub>4</sub> ; their Characterizations and basic properties. Urysohn's lemma, Tietze extension theorem. T <sub>5</sub> spaces and Tychonoff spaces	15
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**Part C - Learning Resource**

**Text Books, Reference Books, Other Resources**

**Text Books Recommended :**

1. Introduction to General Topology By K.D.Joshi, Wiley Eastern Ltd., 1983.
2. Topology, A First Course By James R. Munkres, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.

**References Books Recommended :**

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
2. George F. Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company
3. J. Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W. Thron, Topologically Structures, Holt, Rinehart and Winston, New York, 1966.
7. N. Bourbaki, General Topology Part I (Transl.), Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.
10. E.H. Spanier, Algebraic Topology, McGraw-Hill, New York, 1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.

**E-Recourses:**

- <https://onlinecourses.nptel.ac.in>
- <https://epqp.inflibnet.aci.in>
- <https://swayam.gov.in>
- <https://www.mooc.org>

**Part D: Assessment and Evaluation**

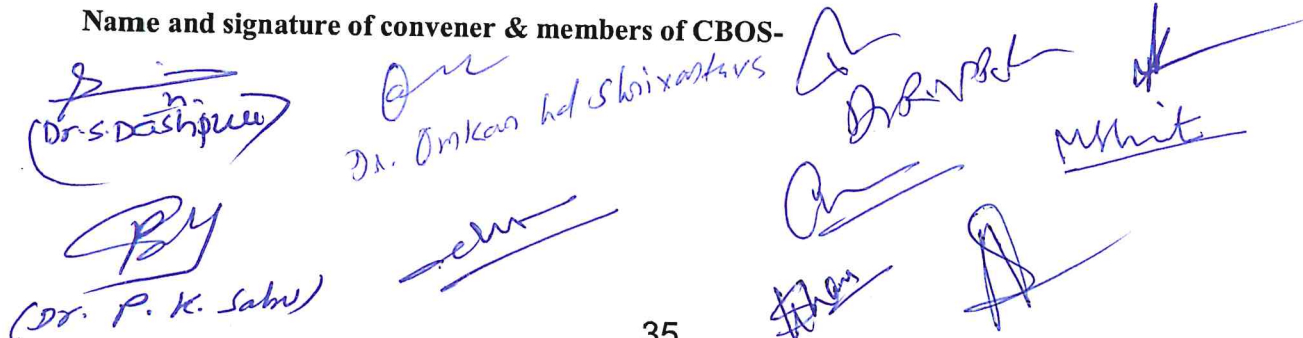
**Suggested Continuous Evaluation Methods:**

<b>Maximum Marks:</b>	<b>100 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>
<b>End Semester Examination (ESE):</b>	<b>70 Marks</b>

<b>Continuous Internal Assessment (CIA)</b> (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
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<b>End Semester Examination (ESE)</b>	<b>Two Section-A&amp;B</b> Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks
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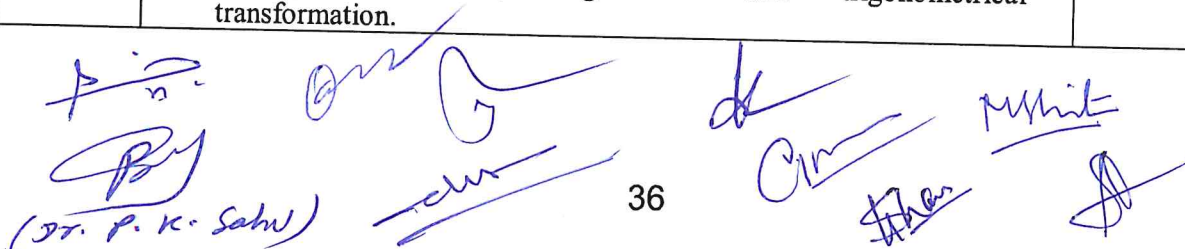
Name and signature of convener & members of CBOS-


  
 (Dr. S. Dashgupta)
   
 Dr. Ankan kumar Shrivastava
   
 (Dr. P. K. Sahu)

**FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)**  
**DEPARTMENT OF MATHEMATICS**  
**COURSE CURRICULUM**

<b>Part A: Introduction</b>			
<b>Program: Bachelor in Science ( Honors/Honors with Research)</b>		<b>Semester - VII</b>	<b>Session:2024-2025</b>
1	Course Code	<b>MASE -07</b>	
2	Course Title	<b>Complex Analysis - I</b>	
3	Course Type	<b>Discipline Specific Elective (DSE)</b>	
4	Pre-requisite(if any)	Basic knowledge of complex analysis and calculus.	
5	Course Learning Outcome (CLO)	<b>This Course will enable the students to:</b> <ul style="list-style-type: none"> <li>➤ Understand Complex number and their properties.</li> <li>➤ Learn about properties of linear transformation and isomorphism theorems.</li> <li>➤ Understand the concept of Limit, Continuity, Differentiability of Complex and Analytic function.</li> <li>➤ Obtain various variants of Mobius transformations.</li> <li>➤ Obtain various Conformal mapping and types of transformations.</li> </ul>	
6	Credit Value	<b>4C</b>	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks :100	Minimum Passing Marks :40

<b>Part B: Content of the Course</b>		
<b>Total no of teaching – learning period =60 Periods (60 Hours)</b>		
<b>Unit</b>	<b>Topics</b>	<b>No. of Periods</b>
I	<b>Complex Numbers and Their Geometrical Representation:</b> Complex numbers as ordered pairs, Geometrical representation of complex numbers, Modulus and argument of complex numbers and its Properties, Equation of straight line and circle, Cauchy's inequality and Lagrange's identity.	15
II	<b>Continuity and Differentiability of Complex and Analytic Functions:</b> Limit, Continuity, Differentiability of functions of a Complex variables, Analytic function, Cauchy – Riemann equations, Conjugate function, Laplace's Differential equations, Harmonic functions, Orthogonal system and Construction of Analytic function.	15
III	<b>Mobius Transformation:</b> Jacobian of Transformation, Linear Transformation, Mobius Transformation, Linear Group, Fixed point of Mobius transformation, Cross ratio, Inverse Point, Properties of Mobius transformation.	15
IV	<b>Conformal Mappings:</b> Conformal mapping, Necessary and sufficient condition for $w = f(z)$ to represent a conformal mapping, Transformation $w = z^a$ , Inverse, exponential, logarithmic and trigonometrical transformation.	15



### Part C - Learning Resource

#### Text Books, Reference Books, Other Resources

**Text Books Recommended :**

1. Complex Analysis By L.V.Ahlfors, McGraw - Hill, 1979.
2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student- Edition, Narosa Publishing House, 1980.
3. H.K. Pathak, Complex Analysis and Applications, ShikshaSahityaPrakashan , 2019

**Reference Books Recommended :**

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Complex Function Theory By D.Sarason
3. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. S. Lang, Complex Analysis, Addison Wesley, 1977.
5. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
6. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.
7. C.Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.
8. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.
9. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

**E-Recourses:**

- <https://onlinecourses.nptel.ac.in>
- <https://epqp.inflibnet.aci.in>
- <https://swayam.gov.in>
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### Part D: Assessment and Evaluation

