



Re-Accredited 'B++' 2.86 CGPA by NAAC

**VEER NARMAD SOUTH GUJARAT UNIVERSITY**

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

**વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી**

યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

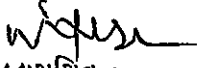
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## **-: પરિપત્ર :-**

યુનિવર્સિટી સંલગ્ન કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા હેઠળની તમામ બીસીએ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૬-૨૭ થી અમલમાં આવનાર B.C.A. Honours Data Science and Analytics Sem.-5 & 6 નો પેટાસમિતિ દ્વારા તૈયાર કરવામાં આવેલ અભ્યાસક્રમ કોમ્પ્યુટર સાયન્સ વિષયની અભ્યાસ સમિતિ ની તા.૨૫/૦૩/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંક:૦૪ થી મંજૂર કરી કોમ્પ્યુટર સાયન્સ ફેકલ્ટીને કરેલ ભલામણ કોમ્પ્યુટર સાયન્સ ફેકલ્ટીની તા.૨૯/૦૪/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંક:૦૨ થી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૦૭/૦૫/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંક:૪૫ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક:ઓથો./પરિપત્ર/૯૯૩૦/૨૦૨૬  
તા.૧૨/૦૫/૨૦૨૬.

  
કુલસચિવ

પ્રતિ,

- ૧) યુનિવર્સિટી સંલગ્ન તમામ બીસીએ કોલેજોના આચાર્યશ્રીઓ.  
.....આપશ્રીની કોલેજ/વિભાગના સંબંધિત શિક્ષકો/વિદ્યાર્થીને જાણ કરી અમલ કરવા સારુ.
- ૨) ઈ.ચા.ડીનશ્રી, કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા.
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.  
.....તરફ જાણ તેમજ અમલ સારુ.

# **Veer Narmad South Gujarat University, Surat**

**Computer Science and Information Technology Faculty Syllabus for  
(Semester-V and Semester-VI) of TYB.C.A.(Honours)- Data Science and Analytics**

**As per NEP-2020**

**To be implemented from**

**Academic Year: June, 2026-2027**

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**Veer Narmad South Gujarat University, Surat Bachelor of  
Computer Application (B.C.A.(Honours)-Data Science and  
Analytics Under the Faculty of  
Computer Science and Information Technology**

<b>Name of Program:</b>	Bachelor of Computer Application (Honours)-Data Science and Analytics
<b>Abbreviation:</b>	B.C.A.(Honours)-Data Science and Analytics: Four-year Integrated Program.  With Multi-Level Entry and Exit option
<b>Multi-level Exit Criteria:</b>	<p>i) Under Graduate Certificate in Computer Application: If the student wish to exit after completion of First year ( Semester-1 and Semeter-2 ) without any back- log and secure additional 4 credits from work based skill oriented university approved courses /vocational courses / summer internship / Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester.</p> <p>ii) Diploma in Computer Application: If the student wish to exit after completion of Second year (Semester-1 to Semeter-4) without any back-log and secure additional 4 credits from work based skill oriented university approved courses /vocational courses / summer internship / Apprenticeship offered at end of first or second year in addition to 6 credits from skill-based courses earned during first four semesters.</p> <p>iii) B.C.A.-Data Science and Analytics (Bachelor’s in Computer Application): If the student wish to exit after completion of Third year (Semeste-1 to semester-6) without any back-log and secure additional 4 credits from work based skill oriented university approved courses /vocational courses / summer internship / Apprenticeship offered at end of third year in addition to 6 credits from skill-based courses earned during first four semesters.</p>
<b>Multi-Level Entry Criteria:</b>	As per the norms of the Veer Narmad South Gujarat University.
<b>Duration:</b>	4 year of B.C.A.(Honors) –Data Science and Analytics degree program with multi-level exit options at 1 <sup>st</sup> , 2 <sup>nd</sup> and 3 <sup>rd</sup> Year to obtain Certificate, Diploma, Degree and Honours Degree in Computer Application respectively.
<b>Eligibility:</b>	<p>Candidate must have passed standard 12th (H.S.C.) Examination in Science (Any Group) / Commerce / vocational / General stream from Gujarat Higher Secondary Board (G.H.S.E.B.) or any other equivalent board (C.B.S.E. / I.C.S.E. / NIOS etc. which must be approved and possess equivalence certificate from Veer Narmad South Gujarat University) with English as one of the subject.</p> <p>In case of candidates passed out from 12th Board from General Stream; having English as one of the subjects. In case of Students passed out with 12th (H.S.C.) vocational stream, Computer and English must be one of the subject.</p>
<b>Objective of the Program:</b>	<p>The objective of the B.C.A. (Data Science and Analytics) program is to equip students with a strong foundation in computer applications while focusing on specialized skills in data science and analytics.</p> <p>Through a blend of theoretical knowledge and practical application, the program aims to prepare students to handle large datasets, analyze data using statistical methods and machine learning techniques, and derive meaningful insights to support decision-making processes in various industries. Students will also gain proficiency in programming languages, data visualization tools, and database management systems, enabling them to pursue careers as data analysts, data scientists, or pursue further studies in related fields.</p>

<p><b>Program Outcome:</b></p>	<p><b>PO1:</b> Develop Proficiency in Data Analysis: Equip students with skills to collect, clean, analyze, and interpret data using statistical methods and advanced analytics techniques.</p> <p><b>PO2:</b> Master Programming and Tools: Provide a strong foundation in programming languages such as Python and tools (Tableau, Power BI) essential for manipulating and visualizing data.</p> <p><b>PO3:</b> Apply Machine Learning Algorithms: Enable students to apply machine learning algorithms to solve real-world problems, including supervised and unsupervised learning approaches.</p> <p><b>PO4:</b> Prepare for Industry Roles: Prepare graduates to excel in roles such as data analysts, business analysts, or entry-level data scientists by integrating practical projects, internships, and industry-relevant skills into the curriculum.</p> <p><b>PO5:</b> An ability to apply design and development principles in construction of ML Models using various algorithms.</p> <p>Overall, the program outcomes aim to produce graduates who are: (a) competent in computer application, development and design ML Model. (b) Adapt to changing technology and industry trends. (c) Can make significant contributions to the software applications coding, designing, database managements, testing, deployments and ready to adapt any upcoming technologies.</p>
<p><b>Program Specific Outcome:</b></p>	<p>PSO1: Provide a solid foundation in computer science and mathematics necessary for data science, including programming languages, discrete mathematics, and calculus.</p> <p>PSO2: Train students in collecting, cleaning, and preprocessing large datasets from various sources to ensure data quality and readiness for analysis.</p> <p>PSO3: Equip students with statistical techniques such as hypothesis testing, correlation analysis, and regression analysis to derive insights and make data driven decisions.</p> <p>PSO4: Develop proficiency in applying machine learning algorithms for tasks such as classification, clustering, regression, and natural language processing, supported by practical applications.</p> <p>PSO5: Familiarize students with tools and techniques for handling big data, including distributed computing frameworks like Hadoop and Spark, and NoSQL databases.</p> <p>PSO6: Enable students to effectively visualize data using tools like matplotlib, seaborn, or Tableau, and interpret visualizations to communicate insights effectively.</p> <p>PSO7: Educate students on the ethical implications and legal considerations related to data collection, storage, and usage, emphasizing privacy, security, and regulatory compliance.</p> <p>PSO8: Offer opportunities for students to engage in capstone projects and internships with industry partners, allowing them to apply their skills in real-world scenarios and gain practical experience in data science and analytics roles.</p>

<b>PO and PSO mapping:</b>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	PO1								
	PO2								
	PO3								
	PO4								
	PO5								
	PO6								
<b>Medium of Instruction:</b>	English								
<b>Program Structure:</b>	Semester-wise Breakup of the course is given as follows :								

## Veer Narmad South Gujarat University, Surat

**Program Structure: T.Y.B.C.A.-Data Science and Analytics  
(SEM – 5 and SEM – 6) (w.e.f. Academic Year June, 2026-2027)**

### **Bachelor of Computer Application (B.C.A.) –Data Science and Analytics– Three Year Program**

**Bachelor of Computer Application (B.C.A.(Hon.)) Data Science and Analytics–  
Four Year Integrated Program**

#### Program Structure

Semester-wise break up for the courses :

#### SEMESTER – 5

Course Code	Course Title	Course Category	Level of Course	Course Credits	Teaching Hours/week	
				Th.+Pra.	Theory	Practical/ Fieldwork /Project/ Internship
501	Data Visualization using Tableau (Minor-04)	Minor Course	200-299 Intermediate Level Course	4	3	2
502	Concepts of Big Data (Minor-05)	Minor Course	200-299 Intermediate Level Course	4	4	0
503	Machine Learning Algorithms (minor Project) (Major-11)	Major Course	400-499 Advanced Courses	4	2	4
504	Business Analytics (Major-12)	Major Course	400-499 Advanced Courses	4	2	4
505	Deep Learning* (Major-13)	Major Course	400-499 Advanced Courses	4	2	4
	Project (Based on course code: 503)	Project will be developed in group of maximum three students based on approved definition by the concerned faculty members. The project report will be submitted by the students regularly. The final evaluation will be based on Project Presentation, E-report and viva-voce.				
	Practical (Based on Course Code:501 ,504 and 505)	Students will prepare separate practical journals for a ll 3 courses. The final Practical exam/viva-voce will be based on Courses-501,504 and 505 separately.				
506	<b>Skill Enhancement Course-V</b> (SEC-05) Ethics of Data Science	Skill Enhancement Course	200-299 Intermediate Level Course	2	2	-
Other Activities	The student is expected to participate in activities related to National Service Scheme (NCC), National Cadet Corps (NCC), adult education/literacy initiatives, mentoring school students, Elderly literacy program/ Environment preservation activities and other similar activities.			-	-	-
Total				22	15	14

Course Code	Course Title	Course Credit	University Exam Type	Exam Duration	External Marks	Internal Marks	Total Marks
501	Data Visualization using Tableau (Minor-04) **	4	Theory/ Written : Practical :	1 Hours 2 Hours	25 25	25 25	100
502	Concepts of Big Data (Minor-05)	4	Theory/ Written	2 Hours	50	50	100
503	Machine Learning Algorithms (minor Project) (Major-11)**	4	Theory/ Written : Project :	1 Hours 2 Hours	25 25	25 25	100
504	Business Analytics (Major-12)**	4	Theory/ Written : Practical :	1 Hours 2 Hours	25 25	25 25	100
505	Deep Learning** (Major-13)	4	Theory/ Written : Practical :	1 Hours 2 Hours	25 25	25 25	100
506	Ethics of Data Science Skill Enhancement Course-V# (SEC-05)	2	-	-	25	25	50 <sup>#</sup>
Total		22			275	275	550

#### For Practical and Project:

- Batch Size: Maximum 40 students can be accommodated in a batch. Separate batch should be considered if the student strength exceed 45 numbers.
- Practical includes Lab. sessions for courses-501 ,504 and 505.
- Project hours includes Lab. sessions of 2 Hours for the course-503 per week. The students can work on project in-house/out-house as per their internal guide's guidance. Group of maximum three students can work on a project definition. One Internal Project guide will be allocated to each group. Each group is expected to work minimum 4 hours each on Project per week. Out of which 2 hours will be in supervised mode and balance hours in un-supervised mode.
- The Practical journal/Project final reports must be certified by the concerned faculty and by the Head of the Department, failing which the student will not be allowed to appear for External Practical/Project Examination. Student will submit softcopy of Project duly certified by the internal guide.

**Internship:** A student who wish to exit after successfully completion of Third year (Semester-5 and Semester-6) without any backlog is required to obtain Four credits at the end of the year either through the internship/field-work or university approved two skill based certificate courses(two courses of 2-credits each or one 4-credit course). Student is required to enroll for the certificate courses separately by paying the course fees as decided by the college/institute. For Internship, the Institute/college will grant the permission and evaluate the training outcomes. Based on satisfactory completion of the internship training, the Institute head will recommend to the university to grant four credits for summer training. [All expenses for the internship/skill course/field-work will be bear by the student.]

**# Marks:** : The students will enrol for the course from the given university approved list of certificate courses offered by the respective college/department. The student will select and enrol separately for any of the offered list of courses at college/department/institute and obtain respective credits. The institute will evaluate the performance (preferably continuous evolution) as per the SOP of certificate courses and on successfully completion of the course, the student will be eligible to obtain respective credits for the course. These credits will be considered and reflect in student's mark-sheet as well as in ABC(Academic Bank of Credit). These courses are mandatory and student is required to obtain the specified credits in process to acquire the certificate/diploma/degree.