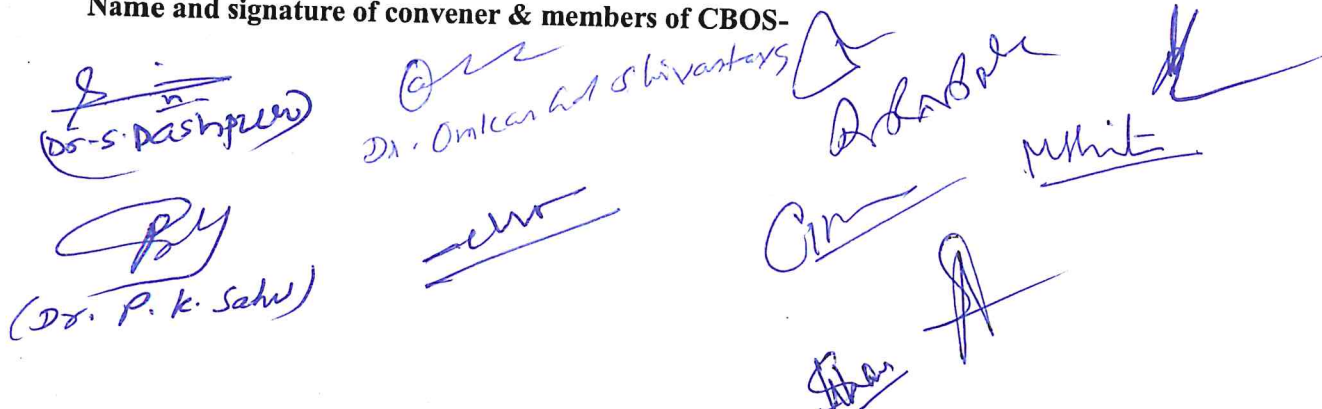
**Suggested Continuous Evaluation Methods:**

<b>Maximum Marks:</b>	<b>100 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>
<b>End Semester Examination (ESE):</b>	<b>70 Marks</b>

<b>Continuous Internal Assessment (CIA)</b> (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
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<b>End Semester Examination (ESE)</b>	<b>Two Section-A&amp;B</b> Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks
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**Name and signature of convener & members of CBOS-**

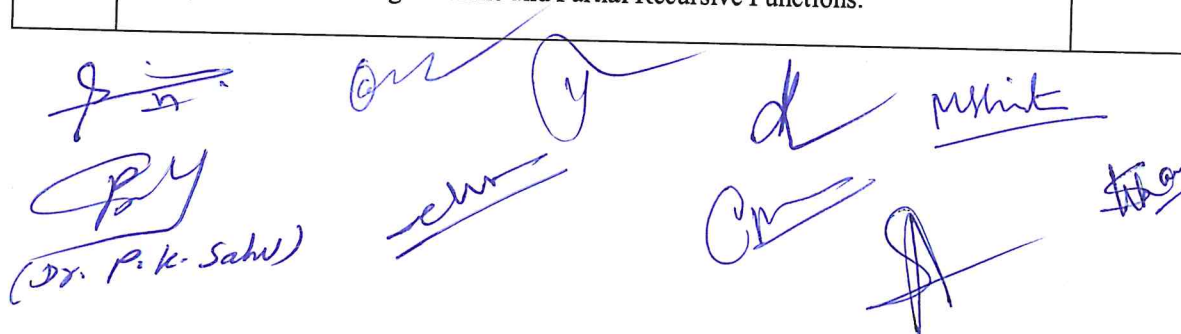

  
 (Dr. S. Dashpreet)      Dr. Omkar Ashishvankar      Adarsh      Mihir

(Dr. P. K. Sahu)      [Signature]      [Signature]      [Signature]

**FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)**  
**DEPARTMENT OF MATHEMATICS**  
**COURSE CURRICULUM**

<b>Part A: Introduction</b>			
<b>Program: Bachelor in Science (Honors/Honors with Research)</b>		<b>Semester - VII</b>	<b>Session:2024-2025</b>
1	Course Code	<b>MASE-08</b>	
2	Course Title	<b>Discrete Mathematics</b>	
3	Course Type	<b>Discipline Specific Elective (DSE)</b>	
4	Pre-requisite ( if any)	Basic idea of logic and order relations.	
5	Course Learning Outcome (CLO)	<b>This Course will enable the students to:</b> <ul style="list-style-type: none"> <li>➤ The course aims at introducing the concepts of Lattices, sub Lattices and Homomorphisms between Lattices.</li> <li>➤ Understand the uses of Boolean algebra in daily life.</li> <li>➤ Understand the uses of grammar and languages in daily life.</li> <li>➤ Learn about the Finite state machines in different fields.</li> <li>➤ Solve real-life problems using finite-state and Turing machines.</li> </ul>	
6	Credit Value	<b>4C</b>	<b>1Credit = 15 hours- Learning and observation</b>
6	Total Marks	<b>Maximum Marks : 100</b>	<b>Minimum Passing Marks:40</b>

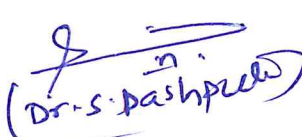
<b>Part B: Content of the Course</b>		
<b>Total no of teaching – learning period =60 Periods (60 Hours)</b>		
Unit	Topics	No. of Periods
I	<b>Lattices</b> -Lattices as partially ordered sets-their properties. Lattices as Algebraic Systems. Sublattices. Direct products and Homomorphisms. Some special Lattices e.g. Complete, Complemented and Distributive Lattices.	15
II	<b>Boolean Algebras:</b> Boolean Algebras. Boolean Algebras as Lattices. Various Boolean Identities. Boolean Functions, The Switching Algebra example, Sub-algebras.	15
III	<b>Grammars, Languages and Regular sets.</b> Phrase-structure Grammars. Rewriting rules. Derivations. Sentential forms. Language generated by a Grammar. Regular, Context-Free and Context Sensitive Grammars and Languages. Regular expressions and the Pumping Lemma. Kleen's theorem. Notions of Syntax Analysis. Polish Notations. Conversion of Infix Expressions to Polish notation. The Reverse Polish notations.	15
IV	<b>Finite state machines</b> – Equivalent machines. Finite state machines as language recognizers. Finite Automata. Acceptors. Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and mealy Machines. Turing Machine and Partial Recursive Functions.	15

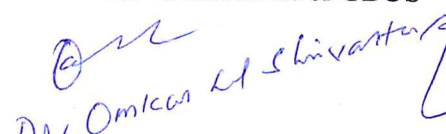



(Dr. P. K. Sahu)


<b>Part C - Learning Resource</b>		
<b>Text Books, Reference Books, Other Resources</b>		
<b>Text Books Recommended :</b>		
1. M.K. Gupta. Discrete Mathematics. Krishna Prakashan Media(P) Ltd 2. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co. New York.		
<b>Reference Books Recommended :</b>		
1. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co. 3. Seymour Lipschutz, Finite mathematics McGraw-Hill Book Co. New York. 4. S. Wiitala Discrete mathematics McGraw-Hill Book Co. New York		
<b>E-Recourses:</b>		
<a href="https://onlinecourses.nptel.ac.in">https://onlinecourses.nptel.ac.in</a> <a href="https://epqp.inflibnet.aci.in">https://epqp.inflibnet.aci.in</a> <a href="https://swayam.gov.in">https://swayam.gov.in</a> <a href="https://www.mooc.org">https://www.mooc.org</a>		
<b>Part D: Assessment and Evaluation</b>		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Maximum Marks:</b>		<b>100 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>		<b>30 Marks</b>
<b>End Semester Examination (ESE):</b>		<b>70 Marks</b>
<b>Continuous Internal Assessment (CIA)</b> (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
<b>End Semester Examination (ESE)</b>	<b>Two Section-A&amp;B</b> Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

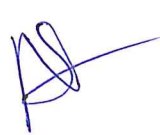
Name and signature of convener & members of CBOS-

  
 (Dr. S. Pashupathi)

  
 Dr. Omkar K. Shivastava

  
 (Dr. P. K. Sahu)

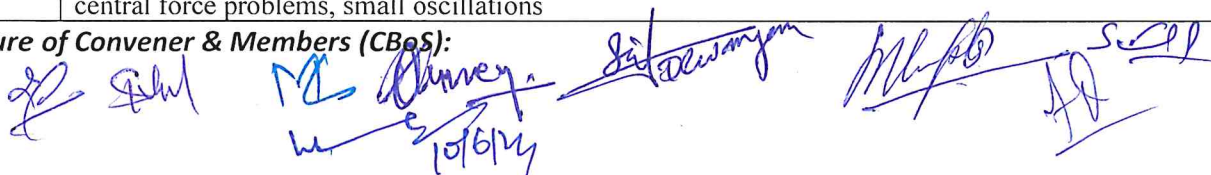
  
 M. H. M. H. M.

  
 A. S.

**FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)**  
**DEPARTMENT OF PHYSICS**  
**COURSE CURRICULUM**

<b>PART – A: INTRODUCTION</b>			
<b>Program: Bachelor in science</b> <i>(Honors/Honors with Research)</i>		<b>Semester: VII</b>	<b>Session: 2024-25</b>
1	Course Code	<b>PHSC-07</b>	
2	Course Title	<b>Classical Mechanics</b>	
3	Course Type	<b>Discipline Specific Course</b>	
4	Pre-requisite (if any)	<b>As per Program</b>	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: <ul style="list-style-type: none"> <li>➤ The ideas and concepts in classical physics</li> <li>➤ Explain Newtonian Mechanics, Lagrangian, and Hamiltonian formulation</li> <li>➤ Gain knowledge about central force problems and its application in scattering phenomena</li> <li>➤ Explain small oscillations and its applications. Apply mechanics to solve various physical problems</li> </ul>	
6	Credit Value	<b>04 Credits</b>	<b>1 Credit = 15 Hours for Learning &amp; Observation</b>
7	Total Marks	<b>Maximum Marks: 100</b>	<b>Minimum Pass Marks: 40</b>
<b>PART – B: CONTENT OF THE COURSE</b>			
<b>Total No. of Teaching-learning Periods (01 Hr. per period) – 60 Periods (60 Hours)</b>			
Unit	Topics		No. of Period
<b>I</b>	<b>Preliminaries of classical mechanics</b> Review of Newtonian Mechanics; Conservation laws; Constraints and their classification; Principle of virtual work; Generalized coordinates and velocities, D' Alembert's principle, Lagrangian and the Euler-Lagrange equations, Simple applications of Lagrangian formulation, Hamilton's principle, Lagrange's equation from Hamilton's principle; Legendre transformations and Hamilton's equation of motion; Hamilton's equation from Hamilton's principle; The principle of least action simple applications of Hamiltonian formulation; Conservation theorems, cyclic coordinates and symmetry properties		15
<b>II</b>	<b>Canonical transformations and relativistic mechanics</b> Canonical transformations; Poisson's Bracket; equation of motion and Conservation theorems in the Poisson Bracket formulation; Hamilton Jacobi (HJ) theory; Harmonic oscillator as an example of HJ method Four vectors; Four velocity and acceleration; Lorentz Covariant form of equation of motion.		15
<b>III</b>	<b>Central forces</b> Two-body central force problems and their reduction to the equivalent one-body problem; The equations of motion and first integrals; one-dimensional problems and classification of orbits; The differential equation of the orbit, Closure and stability of orbits; Kepler's laws and planetary motion; Scattering in central force; Rutherford's scattering		15
<b>IV</b>	<b>Rigid body and Periodic motion</b> Euler's angles, Euler's theorem on the motion of a rigid body; The Coriolis force; The Euler equations of motion of rigid bodies; Small oscillations; normal modes; Formulation of the problem of small oscillations; Vibrating string; normal vibrations; dispersion; Coupled vibrating systems, free vibration of a linear triatomic molecule.		15
<b>Keywords:</b>	Newtonian Mechanics, Lagrangian formulation, Hamiltonian formulation, Poisson's bracket, central force problems, small oscillations		

**Signature of Convener & Members (CBOS):**



## PART – C: LEARNING RESOURCES

### *Text Books, Reference Books and Others*

#### *Text Books Recommended-*

1. Classical Mechanics by Herbert Goldstein, Charles Poole, and John Safko
2. Mechanics by L.D. Landau and E.M. Lifshitz
3. Classical Mechanics: Systems of Particles and Hamiltonian Dynamics by Walter Greiner
4. Introduction to Classical Mechanics: With Problems and Solutions by David Morin
5. Classical Dynamics of Particles and Systems by Jerry B. Marion and Stephen T. Thornton
6. Classical Mechanics by R. Douglas Gregory
7. Analytical Mechanics by Grant R. Fowles and George L. Cassiday

#### *Reference Books Recommended*

1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
3. Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
4. Classical Mechanics: An Introduction, Dieter Strauch, 2009, Springer.

#### *Online Resources (e-books/ learning portals/ other e-resources)*

1. Classical Mechanics-<https://archive.nptel.ac.in/courses/115/106/115106123/>
2. Classical Mechanics- <https://archive.nptel.ac.in/courses/115/105/115105098/>
3. Classical Mechanics- <https://archive.nptel.ac.in/courses/122/106/122106027/>

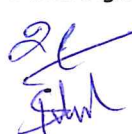
## PART – D: ASSESSMENT AND EVALUATION

### **Suggested Continuous Evaluation Methods:**

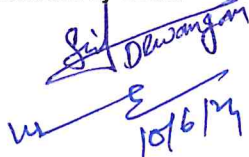
<b>Maximum Marks:</b>	<b>100 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>	<b>30 Marks</b>
<b>End Semester Examination (ESE):</b>	<b>70 Marks</b>

<b>Continuous Internal Assessment (CIA):</b> (By course teacher)	Internal Test/ Quiz (2): <b>20+20</b>	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against <b>30 Marks</b>
	Assignment/ Seminar (1): <b>10</b> Total Marks: <b>30</b>	
<b>End Semester Exam (ESE):</b>	<b>Two section – A &amp; B</b> Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20Marks Section B: Descriptive answer type, 1 out of 2 from each unit- 4 x 10 =40 Marks	

*Name and Signature of Convener & Members of CBoS:*





  
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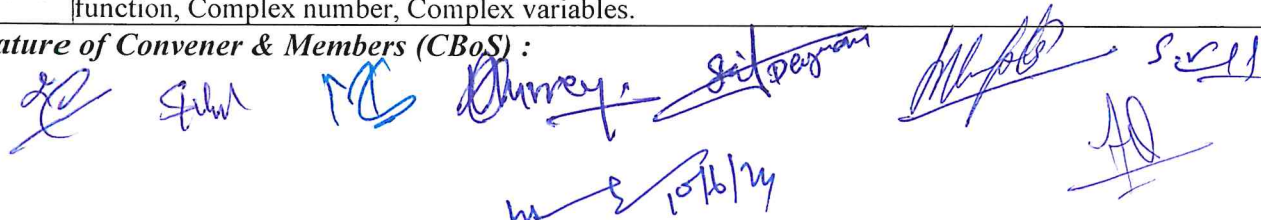
# FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