\*\* Minor/Major Practical based Subjects: Course 501,503,504 and 505 are 4-credit courses consists of two components: Theory and Practical/Project. Course-501 is minor course and carry 4 credits consists of two components: Theory and Practical. For Course-501: 3 Hours of Theory and 2 hours of Practical hours per week are allocated. For Course-503 : 2 Hours of Theory and 4 hours of Project hours per week are allocated. For Course 504 and 505 2 Hours of theory and 4 hours of practical per week are allocated. Major courses carry 100 marks of exam weightage (50 theory and 50 practical/project). External and Internal distribution of marks are in ratio of 50:50 respectively. Students are required to acquire minimum passing marks from theory and practical collectively. Practical exams: For Course-501,504 and 505 (2 hours duration), and 25 marks each.

<p>Project Exam: For course-503 – project presentation and viva-voce will be conducted. External Theory/Practical/Project exam marks (25 marks each for course-501, course-503,504 and 505.) Division of marks for External Practical: Exam evaluation: 20 marks + Viva-voce: 5 Marks.</p> <p>Students are required to pass in both components (Theory and Practical/Project) collectively for course 501, 503 504 and 505 as combined head (Theory + Practical/Project). It is mandatory for Students to appear for internal and external theory and practical exams for all courses. Similarly, In case students remain absent in any of the component of Theory or Practical of minor/major course, the student will be considered fail.</p>	
<b>Program Passing Rules:</b>	As per University rules.
<p>Program Fees : (Per Semester) (One time fees and exam fees are additional as prescribed by the university) (w.e.f. Academic Year : 2026-27)</p>	<p>Semester Tuition Fees : As per norms of University Semester Laboratory Utilization fees : As per norms of University [Other one time /affiliation /exam fees, will be as per the norms of the University] [The fees for all certificate courses, Skill Enhancement Courses / Value Addition Courses; fees will be as per the prescribed limit for per credit as per the SOP of certificate courses decided by the university.]</p>
Internal Marks Distribution :	<p>For All Theory subjects ( Out of 25) : Home Assignment ( 3 marks ) + Class Assignment (3 Marks) + Attendance (4 Marks) + Internal Test (15 marks)</p> <p>For All Practical/Project subjects ( Out of 25) : Lab. work ( 3 marks ) + Lab. Journal (3 Marks) + Attendance (4 Marks) + Internal Test (15 marks)</p> <p>For All Theory subjects ( Out of 50) : Home Assignment ( 6 marks ) + Class Assignment (6 Marks) + Attendance (8 Marks) + Internal Test (30 marks)</p> <p>For All Practical/Project subjects ( Out of 50) : Lab. work ( 6 marks ) + Lab. Journal (6 Marks) + Attendance (8 Marks) + Internal Test (30 marks)</p>

**Course Code: 501**

**Course Title: Data Visualization using Tableau**

[Subject code for Theory-2611000905044005] [Subject code for Practical-2611000905044006]

Course Code	501				
Course Title	Data Visualization using Tableau				
Credits	4				
Course Category	Minor Course				
Level of Course	200-299 ( Intermediate Level )				
Teaching per Week	3 Hours Theory + 2 Hours Practical work				
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)				
Review / Revision	-				
Implementation Year:	A.Y. 2026-2027				
Purpose of Course	This course introduces students to data visualization concepts, techniques, and tools using Tableau, an industry-leading visual analytics platform. Students will learn how to convert raw data into interactive visual dashboards and stories for effective data-driven decision-making.				
Course Objective	<ol style="list-style-type: none"> <li>1. Introduce fundamentals of data visualization and visual analytics</li> <li>2. Develop skills to connect, clean, and explore data using Tableau</li> <li>3. Enable students to create interactive charts and dashboards</li> <li>4. Apply visualization techniques for analytical insights</li> <li>5. Promote effective storytelling using data</li> </ol>				
Pre-requisite	Basic knowledge of data. Fundamental knowledge of data cleaning, Familiarity with data handling concepts such as datasets, variables, and data types Introductory understanding of data analysis and visualization concepts.				
Course Outcomes	<ul style="list-style-type: none"> <li>• CO1: Explain principles and importance of data visualization</li> <li>• CO2: Connect and prepare datasets in Tableau</li> <li>• CO3: Design effective charts and visual representations</li> <li>• CO4: Create interactive dashboards and stories</li> <li>• CO5: Interpret visual insights for decision-making</li> </ul>				
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4
	CO1		-	-	-
	CO2			-	
	CO3	-			
	CO4	-			
	CO5	-	-		

Course Content	<p><b>Unit 1: Introduction to Data Visualization</b></p> <ol style="list-style-type: none"> <li>1.1 Definition and scope of data visualization</li> <li>1.2 Role of visualization in data science</li> <li>1.3 Types of data: categorical, numerical, temporal, spatial</li> <li>1.4 Visualization principles and best practices</li> <li>1.5 Human perception and visual cognition</li> <li>1.6 Introduction to Tableau and use cases</li> </ol> <p><b>Unit 2: Tableau Basics and Data Connections</b></p> <ol style="list-style-type: none"> <li>2.1 Tableau architecture and components</li> <li>2.2 Tableau Desktop interface</li> <li>2.3 Connecting to data sources (Excel, CSV, Text files, Databases)</li> <li>2.4 Live vs Extract connections</li> <li>2.5 Dimensions and Measures</li> <li>2.6 Data types and data roles</li> </ol> <p><b>Unit 3: Data Preparation and Analysis in Tableau</b></p> <ol style="list-style-type: none"> <li>3.1 Data cleaning and shaping</li> <li>3.2 Sorting, filtering, grouping, and aliasing</li> <li>3.3 Aggregation and granularity</li> <li>3.4 Calculated fields and basic functions</li> <li>3.5 Working with date and time data</li> <li>3.6 Introduction to visual analytics</li> </ol> <p><b>Unit 4: Dashboards, Interactivity, and Storytelling</b></p> <ol style="list-style-type: none"> <li>4.1 Creating charts: bar, line, pie, scatter, map, heat map</li> <li>4.2 Dashboard design principles</li> <li>4.3 Dashboard actions and parameters</li> <li>4.4 Creating stories in Tableau</li> <li>4.5 Publishing and sharing dashboards</li> <li>4.6 Best practices for professional dashboards</li> </ol>
Reference Books	<ol style="list-style-type: none"> <li>1. Practical Data Science with Tableau By Ryan Sleeper, Publisher: O'Reilly Media (First edition 2018) Ben Jones – Communicating Data with Tableau</li> <li>2. Cole Nussbaumer Knaflic – Storytelling with Data</li> <li>3. Learning Tableau 2022 By Joshua N. Milligan, Publisher: Packt Publishing (2022)</li> <li>4. Tableau Your Data! Fast and Easy Visual Analysis with Tableau Software By Daniel G. Murray, Publisher: Wiley (2013)</li> <li>5. Tableau in Action By Chris Stolte, Brian McCullough, Publisher: Manning Publications (2019)</li> <li>6. Mastering Tableau 2021.3/2022.1 By David Baldwin, Publisher: Packt Publishing (2022)</li> </ol>
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	<p>50% Internal assessment.</p> <ul style="list-style-type: none"> <li>- Attendance, Class and home Assignment, Unit tests.</li> <li>- Practical exam, viva-voce,</li> <li>- E-Journal</li> </ul> <p>50% External assessment.</p> <ul style="list-style-type: none"> <li>- Written Theory exam</li> <li>- Practical Exam, viva-voce</li> </ul>

**Course Code: 502**  
**Course Title: Concept of Big Data**  
[Subject code-2611000905055004]

<b>Course Code</b>	502																																																																						
<b>Course Title</b>	Concept of Big Data																																																																						
<b>Credits</b>	4																																																																						
<b>Course Category</b>	Minor Course (Minor-05)																																																																						
<b>Level of Course</b>	200-299 ( Intermediate Level )																																																																						
<b>Teaching per Week</b>	4 Hours Theory																																																																						
<b>Minimum weeks per Semester</b>	15 (Including class work, examination, preparation etc.)																																																																						
<b>Review / Revision</b>	-																																																																						
<b>Implementation Year:</b>	A.Y. 2026-2027																																																																						
<b>Purpose of Course</b>	<ul style="list-style-type: none"> <li>● To build foundational understanding of Big Data and its evolution from traditional data warehousing.</li> <li>● To equip learners with knowledge of architectures, ecosystem tools, and real-world applications.</li> <li>● To prepare students for analytics and computing on large-scale distributed infrastructure.</li> </ul>																																																																						
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Understand characteristics and challenges of large-scale data.</li> <li>2. Analyze limitations of earlier DBMS and Data Warehouse systems.</li> <li>3. Learn distributed storage and computing architectures.</li> <li>4. Explore Big Data ecosystem (Hadoop, Spark, NoSQL).</li> <li>5. Study industry use cases and case studies.</li> <li>6. Perform demos on publicly available Big Data infrastructure.</li> </ol>																																																																						
<b>Pre-requisite</b>	Programming, Database Systems, SQL																																																																						
<b>Course Outcomes</b>	<p><b>CO-1:</b> Explain Big Data concepts, 5Vs, and data types.</p> <p><b>CO-2:</b> Compare earlier warehouse architecture with Big Data architecture.</p> <p><b>CO-3:</b> Describe HDFS, MapReduce, and Spark processing.</p> <p><b>CO-4:</b> Select appropriate ecosystem tools for given problems.</p> <p><b>CO-5:</b> Design simple Big Data workflow and demo deployment.</p> <p><b>CO-6:</b> Evaluate case studies from health, finance, and e-commerce.</p>																																																																						
<b>Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)</b>	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th></th> <th>PSO1</th> <th>PSO2</th> <th>PSO3</th> <th>PSO4</th> <th>PSO5</th> <th>PSO6</th> <th>PSO7</th> <th>PSO8</th> </tr> </thead> <tbody> <tr> <td>CO1</td> <td></td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td></td> <td>-</td> <td>-</td> </tr> <tr> <td>CO2</td> <td></td> <td></td> <td>-</td> <td>-</td> <td></td> <td>-</td> <td>-</td> <td></td> </tr> <tr> <td>CO3</td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td>-</td> <td>-</td> <td></td> </tr> <tr> <td>CO4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td>-</td> <td></td> </tr> <tr> <td>CO5</td> <td>-</td> <td></td> <td>-</td> <td>-</td> <td></td> <td></td> <td>-</td> <td></td> </tr> <tr> <td>CO6</td> <td>-</td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>									PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	CO1		-	-	-	-		-	-	CO2			-	-		-	-		CO3			-			-	-		CO4						-	-		CO5	-		-	-			-		CO6	-	-	-					
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## Course Content

### **UNIT 1: Foundations and Evolution of Big Data**

#### 1.1 Introduction to Data

- 1.1.1 Data, information, knowledge
- 1.1.2 Structured data, Semi-structured data, Unstructured data
- 1.1.3 Transactional processing, Analytical processing, OLTP systems, OLAP systems

#### 1.2 What is Big Data and Evolution

- 1.2.1 Definition, need of Big Data and 5 Vs: Volume, Velocity, Variety, Veracity, Value
- 1.2.2 Batch analytics, Real-time analytics and Data sources
- 1.2.3 Evolution: File systems → DBMS → Data Warehouse → Big Data, OLTP vs OLAP
- 1.2.4 Star schema, Snowflake schema, ETL evolution, Data Lake concept, From warehouse to Lake house

#### 1.3 Limitations of Earlier Systems

- 1.3.1 Vertical scaling limits, Schema rigidity, ETL bottlenecks
- 1.3.2 High licensing cost, Limited concurrency
- 1.3.3 Poor unstructured support, Hardware dependency

#### 1.4 Data Warehouse Concepts And Application Overview

- 1.4.1 Data marts, ETL pipeline, Metadata repository
- 1.4.2 BI tools, Warehouse appliances
- 1.4.3 Application: Web logs, IoT sensor data, Social media data

### **UNIT 2: Big Data Architectures**

#### 2.1 Distributed Computing Basics

- 2.1.1 Scale-out, Scale-up, Shared nothing architecture
- 2.1.2 Cluster concepts, Master node, Worker node, Resource manager

#### 2.2 Hadoop Architecture

- 2.2.1 HDFS design, NameNode, DataNode, Replication
- 2.2.2 Fault tolerance, Block storage

#### 2.3 MapReduce Processing

- 2.3.1 Mapper, Reducer, Shuffle, Word count logic
- 2.3.2 Limitations of MapReduce, Disk based computing

#### 2.4 Modern Lambda / Kappa

- 2.4.1 Batch layer, Speed layer, Serving layer
- 2.4.2 Kappa idea, unified pipeline

#### 2.5 Storage Models

- 2.5.1 Columnar storage, Data lake, Object storage
- 2.5.2 Distributed file system, Parquet/ORC

### **UNIT 3: Big Data Ecosystem**

#### 3.1 Hadoop Ecosystem

- 3.1.1 YARN, Hive, Pig, Sqoop, Flume, Oozie
- 3.1.2 Hadoop services, workflow scheduling

#### 3.2 Apache Spark

- 3.2.1 RDD, DataFrame, DAG, In-memory computing
- 3.2.2 Spark vs MapReduce, transformations/actions

#### 3.3 NoSQL Databases

- 3.3.1 CAP theorem, BASE vs ACID, Key-value model
- 3.3.2 Column model, Document model, Graph model

#### 3.4 Streaming Tools

- 3.4.1 Kafka, Spark Streaming
- 3.4.2 Flink introduction, real time ingestion

#### 3.5 Cloud Big Data Services

- 3.5.1 AWS EMR, Google Dataproc
- 3.5.2 Azure HDInsight, Databricks, cloud clusters

### **UNIT 4: Applications, Case Studies and Infrastructure Demos**

#### 4.1 Use Cases by Domain

- 4.1.1 Healthcare literature analytics, FinTech fraud detection, E-commerce recommendation, Smart city IoT

#### 4.2 Case Study

	<p>4.2.1 Case Study-1 : Netflix/Amazon  4.2.1.1 Clickstream pipeline, real-time personalization, Recommendation architecture, streaming + batch</p> <p>4.2.2 Case Study-2 : Covid-19 Literature QA  4.2.2.1 COR-19 dataset structure, Hybrid search, analytics need, earlier warehouse limitation, distributed IR</p> <p>4.3 Popular Infrastructure Demos  4.3.1 Google Colab processing, Kaggle BigQuery public dataset  4.3.2 AWS EMR lab walkthrough, Databricks community edition, Cloud infra overview</p>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Tom White – Hadoop: The Definitive Guide, O’Reilly (Core Hadoop Architecture).</li> <li>2. Seema Acharya, Subhashini Chellappan – Big Data and Analytics, Wiley.</li> <li>3. Judith Hurwitz – Big Data for Dummies, John Wiley.</li> <li>4. Eric Sammer – Hadoop Operations, O’Reilly.</li> <li>5. Bill Inmon – Building the Data Warehouse, Wiley (Evolution background).</li> <li>6. Holden Karau – Learning Spark, O’Reilly.</li> </ol>
<b>Teaching Methodology</b>	Class Work, Discussion, Self-Study, Seminars and/or Assignments
<b>Evaluation Method</b>	<p>50% Internal assessment.  Class attendance, class assignment, home assignment, Unit Tests.</p> <p>50% External assessment.  Theory/Written examination</p>

**Course Code: 503**

**Course Title: Machine Learning Algorithms**

<b>Course Code</b>	503																																													
<b>Course Title</b>	Machine Learning Algorithms																																													
<b>Credits</b>	4																																													
<b>Course Category</b>	Major Course																																													
<b>Level of Course</b>	400-499 (Advance Level)																																													
<b>Teaching per Week</b>	2 Hours Theory + 4 Hours Practical/Project work																																													
<b>Minimum weeks per Semester</b>	15 (Including class work, examination, preparation etc.)																																													
<b>Review / Revision</b>	-																																													
<b>Implementation Year:</b>	A.Y. 2026-2027																																													
<b>Purpose of Course</b>	The purpose of this course is to introduce Machine Learning and its various applications. Students will gain knowledge of algorithms and techniques used in ML. Course covers supervised and unsupervised learning models. Students will also explore challenges associated with ML																																													
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Understand the concepts of various types Machine Learning algorithms and their applications.</li> <li>2. To provide hands-on experience in implementing ML models.</li> <li>3. Able to understand challenges and limitations of developing ML models.</li> <li>4. To develop problem solving skills for ML models.</li> <li>5. To compare different ML algorithms to evaluation of best fit models.</li> </ol>																																													
<b>Pre-requisite</b>	Knowledge of Python programming. Fundamental concepts of Machine Learning Fundamental knowledge of statistics, including mean, median, probability, and correlation. Basic understanding of data analysis.																																													
<b>Course Outcomes</b>	<b>CO1:</b> Apply supervised and unsupervised learning techniques. <b>CO2:</b> Understand and implement supervised learning <b>CO3:</b> Implement unsupervised learning algorithms like Clustering and Association Rule Mining. <b>CO4:</b> Understand the use cases and their relevance in the field of ML																																													
<b>Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)</b>	<table border="1"> <thead> <tr> <th></th> <th>PSO1</th> <th>PSO2</th> <th>PSO3</th> <th>PSO4</th> <th>PSO5</th> <th>PSO6</th> <th>PSO7</th> <th>PSO8</th> </tr> </thead> <tbody> <tr> <td>CO1</td> <td></td> <td></td> <td>-</td> <td>-</td> <td>-</td> <td></td> <td>-</td> <td>-</td> </tr> <tr> <td>CO2</td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td>-</td> <td>-</td> </tr> <tr> <td>CO3</td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td>-</td> </tr> <tr> <td>CO4</td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td> </tr> </tbody> </table>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	CO1			-	-	-		-	-	CO2					-		-	-	CO3					-			-	CO4	-							-
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## Course Content

### **Unit 1: Supervised Learning: Decision Tree**

- 1.1. Introduction to Supervised Learning.
  - 1.1.1 Concept of Supervised Learning
  - 1.1.2 Classification vs Regression
  - 1.1.3 Features and Labels
  - 1.1.4 Training Set vs Test Set
- 1.2 Fundamentals of Decision Tree Learning
  - 1.2.1 Introduction to Decision Tree
  - 1.2.2 Working of Decision Tree
  - 1.2.3 Decision Tree Algorithms (ID3,C4.5, CART)
  - 1.2.4 Attribute selection Methods  
(Entropy, Gini Impurity and Information Gain)
  - 1.2.5 Searching for simple trees and computational complexity.
  - 1.2.6 Overfitting and Underfitting
  - 1.2.7 Tree Pruning Techniques( Pre-Pruning, Post-Pruning)
- 1.3 Model Evaluation Techniques
  - 1.3.1 Train–Test Split
  - 1.3.2 Cross-Validation
  - 1.3.3 Learning Curves
  - 1.3.4 Confusion Matrix
  - 1.3.3 Evaluation Metrics (Accuracy, Precision, Recall, F1-Score)

### **Unit 2: Supervised Learning :SVM**

- 2.1 Introduction to Support Vector Machine
- 2.2 Types of SVM
- 2.3 Linear SVM
  - 2.3.1 Hard Margin vs. Soft Margin
  - 2.3.2 Cost Parameter
  - 2.3.3 Optimization and Optimization Constraints
- 2.4 Non-Linear SVM
  - 2.4.1 Kernels and its type(Linear, Polynomial, Gaussian)
  - 2.4.2 Mapping Data
- 2.5 Model Implementation
  - 2.5.1 Kernel selection
  - 2.5.2 Handling overfitting
  - 2.5.3 sklearn.svm implementation
- 2.6 Applications and Model Evaluation
  - 2.6.1 Evaluation Metrics: Accuracy, Recall, Confusion Matrix
  - 2.6.2 Use Case: Fraud Detection

### **Unit 3: Unsupervised Learning : Clustering**

- 3.1 Introduction to Unsupervised Machine Learning.
  - 3.1.1 Concept, differences from supervised learning, and applications.
- 3.2 Introduction to Clustering and its type.
- 3.3 K-Mean Clustering
  - 3.3.1 Introduction to K-Mean Clustering and its use.
  - 3.3.2 Convergence, initialization
  - 3.3.3 Selection of Elbow method
- 3.4 Hierarchical Clustering
  - 3.4.1 Introduction to Hierarchical Clustering and its use
  - 3.4.2 Agglomerative Clustering Approach
  - 3.4.3 Dendrograms
  - 3.4.4 Agglomerative approach VS Dendrograms
- 3.5 Cluster Evaluation and Implementation
  - 3.5.1 Visualization of clusters
  - 3.5.2 Evaluation Metrics: Silhouette score, Davies-Bouldin index

### **Unit 4: Unsupervised Learning: Association Rule Mining and Pattern Discovery**

- 4.1 Introduction to Association Rule Mining and its application area
  - 4.1.1 Concepts of Itemsets, Transactions and Antecedent and Consequent
- 4.2 Introduction to Apriori Algorithm
  - 4.2.1 Discovering frequent itemsets
  - 4.2.2 Association Rule Generation.

	<p>4.3 Applications and Evaluation</p> <p>4.3.1 Case Studies: Market Basket Analysis, Recommendation System</p> <p>4.3.2 Evaluation Metrics(Support, Confidence, lift)</p>
<b>Reference Books</b>	<p>1. Introduction to Machine Learning, Ethem Alpaydin, PHI Learning (India Edition), ISBN: 9788120350780</p> <p>2. Artificial Intelligence and Machine Learning, Prateek Joshi, BPB Publications (India), ISBN: 9789386551934</p> <p>3. Machine Learning with Python, Abhishek Vijayvargia, BPB Publications (India), ISBN: 9789387284497</p> <p>4. Machine Learning using Python, Manaranjan Pradhan &amp; U Dinesh Kumar, Wiley India, ISBN: 9788126579901</p> <p>5. Hands-On Machine Learning with Scikit-Learn, Keras &amp; TensorFlow, Aurélien Géron, O'Reilly Media, ISBN: 9789355423317</p> <p>6. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, ISBN: 9780387310732</p> <p>7. Machine Learning for Decision Sciences with Case Studies in Python, S. Sumathi, Suresh V. Rajappa, CRC Press, Taylor and Francis, 1st Edition</p>
<b>Teaching Methodology</b>	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
<b>Evaluation Method</b>	<p>50% Internal assessment. : - Attendance, Class and home Assignment, Unit tests. - Project demonstration/presentation, viva-voce</p> <p>50% External assessment. : - Theory/Written examination - Project demonstration/presentation, viva-voce</p>

**Course Code: 504**  
**Course Title: Business Analytics**

[Subject code for Theory-2611000905022007] [Subject code for Practical-2611000905022008]

<b>Course Code</b>	504
<b>Course Title</b>	Business Analytics
<b>Credits</b>	4
<b>Course Category</b>	Major Course
<b>Level of Course</b>	400-499 ( Advance Level )
<b>Teaching per Week</b>	2 Hours Theory + 4 Hours Practical work
<b>Minimum weeks per Semester</b>	15 (Including class work, examination, preparation etc.)
<b>Review / Revision</b>	-
<b>Implementation Year:</b>	A.Y. 2026-2027
<b>Purpose of Course</b>	The purpose of this course is to introduce Data Science students to the fundamentals of Business Analytics and its role in data-driven decision-making. The course covers the analytics lifecycle, data preprocessing, visualization, predictive modeling, and prescriptive techniques to help students analyze business data effectively. By integrating real-world applications and case studies, the course enables students to convert data into actionable insights and support strategic business decisions.
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Understand the concepts, types, and lifecycle of Business Analytics in organizational decision-making.</li> <li>2. Collect, pre-process, and manage business data from different sources.</li> <li>3. Apply descriptive analytics techniques for data summarization, visualization, and reporting.</li> <li>4. Use predictive analytics methods such as regression, classification, and time series forecasting.</li> <li>5. Evaluate analytical models and interpret results for business insights.</li> <li>6. Apply prescriptive analytics techniques and case studies to recommend optimal, data-driven business decisions.</li> </ol>
<b>Pre-requisite</b>	<p>Basic knowledge of Python programming.</p> <p>Fundamental knowledge of statistics, including mean, median, probability, and correlation.</p> <p>Familiarity with data handling concepts such as datasets, variables, and data types</p> <p>Introductory understanding of data analysis and visualization concepts.</p>
<b>Course Outcomes</b>	<p><b>CO1:</b> Explain concepts and importance of Business Analytics</p> <p><b>CO2:</b> Apply descriptive and predictive analytics techniques</p> <p><b>CO3:</b> Analyze business data using analytical tools</p> <p><b>CO4:</b> Evaluate analytics results for managerial decision-making</p>

**Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1			-	-	-		-	-
CO2					-		-	-
CO3					-			-
CO4	-							-

**Course Content**

**UNIT 1: Introduction to Business Analytics**

- 1.1 Business Analytics Fundamentals
  - 1.1.1 Definition and overview of Business Analytics
  - 1.1.2 Importance of Business Analytics in modern organizations
- 1.2 Types of Analytics
  - 1.2.1 Descriptive Analytics
  - 1.2.2 Predictive Analytics
  - 1.2.3 Prescriptive Analytics
- 1.3 Analytics Lifecycle
  - 1.3.1 Problem identification and business understanding
  - 1.3.2 Data collection and data preparation
  - 1.3.3 Data analysis and model building
  - 1.3.4 Interpretation, deployment, and monitoring
- 1.4 Role of Data in Business
  - 1.4.1 Data as a strategic business asset
  - 1.4.2 Data-driven decision-making
  - 1.4.3 Business value creation through analytics