## DEPARTMENT OF PHYSICS

### COURSE CURRICULUM

<b>PART-A: INTRODUCTION</b>			
<b>Program : Bachelor in Science</b> <i>(Honors/Honors with Research)</i>		<b>Semester - VII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>PHSE- 05</b>	
2	<b>Course Title</b>	<b>Mathematical Physics -II</b>	
3	<b>Course Type</b>	<b>Discipline Specific Elective</b>	
4	<b>Pre-requisite (if, any)</b>	<b>As per Program</b>	
5	<b>Course Learning Outcomes (CLO)</b>	<ul style="list-style-type: none"> <li>➤ Apply Fourier analysis of periodic functions in physical problems such as vibrating strings etc.</li> <li>➤ Solve the beta, gamma and the error functions and their applications in doing integrations.</li> <li>➤ Relate basic theory of errors, their analysis, and estimation with examples of simple experiments in Physics.</li> <li>➤ Solve partial differential equations with the examples of important partial differential equations in Physics</li> </ul>	
6	<b>Credit Value</b>	<b>4 Credits</b>	<b>Credit = 15 Hours - learning &amp; Observation</b>
7	<b>Total Marks</b>	<b>Max. Marks: 100</b>	<b>Min Passing Marks: 40</b>
<b>PART -B: CONTENT OF THE COURSE</b>			
<b>Total No. of Teaching-learning Periods (01 Hr. per period) - 60 Periods (60 Hours)</b>			
Unit	Topics (Course contents)		No. of Period
<b>I</b>	Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. <b>Partial Differential Equations:</b> Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry		<b>15</b>
<b>II</b>	<b>Fourier Series:</b> Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series		<b>15</b>
<b>III</b>	<b>Frobenius Method and Special Functions:</b> Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite & Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations. <b>Some Special Integrals:</b> Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).		<b>15</b>
<b>IV</b>	<b>Complex Analysis:</b> Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula		<b>15</b>
<b>Keywords</b>	Calculus, Partial derivatives, Differential equations, Periodic function, Singular point, Beta and Gamma function, Complex number, Complex variables.		

**Signature of Convener & Members (CBoS) :**



## PART-C: LEARNING RESOURCES

### Text Books, Reference Books and Others

#### Text Books Recommended-

1. Calculus of Several Variables and Partial Differential Equations by M.L. Krasnov, S.G. Misikin, and A.I. Gromova
2. Fourier Series and Boundary Value Problems by James Brown and Ruel Churchill
3. Differential Equations with Boundary Value Problems by Dennis G. Zill and Warren S. Wright
4. Complex Variables and Applications by James Ward Brown and Ruel V. Churchill

#### Reference Books Recommended-

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. An Introduction to Ordinary Differential Equations, E.A Coddington, 1961, PHI Learning
5. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
6. Partial Differential Equations for Scientists and Engineers, S.J. Farlow, 1993, Dover Publications.
7. Mathematical methods for Scientists & Engineers, D.A. Mc Quarrie, 2003, Viva Books

#### Online Resources-

##### e-Resources / e-books and e-learning portals

1. NPTEL Online Courses: Dr Saurabh Basu (Complex analysis ) <https://nptel.ac.in/courses/115103036>
2. NPTEL Online Course: V. Balkrishanan (Fourier Transform) :<https://nptel.ac.in/courses/115106086>
3. NOC: Mathematical Methods in Physics 1, IISER Bhopal, Prof. Auditya Sharma  
<https://nptel.ac.in/courses/111106148>
4. Vector Calculus, egyankosh: <https://egyankosh.ac.in/handle/123456789/25388>
5. e-PG pathshala: Mathematical Physics,  
<https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+4mIqRALksfwQH9v8YSMrw==>

## PART -D:Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

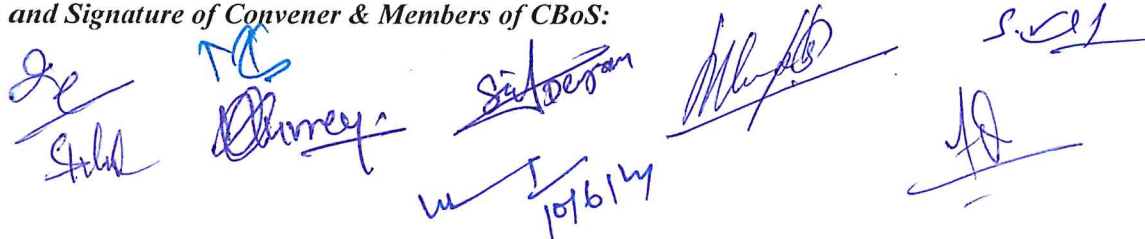
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - Total Marks -	10 30	
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20Marks Section B: Descriptive answer type qts., 1 out of 2 from each unit-4x10=40 Marks		

Name and Signature of Convener & Members of CBoS:



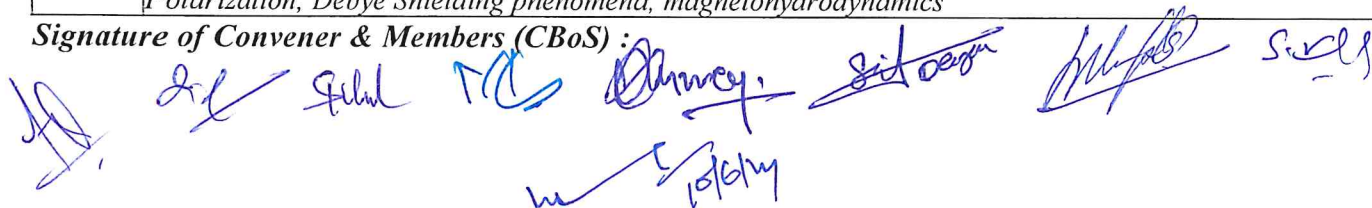
# FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

## DEPARTMENT OF PHYSICS

### COURSE CURRICULUM

<b>PART-A: INTRODUCTION</b>			
<b>Program : Bachelor in Science</b> <i>(Honors/Honors with Research)</i>		<b>Semester - VII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>PHSE- 06</b>	
2	<b>Course Title</b>	<b>Classical Electrodynamics &amp; Electromagnetic Theory</b>	
3	<b>Course Type</b>	<b>Discipline Specific Elective</b>	
4	<b>Pre-requisite (if, any)</b>	<i>As per Program</i>	
5	<b>Course Learning Outcomes (CLO)</b>	<ul style="list-style-type: none"> <li>➤ Calculate the reflection and transmission of waves at the media interface.</li> <li>➤ Understand the aspects related to Polarized lights and its generation as the superposition of different waves.</li> <li>➤ Understanding the plasma state, the concept of Debye screening, and collective behavior</li> </ul>	
6	<b>Credit Value</b>	<b>4 Credits</b>	<i>Credit = 15 Hours - learning &amp; Observation</i>
7	<b>Total Marks</b>	<b>Max. Marks: 100</b>	<b>Min Passing Marks: 40</b>
<b>PART -B: CONTENT OF THE COURSE</b>			
<b>Total No. of Teaching-learning Periods (01 Hr. per period) – 60 Periods (60 Hours)</b>			
Unit	Topics (Course Contents)		No. of Period
<b>I</b>	<b>Maxwell Equations:</b> Review of Maxwell's equations. Vector and Scalar Potentials. Maxwell's equations in terms of scalar and vector potentials. Concept of Gauge. Gauge Transformations: Lorentz and Coulomb Gauge; four-vectors, mathematical properties of space-time in special relativity; matrix representation of Lorentz transformation; Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density and Momentum Density. Radiation Pressure. <b>Radiation by moving charges:</b> Lienard-Wiechert potential and fields for a point charge; total power radiated by an accelerated charge- Larmor's formula and its relativistic generalization		<b>15</b>
<b>II</b>	<b>EM Wave Propagation in Unbounded :</b> Transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, skin depth. Propagation of E.M. Waves in Anisotropic Dielectrics. <b>EM Wave in Bounded Media:</b> Boundary Conditions at Interface between two Media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Brewster's law. Total internal reflection, Metallic reflection (normal Incidence)		<b>15</b>
<b>III</b>	<b>Polarization of Electromagnetic Waves:</b> Description of Linear, Circular and Elliptical Polarization. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extra – ordinary refractive indices. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Optical Rotation. Fresnel's Theory of optical rotation. Specific rotation. Laurent's half-shade polarimeter		<b>15</b>
<b>IV</b>	<b>Plasma:</b> Definition, Debye Shielding phenomena and criteria for plasma, motion of charged particles in electromagnetic field, Uniform E and B fields, electric field drift, non-uniform magneto-static field, Gradient B drift, parallel acceleration and magnetic mirror effect, Elementary concepts of plasma kinetic theory, the Boltzmann equation, the basic plasma phenomena, plasma oscillations; Fundamental equations of magneto - hydrodynamics (MHD); Plasma confinement schemes		<b>15</b>
<b>Keywords</b>	<i>Maxwell Equations, scalar and vector potentials, Lienard-Wiechert potential, EM wave propagation, Polarization, Debye Shielding phenomena, magnetohydrodynamics</i>		