**UNIT 2: Descriptive Analytics**

- 2.1 Data Types and Sources
  - 2.1.1 Types of data: structured, semi-structured, and unstructured
  - 2.1.2 Internal and external data sources
- 2.2 Data Pre-processing
  - 2.2.1 Data cleaning and handling missing values
  - 2.2.2 Data transformation and normalization techniques
- 2.3 Data Visualization Techniques
  - 2.3.1 Graphical representation of data
  - 2.3.2 Exploratory data analysis using visualization
- 2.4 Dashboards and Reporting
  - 2.4.1 Dashboard components and design principles
  - 2.4.2 Business reporting and performance measurement

**UNIT 3: Predictive Analytics**

- 3.1 Introduction to Predictive Analytics
  - 3.1.1 Predictive analytics concepts and objectives
  - 3.1.2 Business use cases of predictive analytics
- 3.2 Regression Analysis
  - 3.2.1 Simple and multiple regression
  - 3.2.2 Business applications of regression models
- 3.3 Classification Techniques
  - 3.3.1 Classification concepts and methods
  - 3.3.2 Applications of classification in business
- 3.4 Introduction to Time Series Forecasting
- 3.5 Model Evaluation
  - 3.5.1 Model performance metrics
  - 3.5.2 Model validation and result interpretation

	<p><b>UNIT 4: Prescriptive Analytics &amp; Applications</b></p> <p>4.1 Introduction to Prescriptive Analytics</p> <p>4.1.1 Concept and importance of prescriptive analytics</p> <p>4.1.2 Comparison of predictive and prescriptive analytics</p> <p>4.2 Optimization Techniques</p> <p>4.2.1 Optimization models for decision-making</p> <p>4.2.2 Business optimization scenarios</p> <p>4.3 Decision Trees</p> <p>4.3.1 Structure and working of decision trees</p> <p>4.3.2 Decision tree applications in business</p> <p>4.4 Business Analytics Applications</p> <p>4.4.1 Applications in marketing, finance, and operations</p> <p>4.5 Case Studies</p> <p>4.5.1 Real-world business case analysis</p> <p>4.5.2 Data-driven solution development</p>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Business Analytics (Methods, Models, and Decisions) – James R. Evans, Pearson Education</li> <li>2. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking – Foster Provost, Tom Fawcett, O'Reilly Media, Inc.</li> <li>3. Python for Data Analysis – Wes McKinney, O'Reilly Media</li> <li>4. Data Analytics – Anil Maheshwari, McGraw Hill Education (India)</li> <li>5. Business Analytics: Data Analysis &amp; Decision Making S. Christian Albright, Wayne L. Winston – Cengage</li> <li>6. Business Analytics: Methods, Models, and Decisions James R. Evans – Pearson</li> <li>7. Analytics at Work: Smarter Decisions, Better Results Thomas H. Davenport, Jeanne G. Harris – Harvard Business Press</li> </ol>
<b>Teaching Methodology</b>	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
<b>Evaluation Method</b>	<p>50% Internal assessment.</p> <p>Class attendance, class assignment, home assignment, Unit Tests.</p> <p>50% External assessment.</p> <p>Theory/Written examination, Practical Exam</p>

**Course Code: 505****Course Title: Deep Learning**

<b>Course Code</b>	505								
<b>Course Title</b>	Deep Learning (Major-13)								
<b>Credits</b>	4								
<b>Course Category</b>	Major Course								
<b>Level of Course</b>	400-499 ( Advance Level )								
<b>Teaching Hours</b>	90 Hrs. ( 30 Hours Theory + 60 Hours Applied/Practical work )								
<b>Minimum weeks per Semester</b>	15 (Including class work, examination, preparation etc.)								
<b>Review / Revision</b>	-								
<b>Implementation Year:</b>	A.Y. 2026-2027								
<b>Purpose of Course</b>	The purpose of this course is to provide students with a strong conceptual foundation and practical understanding of Deep Learning techniques used in modern data-driven applications. The course enables learners to understand how neural networks learn from data, optimize performance, and solve real-world problems involving structured data and images using industry-standard tools.								
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Understand the fundamental concepts and evolution of Deep Learning and its role in Data Science.</li> <li>2. Explain the working of biological and artificial neurons, perceptrons, and neural network architectures.</li> <li>3. Design and train Multilayer Perceptron (MLP) models using forward and backpropagation.</li> <li>4. Apply optimization and regularization techniques to improve model performance and stability.</li> <li>5. Use modern Deep Learning frameworks and GPU platforms to implement practical solutions.</li> </ol>								
<b>Pre-requisite</b>	Basic of Python Programming and Machine learning, Linear Algebra								
<b>Course Outcomes</b>	<p>CO1: Explain core concepts of Deep Learning and distinguish between AI, Machine Learning, and Deep Learning.</p> <p>CO2: Describe the structure and working of biological and artificial neurons and analyze perceptron learning and its limitations.</p> <p>CO3: Design and implement Multilayer Perceptron models and explain forward and backpropagation mechanisms.</p> <p>CO4: Apply optimization, regularization, and hyperparameter tuning techniques to improve neural network performance. Build, train, and evaluate Convolutional Neural Networks for image classification and data augmentation tasks.</p> <p>CO5:</p>								
<b>Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)</b>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								

**UNIT–1: Introduction to Deep Learning & Neural Networks**

1.1 Introduction to Deep Learning

- 1.1.1 What is Deep Learning?
- 1.1.2 Differences between AI, Machine Learning, and Deep Learning
- 1.1.3 Role of Deep Learning in Data Science
- 1.1.4 Applications of Deep Learning in Data Science

1.2 Artificial Neurons

- 1.2.1 Neuron and its role in information processing.
- 1.2.2 Artificial Neuron (Mathematical) Model
- 1.2.3 Neural networks as directed graphs
- 1.2.4 Feedback and feedforward networks

1.3 Perceptron Model

- 1.3.1 Definition of Perceptron & Rosenblatt's Perceptron
- 1.3.2 Working of single-layer perceptron: Input, Weights, Bias, Weighted Sum, Activation
- 1.3.3 Perceptron loss function
- 1.3.4 Perceptron Learning Rule

1.4 Deep Learning Ecosystem : Library & Tools

- 1.4.1 Introduction of Deep Learning Library: Keras, Tensorflow and PyTorch
- 1.4.2 CPU Vs GPU
- 1.4.4 Cloud Based GPU Platform : Google Colab , Kaggle Notebook (Introduction)

**UNIT–2: Multilayer Perceptron & Training Process**

2.1 Multilayer Perceptron (MLP)

- 2.1.1 Need for multilayer networks with Limitation
- 2.1.2 MLP Terminology : Neurons, layers, parameters, hyperparameters, epoch, batch size, iteration
- 2.1.3 MLP architecture and notation
  - 2.1.3.1 Input layer, hidden layer(s), and output layer
  - 2.1.3.2 Fully connected (dense) neural networks
  - 2.1.3.3 Depth vs width of a network
- 2.1.4 Components of an MLP
  - 2.1.4.1 Weight & Bias in Multilayer Networks
  - 2.1.4.2 Activation Function Across Layers
  - 2.1.4.3 Flow of Information from Input to Output

2.2 Forward propagation in MLP

- 2.2.1 Concept of Forward Propagation
  - 2.2.1.1 Definition and intuition
  - 2.2.1.2 Layer Wise Computation
  - 2.2.1.3 Role of Weight & Bias
- 2.2.2 Output Computation
  - 2.2.2.1 Linear combination (weighted sum)
  - 2.2.2.2 Applying activation functions
  - 2.2.2.3 Producing final network output

2.3 Loss Functions & Activation Functions

- 2.3.1 Difference between Loss & Accuracy
- 2.3.2 Loss functions: MSE, Binary Cross Entropy, Categorical Cross Entropy
- 2.3.3 Activation functions: Sigmoid, Tanh, ReLU

## 2.4 Backpropagation & Learning Process

- 2.4.1 Concept of Backpropagation: Error Correction, Forward Pass , Backward Pass
- 2.4.2 Batch, stochastic, and mini-batch learning

### **UNIT–3: Optimization & Regularization Techniques**

#### 3.1 Gradient Descent Optimization

- 3.1.1 Gradient descent overview
- 3.1.2 Batch gradient descent
- 3.1.3 Stochastic gradient descent
- 3.1.4 Mini-batch gradient descent
- 3.1.5 Learning rate selection

#### 3.2 Optimizers (Concept only)

- 3.2.1 Need for optimizers
- 3.2.2 Momentum-based optimization
- 3.2.3 RMSProp optimizer
- 3.2.4 Adam optimizer

#### 3.3 Regularization Techniques

- 3.4.1 Need for regularization
- 3.4.2 L1 regularization
- 3.4.3 L2 regularization

### **UNIT–4: Convolutional & Recurrent Neural Networks**

#### 4.1 Convolutional Neural Networks (CNN)

- 4.1.1 Key components of CNN
- 4.1.2 Working of CNN
- 4.1.3 Difference between ANN and CNN

#### 4.2 Convolution Operation

- 4.2.1 Digital image representation
- 4.2.2 Filters and kernels
- 4.2.3 Feature extraction using convolution
- 4.2.4 Padding & Stride

#### 4.3 Pooling Layers

- 4.3.1 Need for pooling
- 4.3.2 Max pooling
- 4.3.3 Average pooling

#### 4.4 CNN Architecture

- 4.4.1 Convolution layer
- 4.4.2 Pooling layer
- 4.4.3 Flattening layer
- 4.4.4 Fully connected layer
- 4.4.5 Output layer

#### 4.5 Training and CNN Applications

- 4.5.1 Training process of CNN
- 4.5.2 Image classification using CNN
- 4.5.3 Data augmentation

<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", by Nithin Buduma, Nikhil Buduma, and Joe Papa ISBN-13: 978-1492082187.</li> <li>2. "DEEP LEARNING" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville. ISBN-10. 0262035618.</li> <li>3. "Deep Learning with Python, Second Edition" by François Chollet. ISBN-10. 1617296864</li> <li>4. "Deep Learning with Python: A Hands-on Introduction" by Nitin Ketkar. ISBN-10. 1484240219</li> <li>5. "Deep Learning for Beginners" by Dr. Pablo Rivas. ISBN-13. 9781838640859</li> <li>6. "Deep Learning from Scratch: Building with Python from First Principles" by Seth Weidman ISBN-9781492041382</li> </ol>
<b>Teaching Methodology</b>	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments, Project development, Application Development
<b>Evaluation Method</b>	<p>50% Internal assessment. :</p> <ul style="list-style-type: none"> <li>- Attendance, Class and home Assignment,</li> <li>- Practical/Applied work, Practical journal, Unit test and viva-voce</li> </ul> <p>50% External assessment :</p> <ul style="list-style-type: none"> <li>- Theory/Written examination</li> <li>- Practical examination, viva-voce</li> </ul>

**Course code: 506**  
**Course Title: Ethics of Data Science (SEC-05)**

[Subject code-2611000905066002]

<b>Course Code</b>	506				
<b>Course Title</b>	Ethics of Data Science				
<b>Credit</b>	2				
<b>Category of Course</b>	Skill Enhancement Course				
<b>Level of Course</b>	200-299 ( Intermediate )				
<b>Teaching per Week</b>	2 Hrs per week				
<b>Minimum weeks per Semester</b>	15 (Including class work, examination, preparation etc.)				
<b>Review / Revision</b>	-				
<b>Implementation Year:</b>	A.Y. 2026-2027				
<b>Purpose of Course</b>	<ul style="list-style-type: none"> <li>- As per NEP(National Education Policy-2020), it is mandatory for students to obtain 2 credit for Skill Enhancement Courses given by the university curriculum.</li> <li>- The student can start an alternative career in the field by obtaining higher degree of knowledge in the area.</li> </ul>				
<b>Course Objective</b>	Obtaining skill in particular field along with the regular curriculum of the selected program is essential. It not only enhance the skill but also provide an opportunity to develop skill in particular area where one can pursue career in future. Skill enhancement provides the opportunity and knowledge for an individual to develop and strengthen the necessary skills to gain, maintain, and advance in a chosen area.				
<b>Pre-requisite</b>	Fundamental knowledge of Data Science				
<b>Course Outcomes</b>	<p>CO1: To evaluate the ethical implications of data collection and usage on society.</p> <p>CO2: To Identify and correct bias in algorithms to promote fairness.</p> <p>CO3: To understand the legal and moral obligations regarding data.</p> <p>CO4: To understand security and privacy issues in the field of Data Science.</p>				
<b>Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)</b>		PSO1	PSO2	PSO3	PSO4
	CO1		-	-	-
	CO2			-	
	CO3	-			
	CO4	-			

<p><b>Course Content</b></p>	<p>Unit 1: Data Ethics Foundations</p> <ol style="list-style-type: none"> <li>1.1. Introduction to ethics in data science</li> <li>1.2. Moral principles and ethical frameworks</li> <li>1.3. Ethical issues in data collection and analysis</li> <li>1.3 Responsible use of data</li> <li>1.4 Bias and fairness in algorithms</li> <li>1.5 Role of data scientists in society</li> <li>1.6 Case studies of data misuse and ethical failure</li> </ol> <p>Unit 2: Data Security and Privacy</p> <ol style="list-style-type: none"> <li>2.1 Importance of data security in data science</li> <li>2.2 Types of data breaches</li> <li>2.3 Data privacy principles</li> <li>2.4 Data protection techniques (basic idea) <ol style="list-style-type: none"> <li>2.4.1 Methods to detect, measure, and mitigate bias.</li> </ol> </li> <li>2.5 Data Privacy Regulations (GDPR, Indian Data Protection Act)</li> <li>2.6 Secure handling of sensitive data</li> </ol> <p>Unit 3: Social Impact and Accountability</p> <ol style="list-style-type: none"> <li>3.1 Impact of big data on society</li> <li>3.2 Addressing societal consequences</li> <li>3.3 Algorithmic colonialism</li> <li>3.4 Interpreting model outcomes</li> <li>3.5 Accountability in automated decision-making</li> </ol> <p>Unit 4: Case Studies</p> <ol style="list-style-type: none"> <li>4.1 Analyzing real-world examples such as Facebook’s data Controversies.</li> <li>4.2 A Toolkit for Auditing Bias and Fairness in Machine Learning Models</li> </ol>
<p><b>Reference Books</b></p>	<ol style="list-style-type: none"> <li>1. Ian Foster, Rayid Ghani, Ron S. Jarmin, Frauke Kreuter, Julia Lane, Big Data and Social Science: Data Science Methods and Tools for Research and Practice, Chapman and Hall/CRC, 2nd Edition, 2020.</li> <li>2. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O’Reilly Media., “Doing Good Data Science”</li> </ol>
<p><b>Teaching Methodology</b></p>	<p>Class Work/ Discussion/ Self-Study/ Seminars/ field works/ practical training/ field work and/or Assignments.</p>
<p><b>Evaluation Method</b></p>	<p>50% Internal assessment.</p> <ul style="list-style-type: none"> <li>- Attendance, Class and home Assignment, Unit Tests (Seminar).</li> <li>- Internal presentations, documentation, viva-voce and Seminar</li> </ul> <p>50% External assessment.</p> <ul style="list-style-type: none"> <li>- Documentation, presentation and Viva-voce .</li> </ul>

<b>Evaluation Method</b>	50% Internal assessment. 50% External assessment. (Evaluation and Assessment will be carried out based on the nature of the course. On successful completion of the course, the student will be granted 2 credits.)
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### University Examinations

Course Code	Course	Exam Component	Max. Marks	Duration
501 (Minor-4)	Data Visualization using Tableau	Theory	25	1 Hours
		Practical	25	2 Hours
502 (Minor-5)	Concepts of Big Data	Theory	50	2 Hours
503 (Major-11)	Machine Learning Algorithms	Theory	25	1 Hours
		Project Presentation	25	-
504 (Major-12)	Business Analytics	Theory	25	1 Hours
		Practical	25	-
505 (Major-13)	Deep Learning	Theory	25	1 Hours
		Practical	25	2 Hours
506 (SEC-05)	Skill Enhancement Course Ethics of Data Science	Theory/Practical	25	Evaluation and Assessment will be carried out based on university guideline.

**Internship:** Student willing to exit the program at the end of the two semesters and to avail the Certificate in Computer Application or exit the program at the end of the first four semesters and to avail the Diploma in Computer Application, it is essential to acquire four credits from internship. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning. In option to these internships, the student can avail such four credits by availing two 2-credit university approved courses during any of these semesters. The student is required to enroll and avail these 4-credits and produce the evidence in process to opt the multi-level exit option after successfully completion of first year ( two semester ) or second year(four semesters).

## SEMESTER – 6

Cours Code	Course Title	Course Category	Level of Course	Course Credits	Teaching per week	
					Theory	Practical/ Fieldwork/ Project/ Internship
601 (Minor-6)	Concepts of A.I. and IoT Devices	Minor Course	200-299 Intermediate level	4	4	0
602 (Major-14)	Cloud Analytics & Security	Major Course	400-499 Advanced Courses	4	4	0
603 (Major-15)	Time Series Analysis and Forecasting (minor Project)	Major Course	400-499 Advanced Courses	4	2	4
604 (Major-16)	Project	Major Course	400-499 Advanced Courses	4	0	8
605	Project and Interview Presentation Soft Skills [Ability Enhancement Course] (AEC)	AEC	100-199 Foundation Course	2	0	2
606	INTERNSHIP	Internship	400-499 Advanced Course	4	-	120 hours of Supervised Applied work
Other Activities	The student is expected to participate in activities related to National Service Scheme (NSS), National Cadet Corps (NCC), adult education/literacy initiatives, mentoring school students, Elderly literacy program / Environment preservation activities and other similar activities.			-	-	-
<b>Total</b>				<b>22</b>	<b>10</b>	<b>14</b>

Course Code	Course Title	Course Credit	University Exam Type	Exam Duration	External Marks	Internal Marks	Total Marks
601 (Minor-6)	Concepts of A.I. and IoT Devices	4	Theory/ Written :	2 Hours	50	50	100
602 (Major-14)	Cloud Analytics & Security	4	Theory/Written:	2 Hours	50	50	100
603 (Major-15)	Time Series Analysis and Forecasting (minor Project)	4	Theory/ Written : Practical/Project :	1 Hours 2 Hours	25 25	25 25	100
604 (Major-16)	Project (Major-16) **	4	Project	4 Hours (In-house) + 4 Hours (External Project work)	50	50	100
605	Project and Interview Presentation Soft Skills [Ability Enhancement Course] (AEC)	2	Presentation / Seminar:	-	25	25	50
606	Internship	4	Internship Report presentation	-	50	50	100
Total		22			275	275	550

#### For Practical and Project:

- Batch Size – 40 Maximum (Desirable). Maximum 45 students can be accommodated in a batch. Separate batch should be considered if the student strength exceed 45 numbers.
- Practical includes Practical sessions for course-603. **Minimum** 60 hours of Practical/Project hours for course-603 should be allocated per batch. Out of which 30 hours will be in supervised mode and balance hours in un-supervised mode.
- Students will create an application (in-house project) for course 603 as project. Their /project assessment will be based on the mini-project(application) developed for the concerned courses 603 in terms of demonstration, presentation and viva-voce. E-project report should be prepared by the students which must be certified by the concerned faculty and by the Head of the Department, failing which the student should not be allowed to appear for External Practical/project Examination. Student will submit softcopy of Minor Project duly certified by the internal guide.

**Major Course :** Major discipline is the main focus (Core) dominant subject and the degree will be awarded in that discipline. Students must secure a prescribed number of credits (50% of total credits) through core courses in the major discipline. Students can choose the courses from the pool of courses. The number of courses (subjects) in Major may vary from semester to semester.

**Minor Course :** Minor discipline is the broader understanding course beyond the major discipline course. It contains generic-electives for students to choose from the pool of courses. It helps students to gain broader knowledge in addition to relevant major disciplines courses as per their choices. Minor subjects may be from same or different disciplines. Student may make choices according to their interest/need, from ODL courses also.

**Internship:** A student who wish to exit after successfully completion of first year (Semester-1 and Semester-2) without any backlog is required to obtain Four credits at the end of the year either through the summer internship or university approved skill based certificate courses(two courses of 2-credits each or one 4-credit course). Student is required to enrol for the certificate courses separately by paying the course fees as decided by the college/institute. For summer training, the Institute/college will grant the permission and evaluate the training outcomes. Based on satisfactory completion of the summer training, the Institute head will recommend to the university to grant four credits for summer training. The Internship/summer training/skill based certificate courses will be an audit course.[The internship cost/fees will be bear by the student.]

**Ability Enhancement Course (AEC):** To be offered to students to achieve competency in a Modern Indian Language and English Language focused on language and communication skills. It may be a major specific course. The Credit allocated

for these courses is 10 credits of total credits for 3 years' bachelor's degree and four years' bachelor's degree programme. The courses can be selected by the college/institute from available basket of approved 2-credit certificate courses provided by the university.

**Skill Enhancement Course :** As per NEP(National Education Policy-2020), it is mandatory for students to select a 2 credit skill enhancement course out of the choices given by the college/institute (From available basket of courses as per University norms). It will be mandatory for the student to opt minimum one 2-credit Skill enhancement course out of offered courses recognised by University during semester-1 to semester-5.

(The student need to enrol separately and pay the fees as decided by the respective institute/department)

**# Marks: :** The students will enrol for the course from the given university approved list of certificate courses offered by the respective college/department. The student will select and enrol separately for any of the offered list of courses at college/department/institute and obtain respective credits. The institute will evaluate the performance (preferably continuous evolution) as per the SOP of certificate courses and on successfully completion of the course, the student will be eligible to obtain respective credits for the course. These credits will be considered and reflect in student's mark-sheet as well as in ABC(Academic Bank of Credit). These courses are mandatory and student is required to obtain the specified credits in process to acquire the certificate/diploma/degree.

[The student is required to pay separately for these courses as prescribed by the college. The college will decide the fees for these courses based on the University norms/SOP for certificate course/credit fees.]

**\*\* Major Applied Subjects:** Course 603 is major course consists of two components: Theory and Practical/Project. These courses are carrying 4 credits.

Course 602 is major courses consists of one component: Theory. This course is carrying 4 credits.

For Course 603: 30 hours of Theory and 60 hours of practical work per semester are allocated.

Major courses 603 carry 100 marks of exam weightage (50 theory and 50 project/practical). External and Internal distribution of marks are in ratio of 50:50 respectively. Students are required to acquire minimum passing marks from theory and practical collectively.

Project viva-voce for course-603 will be conducted.

External Theory and Practical/Project exam marks (25 marks for course-603)

Division of marks for External Project course-603:

Course 604: Major Project having 4 credits and students undergo full time projects of two months duration.

Project Demonstration and presentation evaluation: 20 marks + Viva-voce: 5 Marks.

Internal and External Major-Project Presentation (Course-604) : 50 Marks (Presentation/Code explanation/project Demonstration)

Project Demonstration and presentation evaluation: 35 marks + Viva-voce: 10 Marks + Project E-Documentation : 5 Marks

Students are required to pass in both components (Theory and Practical/Project) collectively for course 602 as combined head (Theory + Practical) for each major course. It is mandatory for Students to appear for internal and external theory and practical exams for all courses. Similarly, In case, a student remains absent in any of the component of Theory or Practical of particular major subject, the student will be considered fail for that particular major subject.

[It is recommended to complete the theory exams of 601 to 603 between 10<sup>th</sup> and 15<sup>th</sup> of February. (Between 10<sup>th</sup> and 15<sup>th</sup> August for Winter session)].

Program Passing Rules:	As per University rules.
Program Fees : (Per Semester) (One time fees and exam fees are additional as prescribed by the university) (w.e.f. Academic Year : 2026-27)	Semester Tuition Fees : As per the norms of University Semester Laboratory Utilization fees : As per norms of University [Other one time /affiliation /exam fees, will be as per the norms of the University] [For all certificate course fees, Skill Enhancement Courses and Value Addition Courses fees will be as per the prescribed limit for per credit as per the SOP of certificate courses decided by the university.]