**Signature of Convener & Members (CBoS) :**



## PART-C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended –

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Electromagnetic Theory, Chopra & Agrawal, K. Nath Publishing
5. Classical Electrodynamics J. D. Jackson, Wiley

#### Reference Books Recommended –

1. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
2. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press
3. Plasma Physics, Bittencourt
4. Plasma Physics, Chen

#### Online Resources– e-Resources / e-books and e-learning portals

1. All e-books of physics <https://www.e-booksdirectory.com/listing.php?category=2>
2. Free physics textbook in PDF  
[https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB\\_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD\\_BwE](https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE)
3. Cambridge University Books for Physics <https://www.cambridgeindia.org/>
4. Books for solving physics problems <https://bookboon.com/en/physics-ebooks>
5. NPTEL Online courses: [https://onlinecourses.nptel.ac.in/noc21\\_ph05/preview](https://onlinecourses.nptel.ac.in/noc21_ph05/preview)
6. <https://archive.nptel.ac.in/courses/115/104/115104088/>
7. Classical Electromagnetism - 1 (Electrostatics) <https://bsc.hcverma.in/course/cee1>
8. Plasma Physics and Applications [https://onlinecourses.nptel.ac.in/noc24\\_ph20/preview](https://onlinecourses.nptel.ac.in/noc24_ph20/preview)

## PART -D: Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment(CIA): 30 Marks

End Semester Exam(ESE): 70 Marks

<b>Continuous Internal Assessment (CIA):</b> (By Course Teacher)	Internal Test / Quiz-(2): 20 & 20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
<b>End Semester Exam (ESE):</b>	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20Marks Section B: Descriptive answer type qts., 1 out of 2 from each unit-4x10=40 Marks	

Name and Signature of Convener & Members of CBoS:



**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF PHYSICS**  
**COURSE CURRICULUM**

<b>PART-A: INTRODUCTION</b>			
<b>Program : Bachelor in Science</b> <i>(Honors/Honors with Research)</i>		<b>Semester - VII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>PHSE- 07 T</b>	
2	<b>Course Title</b>	<b>DIGITAL ELECTRONICS</b>	
3	<b>Course Type</b>	<b>Discipline Specific Elective</b>	
4	<b>Pre-requisite (if, any)</b>	<i>As per Program</i>	
5	<b>Course Learning Outcomes (CLO)</b>	<ul style="list-style-type: none"> <li>➤ Understand basics of logic gates, Boolean algebra, and simplifying complex Boolean functions.</li> <li>➤ Learn about combinational circuits, logic families, and digital ICs.</li> <li>➤ Understand the working of flip-flops and thus memory</li> <li>➤ Capable to know the various sequential circuits an Ads &amp; DAs</li> </ul>	
6	<b>Credit Value</b>	<b>3 Credits</b>	<i>Credit = 15 Hours - learning &amp; Observation</i>
7	<b>Total Marks</b>	<b>Max. Marks: 100</b>	<b>Min Passing Marks: 40</b>

**PART -B: CONTENT OF THE COURSE**  
**Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)**

Unit	Topics (Course contents)	No. of Period
<b>I</b>	<p><b>Number system:</b> Decimal, Binary, Octal and Hexadecimal Number System with mutual conversion, Mathematics of number systems (addition, subtraction, multiplication and division), 1's and 2's compliments, addition and subtraction using 1's and 2's compliments.</p> <p><b>Binary Codes:</b> Binary Coded Decimal (BCD), its addition and subtraction, Excess –3 code, its addition and subtraction, Gray code, binary to gray code and gray code to binary code conversion.</p> <p><b>Logic gates:</b> Positive and negative logic, Basic gates, Universal building block. Basic laws of Boolean Algebra, De-Morgan's Theorem</p>	<b>12</b>
<b>II</b>	<p><b>Simplification of Boolean Functions:</b> Simplification of Boolean functions through Boolean laws, Realization through logic gates, Minterms and Maxterms, Two, Three and Four variable Karnough Map (K-Map), and minimization of SOP and POS expressions.</p> <p><b>Combinational Logic Circuits:</b> Half-adder, Full-adder, Binary serial and parallel adders, Half Subtractor, Full Subtractor. Multiplexers (2:1, 4:1 and 16:1), Demultiplexer (1:2, 1:4 and 1:16), Encoders (Octal to Binary encoder, Decimal to BCD), Binary decoders BCD to Decimal, BCD to Seven Segment)</p>	<b>11</b>
<b>III</b>	<p><b>Digital logic Families:</b> Introduction, Basic concepts of RTL, DTL, TTL, ECL and CMOS logic families and their characteristics (Fan-in, Fan-out, Supply voltage range, Power dissipation, Input/ Output logic levels, Noise margin, Speed of operation)</p> <p><b>Flip-flop and timing diagram:</b> RS flip-flop, R-S flip-flop using NOR gate, RS flip-flop using NAND gate, Clocked RS flip-flop, D- latch flip-flop, Flip-flop with Preset and Clearinputs, JK flip-flop, Positive and negative edge triggered flop-flops., JK Master Slave flip-flop</p>	<b>11</b>
<b>IV</b>	<p><b>Sequential Circuits: Counters:</b> Synchronous and Asynchronous counters: Binary ripple counter, up counter, down counter, up-down counter and ring counter with their time diagrams.</p> <p><b>Registers:</b> Shift Register, PIPO, SIPO, PISO, SISO and Bi-directional shift Register, Application of shift register (Serial Adder, Sequence generator)</p> <p><b>Digital to analog converter and Analog to Digital converters:</b> D/A converters using binary weighted resistor network and R-2R ladder Network; Counter type A/D converter, applications of DACs and ADCs</p>	<b>11</b>
<i>Keywords</i>	Number System, Logic gates, Codes, Digital Logic Families, Flip flops, Registers, counters	

**Signature of Convener & Members (CBoS) :**

## PART-C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended-

1. Digital Design by M. Morris Mano and Michael D. Ciletti
2. Modern Digital Electronics by R.P. Jain
3. Digital Electronics: Principles, Devices and Applications by Anil K. Maini

#### Reference Books Recommended-

1. Digital and Analogue Technique- Navneet Gokhale and Kale, Kitab Mahal
2. Digital Electronics and Micro-Computers- R K Gaur, Dhanpat Rai Publications
3. Digital electronics- D K Kaushik, Dhanpat Rai Publication Company
4. Digital Electronics: Principles, Devices and Applications- A K Maini, John Wiley & Sons Ltd.
5. Digital Principles and applications – Malvino and Leach, Tata McGraw Hills, New Delhi
6. Hand Book of Electronics – Gupta and Kumar, Pragati Prakashan, Meerut
7. Digital integrated Electronics \_ Taub and Schilling, McGraw International Edition
8. Fundamentals of Digital Circuits – A.Anand Kumar, Prentice Hall of India, New Delhi
9. Modern Digital Electronics- R P Jain, Tata McGraw Hill Publication, New Delhi