[Subject code of Theory-2711000906044004]

[Subject code for Practical-2711000906044005]

**Course Code: 601**

**Course Title: Concepts of A.I. and IoT Devices**

<b>Course Code</b>	601								
<b>Course Title</b>	<b>Concepts of A.I. and IoT Devices (Minor-6)</b>								
<b>Credits</b>	4								
<b>Course Category</b>	Minor Course								
<b>Level of Course</b>	200-299 ( Intermediate Level )								
<b>Teaching Hours</b>	60 Hours								
<b>Minimum Hours/ Semester</b>	60 hours of Theory (Including class work, examination, preparation etc.)								
<b>Review / Revision</b>	-								
<b>Implementation Year:</b>	A.Y. 2026-2027								
<b>Purpose of Course</b>	The purpose of this course is to provide students with a foundational understanding of Artificial Intelligence (AI) and the role of Internet of Things (IoT) devices in enabling AI applications. It aims to introduce key concepts, tools, and real-life integrations of AI and IoT, preparing students for further learning or project-based exploration in this emerging interdisciplinary field.								
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1) To introduce the basic concepts and history of Artificial Intelligence (AI).</li> <li>2) To explain key AI techniques such as search algorithms, machine learning, and expert systems.</li> <li>3) To familiarize students with IoT devices and their architecture.</li> <li>4) To explore how IoT devices collect and transmit data for AI applications.</li> <li>5) To discuss real-world use cases integrating AI with IoT in domains like healthcare, agriculture, and smart cities.</li> <li>6) To encourage understanding of the challenges and future scope of AI-enabled IoT systems.</li> </ol>								
<b>Pre-requisite</b>	Basic knowledge of computer fundamentals and an introductory understanding of programming or logic-building concepts is recommended. No prior experience with AI or IoT is required.								
<b>Course Outcomes</b>	<p><b>CO1: Remembering:</b> Recall and define key concepts, history, and types of Artificial Intelligence and IoT technologies.</p> <p><b>CO2: Understanding:</b> Explain the architecture, components, and connectivity methods of IoT systems used in AI applications.</p> <p><b>CO3: Applying:</b> Apply AI algorithms to process real-time data collected from IoT devices for smart decision-making.</p> <p><b>CO4: Analyzing:</b> Analyze challenges related to data quality, latency, power consumption, and security in AIoT systems.</p> <p><b>CO5: Creating:</b> Design and present innovative AIoT solutions based on case studies and group collaboration.</p>								
<b>Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)</b>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
<b>Course Content</b>	<p><b>Unit 1: Basics of Artificial Intelligence (AI)</b></p> <p>1.1 Introduction to Artificial Intelligence</p> <p>1.2 History and Evolution of AI</p> <p>1.3 Types of AI – Narrow, General, Super AI</p> <p>1.4 Key Concepts: Machine Learning, Deep Learning, Natural Language Processing</p> <p>1.5 Real-life Applications of AI in Various Sectors (Healthcare, Education, Agriculture, Manufacturing)</p>								

	<p><b>Unit 2: Basics of IoT Devices in AI Applications</b></p> <p>2.1 Introduction to Internet of Things (IoT)</p> <p>2.2 Architecture of IoT Systems – Sensors, Actuators, Gateways, Cloud</p> <p>2.3 Types of IoT Devices Useful in AI Projects</p> <p>2.3.1 Environmental Sensors (Temperature, Humidity, Air Quality)</p> <p>2.3.2 Motion and Position Sensors (Accelerometers, Gyroscopes, PIR)</p> <p>2.3.3 Wearables and Smart Health Devices</p> <p>2.3.4 Cameras and Microphones for Image and Voice Input</p> <p>2.4 Basics of Connectivity: Wi-Fi, Bluetooth, Zigbee, LoRaWAN</p> <p>2.5 Data Flow: From Sensors to AI Processing</p> <p><b>Unit 3: Advanced Integration of AI with IoT</b></p> <p>3.1 Introduction to AIoT (Artificial Intelligence of Things)</p> <p>3.2 Real-Time Data Processing Using AI Algorithms</p> <p>3.3 Edge Computing vs Cloud AI in IoT</p> <p>3.4 AI-Based Decision Making from IoT Inputs (examples: Smart Home, Smart Agriculture)</p> <p>3.5 Challenges in AIoT: Data Quality, Latency, Power Consumption</p> <p>3.6 Privacy, Security, and Ethical Considerations in AIoT</p> <p><b>Unit 4: Summary and Case Study Discussion</b></p> <p>4.1 Summary of Key Concepts from AI and IoT</p> <p>4.2 Case Study 1: Smart Farming using IoT and AI</p> <p>4.3 Case Study 2: AI-Powered Smart Home Automation</p> <p>4.4 Open Discussion on AIoT Trends and Future Scope</p> <p>4.5 Group Activity: Analyze and Present an AIoT Use Case [All Units carry Equal Weightage]</p>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. The Basics of AI and IoT A Beginner's Handbook , Parab Publication, Authors Mrs. Varsha Atul Shukre, Dr. Anuradha Kanade, Ms. Jyoti Narayan Shrote, Mr. Abhijat and Mr. Yogesha T , Dec 2023</li> <li>2. Hands-On Artificial Intelligence for IoT - Second Edition: Expert machine learning and deep learning techniques for developing smarter IoT systems, Author : Amrita Kapoor, packt, Second Edition</li> <li>3. Artificial Intelligence-based Internet of Things Systems , by Souvik Pal, Debashis De, Rajkumar Buyya , Springer, 2022</li> <li>4. Artificial Intelligence for IoT. Michael Roshak, Packt publication, 2021</li> <li>5. Internet of Things: Technologies and Applications for a New Age of Intelligence, Vlasios Tsiatsis, Stamatis Karnouskos and Jan Holler, Academic Press, 2018</li> <li>6. Internet of Things architecture and Design Principles, Raj Kamal, MCGrawhill Education private limited, 2017</li> </ol>
<b>Teaching Methodology</b>	Class Work, Discussion, Presentation, Self-Study, Seminars and/or Assignments
<b>Evaluation Method</b>	<p>50% Internal assessment.</p> <ul style="list-style-type: none"> <li>- Attendance, Class and home Assignment</li> <li>- Unit Tests</li> </ul> <p>50% External assessment.</p> <ul style="list-style-type: none"> <li>- Written Theory exam</li> </ul>

[Subject code-2711000906011006]

**Course Code: 602**

**Course Title: Cloud Analytics & Security**

<b>Course Code</b>	602
<b>Course Title</b>	Cloud Analytics & Security
<b>Credits</b>	4
<b>Course Category</b>	Major Course
<b>Level of Course</b>	400-499
<b>Teaching Hours</b>	60 Hours
<b>Minimum Hours/ Semester</b>	60 hours of Theory (Including class work, examination, preparation etc.)
<b>Review/Revision</b>	-
<b>Implementation Year:</b>	A.Y. 2026-27
<b>Purpose of Course</b>	<ol style="list-style-type: none"><li>1. To introduce students to the fundamental concepts of cloud computing and cloud-based analytics systems.</li><li>2. To provide an understanding of cloud architectures, service models, and deployment models used for data analytics.</li><li>3. To explain how large-scale data is stored, managed, and processed in cloud environments.</li><li>4. To familiarize students with cloud analytics platforms and big data processing frameworks.</li><li>5. To develop awareness of security challenges, threats, and risks associated with cloud computing.</li><li>6. To explain cloud security mechanisms such as identity and access management, encryption, and network security.</li></ol>
<b>Course Objective</b>	<ol style="list-style-type: none"><li>1. To introduce cloud computing concepts, architecture, and service models.</li><li>2. To understand cloud-based data analytics frameworks and platforms.</li><li>3. To study data storage, management, and processing in cloud environments.</li><li>4. To understand cloud security threats, risks, and protection mechanisms.</li><li>5. To learn compliance, governance, and best practices for cloud security.</li></ol>
<b>Pre-requisite</b>	-
<b>Course Outcomes</b>	<p><b>CO1:</b> Understand the fundamentals of cloud computing and cloud analytics, including service models, deployment models, and the role of cloud analytics in data science applications.</p> <p><b>CO2:</b> Explain cloud architecture and data management concepts, including virtualization, containerization, cloud storage systems, and management of structured, semi-structured, and unstructured data.</p> <p><b>CO3:</b> Identify and compare cloud-based analytics platforms and big data frameworks, such as AWS, Microsoft Azure, Google Cloud, Hadoop, and Apache Spark for batch and real-time data processing.</p> <p><b>CO4:</b> Apply cloud security concepts and mechanisms, including identity and access management, encryption techniques, and secure data storage practices in cloud environments.</p> <p><b>CO5:</b> Analyze cloud security threats, compliance requirements, and governance issues, including risk management, regulatory standards (ISO, GDPR), and ethical and legal aspects of cloud analytics.</p>

Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	<b>CO1</b>								
	<b>CO2</b>								
	<b>CO3</b>								
	<b>CO4</b>								
	<b>CO5</b>								
<b>Course Content</b>	<p><b>Unit 1: Fundamentals of Cloud Computing And Analytics</b></p> <p>1.1 Introduction to Cloud Computing</p> <p>1.1.1 Definition and evolution of cloud computing</p> <p>1.1.2 Characteristics and essential features of cloud computing</p> <p>1.1.3 Advantages and limitations of cloud computing</p> <p>1.2 Cloud Service Model</p> <p>1.2.1 Infrastructure as a Service (IaaS)</p> <p>1.2.2 Platform as a Service (PaaS)</p> <p>1.2.3 Software as a Service (SaaS)</p> <p>1.3 Cloud Deployment Models</p> <p>1.3.1 Public cloud</p> <p>1.3.2 Private cloud</p> <p>1.3.3 Hybrid cloud</p> <p>1.3.4 Community cloud</p> <p>1.4 Introduction to Cloud Analytics</p> <p>1.4.1 Meaning and importance of cloud analytics</p> <p>1.4.2 Traditional analytics vs cloud analytics</p> <p>1.4.3 Role of cloud analytics in data science</p> <p><b>Unit 2: Cloud Architecture and Data Management</b></p> <p>2.1 Cloud Architecture</p> <p>2.1.1 Cloud computing architecture components</p> <p>2.1.2 Front-end and back-end architecture</p> <p>2.2.2 Virtualization concepts and types</p> <p>2.2.4 Containerization overview</p> <p>2.2 Cloud storage System</p> <p>2.2.1 Object, block, and file storage</p> <p>2.2.2 Distributed storage systems</p> <p>2.2.3 Data redundancy and fault tolerance</p> <p>2.3 Cloud Data Management</p> <p>2.3.1 Data ingestion and integration</p> <p>2.3.2 Data lakes and data warehouses</p> <p>2.3.3 Handling structured, semi-structured, and unstructured data</p> <p><b>Unit 3: Cloud-Based Analytics Platforms</b></p> <p>3.1 Big Data Analytics in Cloud</p> <p>3.1.1 Characteristics of big data (5V's)</p> <p>3.1.2 Need for cloud in big data analytics</p> <p>3.2 Cloud Analytics Platforms</p> <p>3.2.1 Overview of Amazon Web Services (AWS) analytics services</p> <p>3.2.2 Overview of Microsoft Azure analytics services</p> <p>3.2.3 Overview of Google Cloud analytics services</p> <p>3.3 Data Processing Frameworks</p> <p>3.3.1 Hadoop architecture and ecosystem</p> <p>3.3.2 Apache Spark architecture and applications</p> <p>3.3.3 Batch processing vs real-time stream processing</p> <p><b>Unit 4: Cloud Security Concepts and Mechanisms</b></p> <p>4.1 Cloud Security Concepts, Threats, and Governance</p> <p>4.1.1 Cloud Security Fundamentals and Mechanism</p> <p>4.1.2 Identity and Access Management(IAM)</p> <p>4.1.3 Data Security and encryption Practice</p> <p>4.1.4 Cloud security threat and Risk</p> <p>4.2 Data Security in Cloud</p>								

	<p>4.2.1 Data encryption at rest and in transit</p> <p>4.2.2 Key management systems</p> <p>4.2.3 Secure data storage practices</p> <p>4.3 Cloud Security Threats and Infrastructure Protection</p> <p>4.3.1 Data breaches, data loss, account hijacking, insider threats, DoS and DDoS attacks</p> <p>4.3.2 Virtual Private Cloud, Firewall and Security Groups</p> <p>4.4 Cloud Compliance, Governance, and Ethical Issues</p> <p>4.4.1 Data Privacy and protection. Compliance standards and Regulation (ISO, GDPR, etc.),</p> <p>4.4.2 Governance Challenges and ethical and legal issues related to cloud analytics.</p>
<b>Reference Books</b>	<p>1. Cloud Computing: Concepts, Technology &amp; Architecture – Thomas Erl, Zaigham Mahmood &amp; Ricardo Puttini (Pearson)</p> <p>2. Mastering Cloud Computing – Rajkumar Buyya, Christian Vecchiola, S. T. Selvi (McGraw-Hill)</p> <p>3. Cloud Analytics – Rajkumar Buyya &amp; Sanjay Chaudhary (Wiley)</p> <p>4. Practical Cloud Security: A Guide for Secure Design and Deployment – Chris Dotson (O’Reilly)</p> <p>5. Cloud Security and Privacy – Tim Mather, Subra Kumaraswamy &amp; Shahed Latif (O’Reilly)</p> <p>6. Cloud Security and Privacy - Tim Mather, Subra Kumaraswamy &amp; Shahed Latif, Publisher-O’Reilly</p> <p>7. Cloud Computing: Concepts, Technology &amp; Architecture, Thomas Erl, Zaigham Mahmood &amp; Ricardo Puttini, publisher-Pearson</p> <p>8. Cloud Computing, M.N. RAO, PHI.</p> <p>9. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, John Wiley &amp; Sons ISBN NO: 81-7758- 575-4</p> <p>10. Velte T., Velte A., Elsenpeter R., “Cloud Computing – A practical Approach”, Tata McGrawHill.</p> <p>11. Cloud Computing with Security, Naresh KumarSehgal, Springer, 2019</p>
<b>Teaching Methodology</b>	Class work, discussion, Seminar and/or Assignment
<b>Evaluation Method</b>	50% internal Assessment 50% External Assessment

[Subject code for Theory-2711000906022008]

[Subject code for Practical-2711000906022009]