### Online Resources-

#### e-Resources / e-books and e-learning portals

1. [https://www.freebookcentre.net/Electronics/Digital-CircuitsBooks.html#google\\_vignette](https://www.freebookcentre.net/Electronics/Digital-CircuitsBooks.html#google_vignette)
2. [https://www.researchgate.net/profile/DkKaushik/publication/264005171\\_Digital\\_Electronics/links/53fca84a0cf2364ccc04b6dd/Digital-Electronics.pdf](https://www.researchgate.net/profile/DkKaushik/publication/264005171_Digital_Electronics/links/53fca84a0cf2364ccc04b6dd/Digital-Electronics.pdf)
3. <https://www.freebookcentre.net/electronics-ebooks-download/Digital-Electronics-Notes.html>
4. [https://www.academia.edu/40001993/Digital\\_Electronics](https://www.academia.edu/40001993/Digital_Electronics)
5. <https://www.technicalbookspdf.com/electronic-engineering/digital-electronics/>
6. [https://www.tutorialspoint.com/digital\\_circuits/digital\\_circuits\\_multiplexers.htm](https://www.tutorialspoint.com/digital_circuits/digital_circuits_multiplexers.htm)
7. [https://www.electronics-tutorials.ws/combination/comb\\_3.html](https://www.electronics-tutorials.ws/combination/comb_3.html)
8. <https://www.youtube.com/watch?v=Eb56gaw6JrQ>
9. [https://www.tutorialspoint.com/computer\\_logical\\_organization/digital\\_counters.htm](https://www.tutorialspoint.com/computer_logical_organization/digital_counters.htm)
10. <https://www.youtube.com/watch?v=bAQfPQqKCHs>
11. <https://www.youtube.com/watch?v=K2wPxfiggAU>

## PART -D: Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

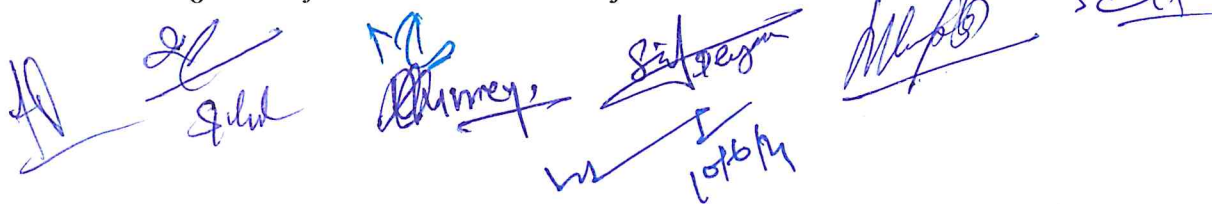
Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam(ESE): 70 Marks

<b>Continuous Internal Assessment (CIA):</b> (By Course Teacher)	Internal Test / Quiz-(2):	20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar -	10	
	Total Marks -	30	
<b>End Semester Exam (ESE):</b>	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20Marks Section B: Descriptive answer type qts., 1 out of 2 from each unit-4x10=40 Marks		

Name and Signature of Convener & Members of CBoS:



**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF PHYSICS**  
**COURSE CURRICULUM**

<b>PART-A: INTRODUCTION</b>			
<b>Program : Bachelor in Science</b> <i>(Honors/Honors with Research)</i>		<b>Semester - VII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>PHSE- 07 P</b>	
2	<b>Course Title</b>	<b>DIGITAL ELECTRONICS</b>	
3	<b>Course Type</b>	<b>Discipline Specific Elective</b>	
4	<b>Pre-requisite (if,any)</b>	<b>As per Program</b>	
5	<b>Course Learning Outcomes(CLO)</b>	<b>After completion of this course a student will be able to-</b> <ul style="list-style-type: none"> <li>➤ Understand the working of logic gates and realization of Functions</li> <li>➤ Clarify the concept of combinational logic circuits</li> <li>➤ Understand the differences between MUX, DMUX, Encoder and Decoder and their uses</li> <li>➤ Familiar with basic memory elements (Flip-flop)</li> <li>➤ Understand the concept of counters and shift registers, Able to use D/A and A/D convertors.</li> </ul>	
6	<b>Credit Value</b>	<b>1 Credits</b>	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	<b>Total Marks</b>	<b>Max. Marks: 50</b>	<b>Min Passing Marks:20</b>

**PART -B: CONTENT OF THE COURSE**

<b>Total No. of learning-Training/performance Periods:30 Periods (30 Hours)</b>		
Module	Topics (Course Contents) At least 10 of the following or related Experiments	No. of Period
<b>Lab./Field Training/ Experiment Contents of Course</b>	<ol style="list-style-type: none"> <li>1. To study and verify the truth-tables of various logic gates</li> <li>2. To study the Binary to Gray and Gray to Binary conversion</li> <li>3. To verify the Boolean Laws with the help of logic gates</li> <li>4. To realize Half Adder and Full Adder</li> <li>5. To realize Half and Full subtractor</li> <li>6. To verify the working and truth table of a Multiplexer</li> <li>7. To verify the working and truth table of a Demultiplexer</li> <li>8. To study the Decimal to BCD Encoder</li> <li>9. To study the BCD to Seven Segment Decoder</li> <li>10. To verify the truth table of (i) R-S flip-flop, (ii) Data latch and (iii) Edge triggered flip-flop</li> <li>11. To verify the truth table of (i) J-K flip-flop, (ii) J-K Master-Slave flip-flop and (iii) T flip-flop</li> <li>12. To understand the working of Ripple counter and verify its truth table</li> <li>13. To understand the working of Up-Down counter and verify its truth table</li> <li>14. To understand the working of Left/Right Shift Register and verify its truth table</li> <li>15. To understand the working of SIPO/ PIPO Shift Register and verify its truth table</li> <li>16. To understand the working of Sequence generator</li> <li>17. To study the R-2R ladder Digital to Analog convertor</li> <li>18. To study Counter type Analog to Digital convertor</li> </ol>	<b>30</b>
<i>Keywords</i>	<i>Logic gates, Boolean algebra, Adders, Multiplexer, Flip-flop, Counter, Shift register. Convertors.</i>	

**Signature of Convener & Members (CBoS):**

## PART-C: LEARNING RESOURCES

### Text Books, Reference Books and Others

#### Text Books Recommended-

1. Digital Electronics: Theory and Practical- Virendra Kumar, New Age International Publications
2. Digital Electronics – A Comprehensive Lab Manual- Cherry Bhargava, B S Publication
3. Digital electronics experiment manual- Toger Tokheim, McGraw Hill
4. Handbook of Experiments in Electronics and Communication- B Sasikala & S P Rao, Vikas Publishing
5. Practical Digital Electronics Manual- Nigel P Cook, Prentice Hall

#### Reference Books Recommended-

1. Digital Design by M. Morris Mano and Michael D. Ciletti
2. Fundamentals of Digital Circuits by A. Anand Kumar
3. Digital Electronics: Principles and Integrated Circuits" by Anil K. Maini
4. Digital Fundamentals by Thomas L. Floyd
5. Modern Digital Electronics by R. P. Jain
6. Digital Logic Design by B. Somanathan Nair

#### Online Resources-

##### ➤ e-Resources / e-books and e-learning portals

1. [https://nationallibraryopac.nvli.in/cgi-bin/koha/opac-detail.pl?biblionumber=15445&query\\_desc=Provider%3ANew%20Age%20International%2](https://nationallibraryopac.nvli.in/cgi-bin/koha/opac-detail.pl?biblionumber=15445&query_desc=Provider%3ANew%20Age%20International%2)
2. [https://books.google.com/books/about/Digital\\_Electronics.html?id=b7WwzQEACAAJ](https://books.google.com/books/about/Digital_Electronics.html?id=b7WwzQEACAAJ)
3. <https://ssit.edu.in/dept/assignment/declabmanual.pdf>