**Course Code: 603**

**Course Title: Time Series Analysis and Forecasting**

<b>Course Code</b>	603									
<b>Course Title</b>	Time Series Analysis and Forecasting									
<b>Credits</b>	4									
<b>Course Category</b>	Major Course									
<b>Level of Course</b>	400-499 ( Advance Level )									
<b>Teaching Hours</b>	30 Hours of class-room teaching + 60 Hours of Applied work(Project)									
<b>Minimum Hours/ Semester</b>	30 hours of Theory + 60 Hours of Applied work (Project) (Including class work, examination, preparation etc.)									
<b>Review / Revision</b>	-									
<b>Implementation Year</b>	A.Y. 2026-2027									
<b>Purpose of Course</b>	The purpose of this course is to equip students with the knowledge and practical skills required to analyse, model, and forecast time-dependent data using statistical and machine learning techniques. The course aims to enable learners to interpret real-world time-series data from domains such as business, finance, healthcare, and IoT and to make data-driven decisions through accurate forecasting and visualization.									
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. Understand the fundamental concepts and components of time-series data.</li> <li>2. Pre-process, visualize and explore time-dependent datasets using Python.</li> <li>3. Apply smoothing, statistical and ARIMA-based forecasting models.</li> <li>4. Evaluate forecasting models using appropriate error metrics.</li> <li>5. Implement machine learning approaches for time-series prediction.</li> <li>6. Develop and present a mini-project based on real-world forecasting problems.</li> </ol>									
<b>Pre-requisite</b>	Students enrolling in this course should have a basic understanding of statistics, including measures of central tendency, dispersion and probability concepts, along with foundational knowledge of Python programming. Familiarity with data handling techniques such as data cleaning, formatting and basic data visualization is also expected. This background will enable learners to effectively process, analyse and model time-series data using statistical and machine learning approaches.									
<b>Course Outcomes</b>	<p><b>CO1 Understand:</b> Understand the fundamental concepts, components and types of time-series data.</p> <p><b>CO2 Apply:</b> Apply data pre-processing and visualization techniques to prepare time-series datasets.</p> <p><b>CO3 Create:</b> Create forecasting models using statistical and machine learning approaches for real-world datasets.</p> <p><b>CO4 Analyse:</b> Analyse time-series patterns and evaluate forecasting models using appropriate error metrics.</p> <p><b>CO5 Apply:</b> Apply time-series forecasting techniques to solve practical problems through a mini project.</p>									
<b>Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)</b>	CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
<b>Course Content</b>	<p><b>Unit-1: Fundamentals of Time Series and Data Preparation</b></p> <ol style="list-style-type: none"> <li>1.1 Definition of time series</li> <li>1.2 Types of time series: univariate, multivariate</li> <li>1.3 Components: Trend, Seasonality, Cyclic, Random</li> <li>1.4 Real-world examples: sales, stock prices, weather, traffic, energy</li> <li>1.5 Time stamps and data formats</li> <li>1.6 Data cleaning and pre-processing for time-series</li> <li>1.7 Time-series visualization using Python</li> </ol>									

	<p><b>Unit-2: Descriptive Analysis and Forecasting Techniques</b></p> <p>2.1 Moving Average  2.2 Weighted Moving Average  2.3 Simple Exponential Smoothing  2.4 Holt’s Linear Trend Method  2.5 Holt–Winters Seasonal Method  2.6 Forecast error measures: MAE, MSE, RMSE, MAPE</p> <p><b>Unit-3: ARIMA and Seasonal Forecasting Models</b></p> <p>3.1 Concept of stationarity  3.2 Trend removal and differencing  3.3 Autocorrelation (ACF)  3.4 Partial Autocorrelation (PACF)  3.5 AR, MA, ARMA, ARIMA models  3.6 Model identification, diagnostics, and forecast intervals</p> <p><b>Unit-4: Machine Learning Applications and Project Development</b></p> <p>4.1 Introduction to regression-based forecasting  4.2 Feature engineering for time series  4.3 Lag variables and rolling window features  4.4 Applications in business, finance, healthcare and IoT</p>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Box, G. E. P., Jenkins, G. M., &amp; Reinsel, G. C. – Time Series Analysis: Forecasting and Control, Wiley</li> <li>2. Brockwell, P. J. &amp; Davis, R. A. – Introduction to Time Series and Forecasting, Springer</li> <li>3. Hyndman, R. J. &amp; Athanasopoulos, G. – Forecasting: Principles and Practice, OTexts</li> <li>4. Shumway, R. H. &amp; Stoffer, D. S. – Time Series Analysis and Its Applications, Springer</li> <li>5. Tsay, R. S. – Analysis of Financial Time Series, Wiley</li> <li>6. Chatfield, C. – The Analysis of Time Series: An Introduction, CRC Press</li> <li>7. Montgomery, D. C., Jennings, C. L., &amp; Kulahci, M. – Introduction to Time Series Analysis and Forecasting, Wiley</li> <li>8. Wei, W. W. S. – Time Series Analysis: Univariate and Multivariate Methods, Pearson</li> <li>9. Enders, W. – Applied Econometric Time Series, Wiley</li> <li>10. Makridakis, S., Wheelwright, S. C., &amp; Hyndman, R. J. – Forecasting: Methods and Applications, Wiley</li> </ol>
<b>Teaching Methodology</b>	Student-centric learning through interactive lectures, Discussion, Lab work, Self-Study, Assignments and mini-projects on real-world time-series datasets.
<b>Evaluation Method</b>	50% Internal assessment. : - Attendance, Class and home Assignment, Unit tests. - Project demonstration/presentation, viva-voce 50% External assessment. : - Theory/Written examination - Project demonstration/presentation, viva-voce

[Subject code-2611001306033001]

**Course Code: 604**  
**Course Title: Project**

<b>Course Code</b>	604 (Major-16)
<b>Course Title</b>	PROJECT
<b>Credits</b>	4
<b>Course Category</b>	Major Course
<b>Level of Course</b>	400-499 ( Advance Level )
<b>Teaching Hours</b>	120 Hours of Applied work(Project)
<b>Minimum Hours/ Semester</b>	120 Hours of Applied work (Project) (Including applied work, E-documentation, viva-voce examination, Project preparation etc.)
<b>Review / Revision</b>	-
<b>Implementation Year:</b>	A.Y. 2026-2027
<b>Purpose of Course</b>	This course is designed to provide students with the opportunity to apply the knowledge and skills they have gained throughout their academic journey in Programming Language, Machine Learning Applications. It encourages hands-on learning by developing a real-world, full-scale project through self-exploration of technologies, structured documentation, and effective presentation.
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1) Understand and analyze the given project definition and plan development accordingly.</li> <li>2) Apply learned and self-acquired knowledge of technologies in designing and implementing project solutions.</li> <li>3) Demonstrate the use of appropriate tools, frameworks, and platforms in project development.</li> <li>4) Develop a well-structured project document covering all phases of the development life cycle.</li> <li>5) Present the project effectively using professional communication and presentation tools.</li> </ol>
<b>Pre-requisite</b>	Students must have completed foundational and intermediate courses on programming languages (such as Python, Java), database concepts, Machine Learning concept and basic software development practices. Prior experience with mini-projects or assignments involving real-world problem-solving is desirable.
<b>Course Outcomes</b>	<p><b>CO1:</b>Analyze: Students will be able to analyze project requirements, identify suitable tools, and prepare an implementation strategy.</p> <p><b>CO2:</b>Create: Students will develop full-fledged applications using relevant Machine Learning Application.</p> <p><b>CO3:</b>Apply: Students will gain experience in applying the Software Development Life Cycle (SDLC) to real-world problems.</p> <p><b>CO4:</b>Create: Students will prepare and submit a comprehensive project report that meets academic and professional standards.</p> <p><b>CO5:</b>Evaluate: Students will present their project solutions confidently and clearly to technical and non-technical audiences.</p>
<b>Project Development</b>	<p><b>STEP-1: Project Planning and Definition</b></p> <ol style="list-style-type: none"> <li>1.1 Understanding Problem Statement</li> <li>1.2 Identify the business objectives</li> <li>1.3 Define the specific Machine Learning Problem</li> <li>1.4 Project Scheduling and Team Role Allocation</li> </ol> <p><b>STEP-2: Project Design and Architecture</b></p> <ol style="list-style-type: none"> <li>2.1 Data Collections, Preparation and Cleaning</li> <li>2.2 Perform EDA and Analyze data to identify pattern</li> <li>2.3 Perform Feature Engineering</li> </ol> <p><b>STEP-3: Project Development and Testing</b></p> <ol style="list-style-type: none"> <li>3.1 To develop model select appropriate algorithm</li> <li>3.2 Split the data in training set, testing set and validation set</li> </ol>

	<p>3.3 Evaluation model on unseen test data</p> <p><b>STEP-4: Documentation and Deployment of Model</b></p> <p>4.1 Preparing Project Documentation: Design Document, User Manual  4.2 Deployment of trained model into a production environment  4.3 Project Report Writing in Standard Format  4.4 Preparing and Delivering Project Presentation</p> <p>[Students will submit E-Document for Project report. One internal guide will be allocated for every ten groups. All groups are required to contact their internal guides once a week to endorse their project progress work.]</p>																	
<p><b>Project Evaluation Scheme</b></p>	<table border="1" data-bbox="552 533 1524 792"> <thead> <tr> <th data-bbox="552 533 997 566">Component</th> <th data-bbox="997 533 1123 566">Marks</th> </tr> </thead> <tbody> <tr> <td data-bbox="552 566 997 600">Problem Definition and Planning</td> <td data-bbox="997 566 1123 600">10%</td> </tr> <tr> <td data-bbox="552 600 997 633">Design and Architecture</td> <td data-bbox="997 600 1123 633">15%</td> </tr> <tr> <td data-bbox="552 633 997 667">Implementation and Functionality</td> <td data-bbox="997 633 1123 667">30%</td> </tr> <tr> <td data-bbox="552 667 997 701">Testing and Deployment</td> <td data-bbox="997 667 1123 701">15%</td> </tr> <tr> <td data-bbox="552 701 997 734">Documentation</td> <td data-bbox="997 701 1123 734">10%</td> </tr> <tr> <td data-bbox="552 734 997 768">Final Presentation &amp; Viva</td> <td data-bbox="997 734 1123 768">20%</td> </tr> <tr> <td data-bbox="552 768 997 792"><b>Total</b></td> <td data-bbox="997 768 1123 792"><b>100%</b></td> </tr> </tbody> </table>		Component	Marks	Problem Definition and Planning	10%	Design and Architecture	15%	Implementation and Functionality	30%	Testing and Deployment	15%	Documentation	10%	Final Presentation & Viva	20%	<b>Total</b>	<b>100%</b>
Component	Marks																	
Problem Definition and Planning	10%																	
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Testing and Deployment	15%																	
Documentation	10%																	
Final Presentation & Viva	20%																	
<b>Total</b>	<b>100%</b>																	
<p><b>Evaluation Method</b></p>	<p>50% Internal assessment.</p> <ul style="list-style-type: none"> <li>- Attendance and reporting to internal guides</li> <li>- Internal project presentation and demonstration, project documentation.</li> </ul> <p>50% External assessment.</p> <ul style="list-style-type: none"> <li>- project presentation and demonstration, viva-voce and e-project report.</li> </ul>																	

[Subject code-2611001306055001]

**Course Code: 605**

**Course Title: Project and Interview Presentation Soft Skills (AEC-06)**

<b>Course Code</b>	605 (Ability Enhancement Course (AEC))									
<b>Course Title</b>	Project and Interview Presentation Soft Skills									
<b>Credits</b>	2									
<b>Course Category</b>	AEC Course									
<b>Level of Course</b>	100-199 ( Fundamental Level )									
<b>Teaching Hours per semester</b>	30 Hours of class-room work									
<b>Minimum Hours/ Semester</b>	30 hours of Class-room work (Including class work, interactive sessions, examination, preparation etc.)									
<b>Review / Revision</b>	-									
<b>Implementation Year:</b>	A.Y. 2026-2027									
<b>Purpose of Course</b>	The purpose of this course is to equip students from the software, computer, and IT industry with essential project execution in the field of Data Science, documentation, and presentation skills. It aims to enhance their technical communication, soft skills, and interview preparedness through hands-on project work, seminars, and structured evaluations.									
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1) To develop students' ability to plan, execute, and manage software/IT projects using industry-standard practices.</li> <li>2) To enhance technical documentation skills through structured project reports and software documentation.</li> <li>3) To build confidence in delivering effective oral presentations and technical demonstrations relevant to software and IT domains.</li> <li>4) To improve soft skills such as teamwork, time management, and problem-solving in a professional IT project environment.</li> <li>5) To prepare students for technical and HR interviews by practicing mock interviews and resume-building activities.</li> </ol>									
<b>Pre-requisite</b>	Learners should have a fundamental understanding of Python programming languages, database management, and software development life cycle. Prior exposure to mini-projects or hands-on experience with development tools and technologies used in the IT/software industry will be beneficial.									
<b>Course Outcomes</b>	<ol style="list-style-type: none"> <li>1) <b>CO1:(Understand):</b> Explain the essential components of professional project documentation and communication in the software and IT industry.</li> <li>2) <b>CO2:(Apply):</b> Demonstrate the ability to present project concepts clearly using structured presentation techniques and visual aids relevant to IT solutions.</li> <li>3) <b>CO3:(Analyze):</b> Evaluate the technical and soft skill requirements of various IT job roles and align personal project work and presentation accordingly.</li> <li>4) <b>CO4:(Create):</b> Develop a mini-project or prototype by integrating appropriate software tools and technologies and document it as per standard industry practices.</li> <li>5) <b>CO5:(Evaluate):</b> Justify design choices, tool selection, and development approach during interviews or viva presentations using logical reasoning and industry-specific language.</li> </ol>									
<b>Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)</b>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
<b>Course Content</b>	<b>Unit 1: Communication and Presentation Skills in the IT Industry</b> 1.1 Fundamentals of Communication 1.1.1 Verbal and Non-verbal Communication 1.1.2 Barriers in Communication in Technical Teams 1.1.3 Listening and Clarity in Technical Discussions 1.2 Presentation Skills for IT Professionals									

	<ul style="list-style-type: none"> <li>1.2.1 Creating Technical Presentations</li> <li>1.2.2 Using Tools like PowerPoint, Canva, Prezi</li> <li>1.2.3 Speaking with Confidence in Team and Client Meetings</li> <li>1.3 Email and Technical Writing Etiquette <ul style="list-style-type: none"> <li>1.3.1 Writing Clear Technical Emails</li> <li>1.3.2 Preparing Professional Reports and Documentation</li> </ul> </li> </ul> <p><b>Unit 2: Project Documentation and Reporting</b></p> <ul style="list-style-type: none"> <li>2.1 Understanding Software Development Life Cycle (SDLC) <ul style="list-style-type: none"> <li>2.1.1 Role of Documentation at Each Phase</li> <li>2.1.2 Agile Documentation vs Traditional Models</li> </ul> </li> <li>2.2 Technical Project Documentation <ul style="list-style-type: none"> <li>2.2.1 Problem Statement and Requirements</li> <li>2.2.2 Design Diagrams: UML, ER Diagrams</li> <li>2.2.3 Testing and Deployment Documentation</li> </ul> </li> <li>2.3 Final Report Writing and Formatting <ul style="list-style-type: none"> <li>2.3.1 Structuring a Complete Project Report</li> <li>2.3.2 IEEE/ACM Style Guidelines and Referencing</li> <li>2.3.3 Common Errors to Avoid in Technical Reports</li> </ul> </li> </ul> <p><b>Unit 3: Interview Readiness and Soft Skills for Developers</b></p> <ul style="list-style-type: none"> <li>3.1 Resume and LinkedIn Profile Building</li> <li>3.2 Components of a Tech Resume</li> <li>3.3 Tailoring Resumes for Software Roles</li> <li>3.4 Interviewing Skills for IT Roles <ul style="list-style-type: none"> <li>3.4.1 Understanding the Interview Process in Software Companies</li> <li>3.4.2 Technical Round vs HR Round Expectations</li> <li>3.4.3 STAR Method for Behavioral Interview Questions</li> </ul> </li> <li>3.5 Mock Interview Sessions <ul style="list-style-type: none"> <li>3.5.1 Self-Introduction Practice</li> <li>3.5.2 Group Feedback and Interview Etiquette</li> </ul> </li> </ul> <p><b>Unit 4: Final Project Presentation and Seminar</b></p> <ul style="list-style-type: none"> <li>4.1 Project Showcase Guidelines <ul style="list-style-type: none"> <li>4.1.1 Preparing for Project Presentation</li> <li>4.1.2 Demonstrating Code, UI, and Deployment</li> </ul> </li> <li>4.2 Seminar and Peer Review <ul style="list-style-type: none"> <li>4.2.1 Presentation to Class and Faculty Panel</li> <li>4.2.2 Peer Evaluation Criteria</li> </ul> </li> <li>4.3 Soft Skill Reflection and Final Assessment <ul style="list-style-type: none"> <li>4.3.1 Student Reflections on Soft Skills Gained</li> <li>4.3.2 Final Grading and Suggestions for Improvement</li> </ul> </li> </ul> <p>[One topic will be allocated to every student. The student will prepare a seminar and presentation along with a documentation.]</p>
<p><b>Reference Books</b></p>	<ul style="list-style-type: none"> <li>1) Technical Communication: Principles and Practice, Meenakshi Raman &amp; Sangeeta Sharma, Oxford University Press India, ISBN: 9780195695747</li> <li>2) Soft Skills: Know Yourself and Know the World, Dr. Alex K., S. Chand Publishing, ISBN: 9789352534357</li> <li>3) Communication Skills for Engineers, Sunita Mishra &amp; C. Muralikrishna, Pearson Education India, ISBN: 9788131733844</li> <li>4) Business Communication, P.D. Chaturvedi &amp; Mukesh Chaturvedi, Pearson Education India, ISBN: 9788131733585</li> <li>5) Developing Soft Skills, Gajendra Singh Chauhan, Wiley India, ISBN: 9788126577500</li> <li>6) The Quick and Easy Way to Effective Speaking, Dale Carnegie, Simon &amp; Schuster, ISBN: 9780743528322</li> <li>7) Cracking the Coding Interview, Gayle Laakmann McDowell, CareerCup, ISBN: 9780984782857</li> </ul>

	8) Presentation Skills for Technical Professionals, Naomi Karten, Dorset House Publishing, ISBN: 9780932633585 9) Interviewing: Principles and Practices, Charles Stewart & William Cash Jr., McGraw-Hill Education, ISBN: 9780078036804 10) The Art of Public Speaking, Stephen E. Lucas, McGraw-Hill Education, ISBN: 9780073523910
<b>Teaching Methodology</b>	Class Work, Discussion, Presentation, Self-Study, Seminars and/or Assignments
<b>Evaluation Method</b>	50% Internal assessment. <ul style="list-style-type: none"> <li>- Attendance, Class and home Assignment, Unit Tests (Seminar).</li> <li>- Internal presentations, documentation, viva-voce and Seminar</li> <li>- 50% External assessment.</li> <li>- Documentation, presentation and Viva-voce.</li> </ul>

[Subject code-2611001306066001]

**Course Code: 606**

**Course Title: Internship**

<b>Course Code</b>	606
<b>Course Title</b>	Internship
<b>Credits</b>	4
<b>Course Category</b>	Internship
<b>Level of Course</b>	400-499 ( Advance Level )
<b>Teaching Hours</b>	120 Hours of internship work
<b>Minimum Hours/ Semester</b>	120 hours of internship work (Including industrial visit, interactive sessions, applied/training work, examination, preparation etc.)
<b>Review / Revision</b>	-
<b>Implementation Year:</b>	A.Y. 2026-2027
<b>Purpose of Course</b>	NEP-2020 emphasizes on Vocationalization of Education. A key aspect of the new UG programme is its utility into a real life situation. All students are expected to do Internships/Apprenticeships/OJT in a firm, industry, or organization. Students will be provided the opportunities for do Internships/Apprenticeships/OJT with local industry, business organizations, health, and allied areas, local governments (such as panchayats, and municipalities), local Police Stations, Parliament or elected representatives, media organizations, artists, crafts persons, and a wide range of organizations so that students may engage with the practical side of their learning, which will improve their employability.
<b>Course Objective</b>	1) To provide students with practical exposure to industry standards and practices. 2) To foster the application of academic knowledge in real-life work scenarios. 3) To enhance students' interpersonal, communication, and problem-solving skills. 4) To help students identify their strengths and areas of interest in professional domains. 5) To inculcate a sense of responsibility, discipline, and work ethics.
<b>Pre-requisite</b>	Students must have completed at least one year of their undergraduate program. They should have basic conceptual knowledge of their core subjects before starting the internship.
<b>Course Outcomes</b>	1) <b>CO1 (Apply):</b> Apply programming, development, or analytical skills gained in the classroom to solve real-world computing problems during the internship. 2) <b>CO2 (Analyze):</b> Analyze the architecture, workflow, and practices of the host organization to understand the integration of computer systems in business or technical environments. 3) <b>CO3 (Evaluate):</b> Evaluate project requirements, software tools, and technologies used during the internship to recommend improvements or alternative approaches. 4) <b>CO4 (Create):</b> Create a structured technical report and project documentation summarizing the tasks, challenges, and outcomes of the internship. 5) <b>CO5 (Present):</b> Present the project findings and experience effectively using professional communication and presentation skills tailored to the IT/software industry.
<b>Internship Structure and Deliverable by Students:</b>	<b>Duration:</b> 120 Hours <b>Mode:</b> Offline / Online / Hybrid <b>Location:</b> Industry, business firms, IT companies, local government offices, health organizations, media, artisans, etc. <b>Deliverables by Student:</b> 1. Internship Joining Report 2. Weekly Progress Logbook 3. Project or Assignment Work (if applicable) 4. Final Internship Report (with photographs, certificates, etc.) 5. Presentation and Viva Voce

<b>Course Evaluation</b>	<b>Component</b>	<b>Marks/Weightage</b>
	Attendance and Participation	20%
	Weekly Progress Logbook	20%
	Final Internship Report	30%
	Presentation & Viva Voce	30%
	<b>Total</b>	<b>100%</b>

<b>Reference Books</b>	<p><b>INTERNSHIP REPORT TEMPLATE (to be submitted after internship completion) Front Page</b>  Title: <i>Internship Report</i>  Student Name:  Roll Number:  Program and Semester:  College Name and Department:  Name of Organization/Company:  Internship Duration (From – To):  Internship Guide Name (Industry and Faculty):  Submission Date:</p> <p><b>1. Acknowledgment</b>  A short paragraph acknowledging the guidance and support of the organization and faculty mentor.</p> <p><b>2. Certificate</b>  Internship Completion Certificate (copy from organization)</p> <p><b>3. Declaration</b>  Declaration by the student that the report is original and submitted for academic purposes.</p> <p><b>4. Internship Details</b>  Name and Address of Organization  Nature of Business/Services  Department/Team worked in  Name and Designation of Industry Supervisor</p> <p><b>5. Objectives of Internship</b>  What you aimed to learn and accomplish.</p> <p><b>6. Description of Work Done</b>  Overview of the tasks and responsibilities handled  Description of technologies/tools used  Screenshots, flowcharts, or diagrams (if applicable)</p> <p><b>7. Learning Outcomes</b>  Skills developed, software or tools learned, industry exposure gained.</p> <p><b>8. Challenges and Solutions</b>  Mention any problems faced and how you solved them.</p> <p><b>9. Weekly Summary</b>  Brief of what was done in each week (can be derived from the logbook).</p> <p><b>10. Conclusion</b>  Summary of overall experience, learning, and impact on career development.</p> <p><b>11. References</b>  Any websites, books, or resources referred to during the internship.</p> <p><b>INTERNSHIP LOGBOOK FORMAT (to be maintained weekly)</b></p> <table border="1"> <thead> <tr> <th>Week No.</th> <th>Date (From–To)</th> <th>Tasks Assigned</th> <th>Tasks Completed</th> <th>Tools/Technologies Used</th> </tr> </thead> <tbody> <tr> <td>Week 1</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Week 2</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>...</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Week N</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p><b>Note:</b> The logbook must be signed weekly by the industry/place of internship allocated supervisor and finally verified by the faculty mentor allocated by the institute.</p>	Week No.	Date (From–To)	Tasks Assigned	Tasks Completed	Tools/Technologies Used	Week 1					Week 2					...					Week N				
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### University Examinations

Course Code	Course	Exam Component	Max. Marks	Duration
601 (Minor-5)	Concepts of A.I. and IoT Devices	<b>Theory</b>	<b>50</b>	<b>2 Hours</b>
602 (Major-14)	Cloud Analytics & Security	<b>Theory</b>	<b>50</b>	<b>2 Hours</b>
603 (Major-15)	Time Series Analysis and Forecasting (minor project)	<b>Theory</b>	<b>25</b>	<b>1 Hours</b>
		<b>Project</b>	<b>25</b>	<b>-</b>
604 (Major-16)	PROJECT	<b>Project</b>	<b>50</b>	<b>-</b>
605 (AEC-06)	Project and Interview Presentation Soft Skills	<b>Seminar/Presentation</b>	<b>50</b>	<b>-</b>
606 (Major)	Internship	<b>Project report/ presentation/ viva-voce</b>	<b>100</b>	<b>-</b>

[University theory exams Course code: 601, 602, 603 and 605 will be scheduled between 5<sup>th</sup> February to 11<sup>th</sup> February. Following to the theory exams, students will work on full time Projects and Internship. Project exams will be scheduled between 10<sup>th</sup> April to 20<sup>th</sup> April.]