## PART-D: ASSESSMENT AND EVALUATION

### Suggested Continuous Evaluation Methods:

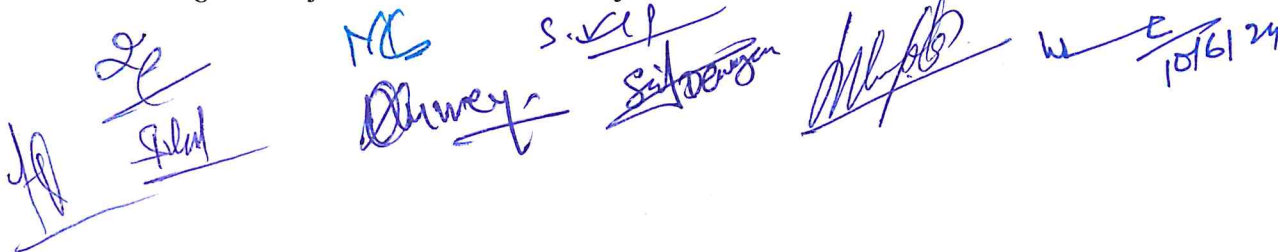
Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2):	10 & 10	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
	Assignment/Seminar + Attendance- Total Marks -	05 15	
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment		Managed by Course teacher as per lab. status
	A. Performed the Task based on lab. work - 20 Marks		
	B. Spotting based on tools & technology (written) – 10 Marks C. Viva-voce (based on principle/technology) - 05 Marks		

Name and Signature of Convener & Members of CBoS:



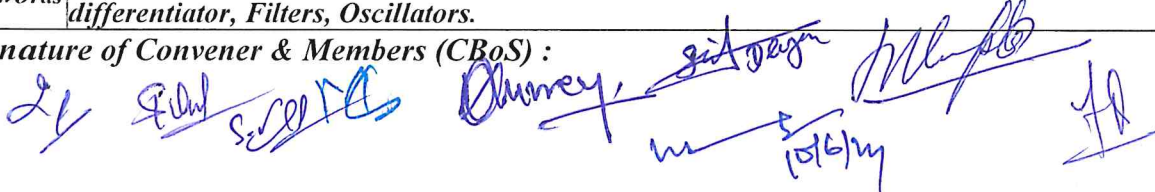
# FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

## DEPARTMENT OF PHYSICS

### COURSE CURRICULUM

<b>PART-A: INTRODUCTION</b>			
<b>Program : Bachelor in Science</b> <i>(Honors/Honors with Research)</i>		<b>Semester -VII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>PHSE- 08 T</b>	
2	<b>Course Title</b>	<b>Operational Amplifier &amp; Its Applications</b>	
3	<b>Course Type</b>	<b>Discipline Specific Elective</b>	
4	<b>Pre-requisite (if, any)</b>	<i>As per Program</i>	
5	<b>Course Learning Outcomes (CLO)</b>	After completion of the course students will be able to – <ul style="list-style-type: none"> <li>➤ The Idea and concepts of differential amplifier</li> <li>➤ Basic concepts of Ideal operational amplifier and Practical operational amplifier with its electrical parameters</li> <li>➤ Gain the knowledge of op-amp with feedback and its effect on different parameters</li> <li>➤ Understand the concept of various oscillators and their applications</li> <li>➤ Know the uses of Timer circuits and their applications</li> </ul>	
6	<b>Credit Value</b>	<b>3 Credits</b>	<i>Credit = 15 Hours - learning &amp; Observation</i>
7	<b>Total Marks</b>	<b>Max. Marks: 100</b>	<b>Min Passing Marks: 40</b>
<b>PART -B: CONTENT OF THE COURSE</b>			
<b>TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)</b>			
Unit	Topics (Course Contents)		No. of Period
<b>I</b>	<b>Differential amplifier:</b> Basic idea of direct coupled amplifier and its drawbacks, Circuit configurations of Differential amplifier, need for dual power supply, Basics of different configurations, dual input-balanced output differential amplifier, Its DC analysis and AC analysis. Inverting and Non-Inverting inputs, CMRR, need for constant current bias level transistor circuit Level translator		<b>11</b>
<b>II</b>	<b>Operational Amplifier:</b> Introduction, Block diagram, Functions of each block, Electrical parameters, Ideal op-amp, it's characteristics and equivalent circuit, <b>Open-loop configurations:</b> Differential, Inverting and Non-inverting amplifiers, <b>Op-Amp with negative feedback:</b> Block diagrams of feedback configurations, Voltage series feedback and its effect on Input resistance, Output resistance, Bandwidth, Total output offset voltage. Voltage follower, Voltage shunt feedback, Inverting input terminal at virtual ground, its effect on Input resistance, Output resistance, Bandwidth, Total output offset voltage		<b>12</b>
<b>III</b>	<b>Practical Op-Amp:</b> Input offset voltage, Input bias current, Input offset current, Total output offset voltage, Thermal drift, Error voltage, Common mode configuration and CMMR, <b>Linear Applications:</b> Summing, Scaling and Averaging amplifiers, Basics of Instrumentation amplifier, Instrumentation amplifier using Transducer bridge, Its uses, Voltage to current converter, Theory of Integrator and Differentiator		<b>11</b>
<b>IV</b>	<b>Active Filters Using Op-Amp:</b> Idea of active filters and their classification, First order and Second order low-pass Butterworth filter <b>Op-Amp Oscillators:</b> Oscillator block diagram and condition for sustained oscillations, Phase Shift oscillator, Wien Bridge oscillator and calculation for their frequency of oscillations. Square-wave generator, Triangular wave generator. <b>The 555 Timer:</b> Block diagram of 555, The 555 as a Monostable Multivibrator, Its use as pulse stretcher, 555 as a Stable Multivibrator, Its use as Square-wave oscillator		<b>11</b>
<i>Keywords</i>	<i>Differential Amplifier, Operational Amplifier, Configuration, Feedback, Practical op-amp, Integrator, differentiator, Filters, Oscillators.</i>		

Signature of Convener & Members (CBoS) :



## PART-C: LEARNING RESOURCES

### Text Books, Reference Books and Others

#### Text Books Recommended-

1. Op-amps and Linear Integrated Circuits- Ramakant A Gayakwad, Prentice Hall, India
2. Op-amps and Linear Integrated Circuits- R F Coughlin & F F Driscoll, Prentice Hall, India
3. Op- Amp and Linear Integrated circuits: K. Lal. Kishore, Pearson Education, Delhi
4. Op- Amp with Linear Integrated circuits: William D. Stanly, Pearson Education, Delhi
5. Linear Integrated circuits: D. Roy Choudhury and Shail B. Jain, New Age International Publications, New Delhi.
6. Op- Amp and Linear Integrated circuits: concept and applications- James N Flore, Cengage Learning India Pvt. Ltd

#### Reference Books Recommended-

1. Microelectronic Circuits by Adel S. Sedra and Kenneth C. Smith
2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky
3. Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll
4. Design with Operational Amplifiers and Analog Integrated Circuits by Sergio Franco
5. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad
6. Operational Amplifiers with Linear Integrated Circuits" by William D. Stanley\*\*
7. Analog Filter Design" by M.E. Van Valkenburg\

#### Online Resources-

##### e-Resources / e-books and e-learning portals

1. [https://www.reddit.com/r/AskElectronics/comments/aevtj1/looking\\_for\\_some\\_books\\_to\\_learn\\_about\\_opamps/](https://www.reddit.com/r/AskElectronics/comments/aevtj1/looking_for_some_books_to_learn_about_opamps/)
2. <https://open.umn.edu/opentextbooks/textbooks/574>
3. <https://community.element14.com/learn/publications/ebooks/w/documents/27823/a-quick-beginner-s-introduction-to-op-amps---ebook>
4. <https://www.analog.com/en/resources/technical-books/op-amp-applications-handbook.html>
5. <https://mgcub.ac.in/pdf/material/202004041708263c4d2b87a6.pdf>
6. [https://mrcet.com/downloads/digital\\_notes/ECE/III%20Year/10082021/LINEAR%20&%20DIGITAL%20IC.pdf](https://mrcet.com/downloads/digital_notes/ECE/III%20Year/10082021/LINEAR%20&%20DIGITAL%20IC.pdf)
7. <https://alan.ece.gatech.edu/ECE3040/Lectures/Lecture28-Operational%20Amplifier.pdf>

## PART -D:ASSESSMENT ANDEVALUATION

### Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

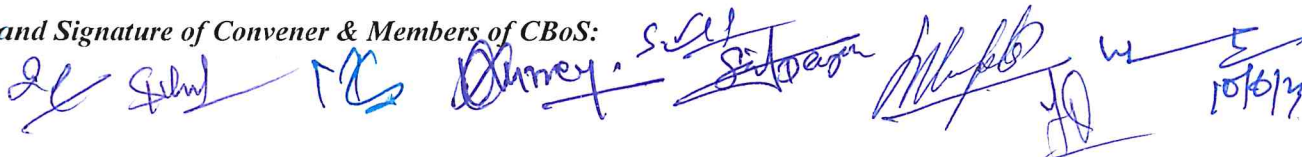
Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

<b>Continuous Internal Assessment (CIA):</b> (By Course Teacher)	Internal Test / Quiz-(2):	20 +20	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
	Assignment / Seminar - Total Marks -	10 30	

<b>End Semester Exam (ESE):</b>	<b>Two section – A &amp; B</b> Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks
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Name and Signature of Convener & Members of CBoS:



**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF PHYSICS**  
**COURSE CURRICULUM**

<b>PART-A: INTRODUCTION</b>			
<b>Program: Bachelor in Science</b> <i>(Honors/ Honors with Research)</i>		<b>Semester - VII</b>	<b>Session: 2024-2025</b>
1	<b>Course Code</b>	<b>PHSE- 08 P</b>	
2	<b>Course Title</b>	<b>Operational Amplifier &amp; Its Applications</b>	
3	<b>Course Type</b>	<b>Discipline Specific Elective</b>	
4	<b>Pre-requisite (if, any)</b>	<b>As per Program</b>	
5	<b>Course Learning Outcomes(CLO)</b>	<b>After completion of this course a student will be able to-</b> <ul style="list-style-type: none"> <li>➤ Understand the working of differential amplifier and its inverting and non-inverting configurations.</li> <li>➤ Know the importance of negative feedback</li> <li>➤ Know the uses of op-amp IC. Understand the idea of Oscillators</li> <li>➤ Understand the working of active filters</li> <li>➤ Have the idea about Multivibrators</li> </ul>	
6	<b>Credit Value</b>	<b>1 Credits</b>	<i>Credit =30 Hours Laboratory or Field learning/Training</i>
7	<b>Total Marks</b>	<b>Max.Marks:50</b>	<b>Min Passing Marks:20</b>

**PART -B: CONTENT OF THE COURSE**

<b>Total No. of learning-Training/performance Periods - Periods (30 Hours)</b>		
Module	Topics(Course Contents) At least 10 of the following or related Experiments	No. of Period
<b>Lab./ Experiment Contents of Course</b>	<ol style="list-style-type: none"> <li>1. To study the differential amplifier and to find the voltage gain</li> <li>2. To study Inverting and Non-Inverting op-amp</li> <li>3. To study Voltage series feedback and its effect on Input resistance, Output resistance using op-amp</li> <li>4. To study Summing op-amp (IC741) and verify their theoretical and practical output</li> <li>5. To study Subtractor op-amp (IC741) and verify their theoretical and practical output</li> <li>6. To study Scaling op-amp (IC741) and verify their theoretical and practical output</li> <li>7. To study the operation of the Integrator &amp; differentiator using op-amp and trace the output wave forms for sine and square wave inputs</li> <li>8. To study the operation of RC phase shift oscillators using op-amp and trace the output wave forms</li> <li>9. To study the operation of Wien bridge oscillators using op-amp and trace the output wave forms</li> <li>10. To study the First order low-pass Butterworth filter</li> <li>11. To study the Second order low-pass Butterworth filter</li> <li>12. To study the function of Square wave generator and trace the expected wave form</li> <li>13. To study the function of Triangular wave generator and trace the expected wave form</li> <li>14. To use 555 timer as Monostable multivibrator and trace the expected wave form</li> <li>15. To use 555 timer as Astable multivibrator and trace the expected wave form</li> </ol>	<b>30</b>
<b>Keywords</b>	Differential amplifier, Feedback, Op-amp, Integrator, Differentiator, Oscillator, Waveforms, Filters, Multivibrators.	

**Signature of Convener & Members (CBoS):**

## PART-C:LEARNING RESOURCES

### Text Books, Reference Books and Others

#### Text Books Recommended-

1. Handbook of operational amplifier applications- Bruce Carter and Thomas R. Brown, Texas Instruments
2. Operational Amplifier: Theory and Experiments- Shrikrishna Yawale & Sangita Yawale, Springer
3. Op-Amps for Everyone- Ron Mancini, Texas Instruments

#### Reference Books Recommended-

1. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad
2. Design with Operational Amplifiers and Analog Integrated Circuits by Sergio Franco
3. Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll
4. Op Amps for Everyone by Ron Mancini
5. Op Amp Applications Handbook by Analog Devices Inc.
6. Practical Electronics for Inventors by Paul Scherz and Simon Monk
7. Electronic Devices and Circuits by David A. Bell
8. Electronic Principles by Albert Malvino and David J. Bates

#### Online Resources-

##### e-Resources / e-books and e-learning portals

1. <https://www.scribd.com/document/370796028/Op-Amp-Lab-Manual>
2. [https://gnindia.dronacharya.info/ECE/Downloads/Labmanuals/EC\\_%20LAB\\_\(EE-451\)\\_IVSem\\_18012013.pdf](https://gnindia.dronacharya.info/ECE/Downloads/Labmanuals/EC_%20LAB_(EE-451)_IVSem_18012013.pdf)
3. [https://www.researchgate.net/publication/282055366\\_7\\_Lab\\_Experiments\\_with\\_Op-amp\\_A\\_manual\\_for\\_undergrad\\_students\\_teaching\\_staff](https://www.researchgate.net/publication/282055366_7_Lab_Experiments_with_Op-amp_A_manual_for_undergrad_students_teaching_staff)
4. <https://www.utdallas.edu/~rmh072000/EE3101/exp5.pdf>
5. <https://www.csun.edu/sites/default/files/ECE340%20Lab%20Manual.pdf>
6. <https://link.springer.com/book/10.1007/978-981-16-4185-5>

## PART-D:ASSESSMENT ANDEVALUATION

### Suggested Continuous Evaluation Methods:

<b>Maximum Marks:</b>	<b>50 Marks</b>
<b>Continuous Internal Assessment (CIA):</b>	<b>15 Marks</b>
<b>End Semester Exam (ESE):</b>	<b>35 Marks</b>

<b>Continuous Internal Assessment (CIA):</b> (By Course Teacher)	Internal Test / Quiz-(2): <b>10 &amp; 10</b> Assignment/Seminar +Attendance- <b>05</b> Total Marks - <b>15</b>	Better marks out of the two Test / Quiz *obtained marks in Assignment shall be considered against <b>15</b> Marks
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<b>End Semester Exam (ESE):</b>	<b>Laboratory / Field Skill Performance: On spot Assessment</b> A. Performed the Task based on lab. work - <b>20</b> Marks B. Spotting based on tools& technology (written) - <b>10</b> Marks C. Viva-voce (based on principle/technology) - <b>05</b> Marks	<b>Managed by Course teacher as per lab. status</b>
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Name and Signature of Convener & Members of CBoS:

