



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.

Tel : +91 - 281 - 2227141 to 2227146, Toll Free : 1800 2333 011, Digital Helpline No.- 0261 2388888

E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

- સંદર્ભ: (૧) એકેડેમિક કાઉન્સિલની તા. ૧૫/૦૬/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંક:૯૦
(૨) અત્રેના વિભાગની તા. ૧૪/૦૮/૨૦૨૬ ની કાર્યાલય નોંધ

-: પરિપત્ર :-

યુનિવર્સિટી સંલગ્ન કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા હેઠળની તમામ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે,
NEP-2020 અંતર્ગત શૈક્ષણિક વર્ષ ૨૦૨૭-૨૮ થી અમલમાં આવનાર B.Sc. Data Science (Honours)
Sem.-5 & 6 નો અભ્યાસક્રમ આ સાથે સામેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક:ઓથો./પરિપત્ર/૧૮૭૦૮/૨૦૨૬
તા. ૧૭/૦૮/૨૦૨૬

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કુલસચિવ

પ્રતિ,

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

Veer Narmad South Gujarat University, Surat



Computer Science and Information Technology Faculty

Syllabus for T.Y. B.SC. (DATA SCIENCE) (HONOURS)

(Semester-V and Semester-VI)

as per the NEP-2020

To be implemented from

Academic Year: June, 2027-2028

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B.Sc.(Data Science)
Semester-5 and Semester-6

Name of Program	Bachelor of Computer Science in Data Science
Program Abbreviation	B.Sc.(Data Science)
Duration	Four-year Integrated Program with Multi-Level Entry and Exit option
Eligibility Criteria	As per University Criteria
Pre-requisite	Second Year of B.Sc.(Data Science and Analytics)
Medium of Instruction	English
Objective of Program	The B.Sc.(Data Science and Analytics) program aims to provide strong foundations in data science, statistics, and computing. It develops analytical and problem-solving skills to address real-world data-driven challenges. The program equips students with programming and technical skills required for data analysis and model implementation. It emphasizes transforming data into meaningful insights through visualization and analytics. Practical learning is promoted through labs, projects, and case studies. Ethical and responsible use of data is strongly emphasized. The program enhances communication and teamwork skills for effective presentation of insights. Students are encouraged toward independent learning and innovation. The curriculum prepares learners for industry roles, entrepreneurship, higher studies, and research. Overall, the program builds competent data professionals ready for evolving technological landscapes.
Program Outcome (PO)	PO1: To build strong foundations in mathematics, statistics, computing, and core data science principles for data-driven analysis. PO2: To develop analytical, critical thinking, and problem-solving skills for interpreting and extracting insights from data. PO3: To equip students with practical programming, data analysis, visualization, and modeling skills using modern tools and technologies. PO4: To enable the design and implementation of data-driven solutions for real-world and interdisciplinary problems. PO5: To promote ethical, responsible, and secure use of data, including awareness of privacy, governance, and professional ethics. PO6: To prepare graduates for careers, higher education, research, and lifelong learning in data science, analytics, and related fields.
Program Specific Outcomes (PSO)	PSO1: Apply statistical and computational techniques to collect, preprocess, and analyze structured and unstructured datasets. PSO2: Design and implement data analytics solutions using programming languages, libraries, and frameworks relevant to data science. PSO3: Develop and evaluate predictive and descriptive models using machine learning and analytical techniques. PSO4: Create meaningful data visualizations and dashboards to communicate analytical findings effectively to technical and non-technical stakeholders. PSO5: Integrate databases, data warehouses, and big data tools for efficient data storage, retrieval, and processing. PSO6: Apply ethical principles, data privacy laws, and governance frameworks while handling and analyzing data. PSO7: Work effectively as an individual and as part of a team to solve real-world data-driven problems through projects and case studies.

	PSO8: Demonstrate self-learning ability and adaptability by exploring emerging tools, technologies, and research trends in data science and analytics.								
Mapping between POs and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	PO1								
	PO2								
	PO3								
	PO4								
	PO5								
	PO6								

T.Y.B.Sc.(DATA SCIENCE)
(SEM – 5)
(w.e.f. Academic Year June, 2027-2028)

Structure of Program (Semester-5)

Course Category	Course Code	Course Title	Marksheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit	Internal Marks		External Marks		Total Marks
					TH	PR	TH	PR		TH	PR	TH	PR	
MINOR	DS-501	Cloud Computing Fundamentals	Cloud Computing Fundamentals	300-399	4	-	2	-	4	50	-	50	-	100
MINOR	DS-502	Computer Network	Computer Network	300-399	4	-	2	-	4	50	-	50	-	100
MAJOR	DS-503	Fundamentals of Machine Learning	Fundamentals of Machine Learning	400-499	2	4	1	2	4	25	25	25	25	100
MAJOR	DS-504	Advanced Data Visualization and Dashboard Development	Advanced Data Visualization and Dashboard Development	400-499	2	4	1	2	4	25	25	25	25	100
MAJOR	DS-505	Big Data Handling and Management for Machine Learning Applications	Big Data Handling and Management for Machine Learning Applications	400-499	2	4	1	2	4	25	25	25	25	100
SEC (Skill Enhance ment Course)	DS-506	Ethics of Data Science	Ethics of Data Science	200-299	2	-	-	2	2	-	25	-	25	50

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT B.Sc.(Data Science) (Semester-5) SYLLABUS DS-501: Cloud Computing Fundamentals									
Program Name	Bachelors of Science in Data Science								
Semester	5								
NCrF Credit Level	5.5								
Course Type	Minor								
Course Subtype	Employability								
Subject Type	Discipline Specific								
Course Code	DS-501								
Course Level	300-399								
Course Title	Cloud Computing Fundamentals								
Credit	4 Credit								
Effective From	Academic Year : 2027-2028								
Course Outcomes	CO1: Explain the history, evolution, merits, and limitations of cloud computing, highlighting the need for cloud-based solutions in modern IT environments. CO2: Describe and compare the core concepts, characteristics, and service models of cloud computing, including the paradigm shift from traditional computing to cloud-based architectures. CO3: Differentiate and evaluate various cloud deployment models and service models, along with their advantages, challenges, and real-world use cases. CO4: Identify and demonstrate the use of popular cloud service providers and platforms, such as Amazon Web Services (AWS) and Microsoft Azure, for basic cloud operations and services. CO5: Discuss advanced cloud concepts, emerging technologies, and future trends, including scalability, cloud security concerns, and the evolving role of cloud computing in industry.								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Basics of Cloud Computing 1.1 Introduction to Cloud Computing 1.1.1 Definition and Key Characteristics 1.1.2 Evolution and History of Cloud Computing 1.1.3 Benefits: Cost-efficiency, Scalability, Flexibility, Reliability 1.1.4 Challenges: Security, Compliance, Vendor Lock-in								

	1.2. Cloud Models 1.2.1 Deployment Models: Public, Private, Hybrid, Multi-Cloud 1.2.2 Service Models: 1.2.2.1 IaaS, PaaS, SaaS 1.2.2.2 Additional Models: Network as a Service (NaaS), Database as a Service (DBaaS) 1.3 Cloud Applications and Use Cases 1.3.1 Business Applications 1.3.2 Data Backup and Recovery 1.3.3 Media Streaming, File Sharing Unit 2: Cloud Architecture and Virtualization 2.1 Cloud Computing Architecture 2.1.1 Components of Cloud Infrastructure 2.1.2 Front-end and Back-end Architecture 2.1.3 Resource Pooling and Multi-tenancy 2.2 Virtualization Technologies 2.2.1 Concept of Virtualization 2.2.2 Types of Virtualization: Hardware (Full, Para, Emulation) 2.2.3 Hypervisors: Type 1 and Type 2 2.2.4 Role of Virtual Machines in Cloud 2.3 Cloud Planning and Design 2.3.1 Business and IT Architecture 2.3.2 Cloud Transformation Planning 2.3.3 Introduction to Service-Oriented Architecture (SOA) 2.3.4 Utility Computing Concepts Unit 3: Cloud Platforms and Management (AWS and Azure) 3.1 Overview of Leading Cloud Platforms 3.1.1 Basic Concepts of AWS, Azure 3.1.2 Global Infrastructure: Regions and Availability Zones 3.2 Compute and Storage Services 3.2.1 AWS EC2 and Azure Virtual Machines 3.2.2 AWS Lambda and Azure Functions (Serverless Computing) 3.2.3 AWS S3 vs Azure Blob Storage 3.2.4 Backup and Archival Services (Amazon Glacier, Azure Backup) 3.3 Databases and Networking 3.3.1 AWS RDS and Azure SQL Database 3.3.2 NoSQL: DynamoDB (AWS), Cosmos DB (Azure) 3.3.3 Basics of Networking: Virtual Private Cloud (VPC), Azure Virtual Network (VNet) 3.4 Cloud Management and Monitoring 3.4.1 AWS CloudWatch, Azure Monitor 3.4.2 Resource Management Tools: AWS CloudFormation, Azure Resource Manager 3.4.3 Identity and Access Management (IAM and AAD) Unit 4: Cloud Security, Big Data & Emerging Trends 4.1 Cloud Security and Compliance 4.1.1 Cloud Security Principles 4.1.2 Cloud Security Alliance (CSA) 4.1.3 Role-Based Access Control (RBAC) 4.1.4 Compliance: GDPR, HIPAA, SOC2 4.2 Cloud Operations and Service Agreements
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	4.2.1 Service Level Agreements (SLAs) 4.2.2 Operational Models 4.2.3 State Management and Automation Tools 4.3 Big Data and Data Lakes 4.3.1 Introduction to Big Data 4.3.2 OLTP vs OLAP 4.3.3 Data Warehouse vs Data Lake 4.3.4 Architecture and Benefits of Data Lakes 4.4 Future of Cloud Computing 4.4.1 Edge Computing and IoT (AWS IoT Core, Azure IoT Hub) 4.4.2 Cloud for AI & ML (SageMaker, Azure ML) 4.4.3 Trends: Quantum Computing, Green Cloud
Reference Books	1. Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, Prentice Hall, ISBN: 9780133387520 2. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, McGraw-Hill Education, ISBN: 9780071626943 3. Cloud Computing Bible, Barrie Sosinsky, Wiley India, ISBN: 9780470903568 4. Cloud Computing and Distributed Systems, Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Morgan Kaufmann, ISBN: 9780123850591 5. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley, ISBN: 9780470887998 6. Architecting the Cloud: Design Decisions for Cloud Computing Service Models, Michael J. Kavis, Wiley, ISBN: 9781118617618 7. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw-Hill Education (India), ISBN: 9780070683534 8. Cloud Computing for Dummies, Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Wiley, ISBN: 9780470484708 9. Cloud Computing Black Book, Kailash Jayaswal, Dreamtech Press (India) ISBN: 9789351194174 10. Cloud Computing and Virtualization, Borko Furht, Armando Escalante, Springer, ISBN: 9781461479463
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	Internal Assessment : - Continuous evaluation, Assignment, Attendance - 50% weightage External Assessment : - Theory exam - 50% weightage

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT B.Sc.(Data Science) (Semester-5) SYLLABUS DS-502: Computer Network										
Program Name	Bachelors of Science in Data Science									
Semester	5									
NCrF Credit Level	5.5									
Course Type	Minor									
Course Subtype	Employability									
Subject Type	Discipline Specific									
Course Code	DS-501									
Course Level	300-399									
Course Title	Computer Network									
Credit	4 Credit									
Effective From	Academic Year : 2027-2028									
Course Outcomes	CO1: Explain the fundamental concepts of computer networks, including network types, topologies, transmission media, and networking models. CO2: Describe the functions and working of OSI and TCP/IP reference models and compare their respective layers and protocols. CO3: Apply knowledge of data communication techniques, switching methods, and network devices to analyze basic networking scenarios. CO4: Analyze the working of core network protocols related to IP addressing, routing, transport, and application services. CO5: Evaluate network performance, security issues, and emerging trends in computer networking for real-world applications.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	Unit 1: Network Fundamentals & Architecture 1.1 Introduction to Networks 1.1.1 Types of networks (LAN, WAN, MAN, PAN) 1.1.2 Need, uses, and advantages of networking 1.2 Networking Topologies 1.2.1 Bus, Star, Ring, Mesh, Hybrid 1.2.2 Advantages and disadvantages of each 1.3 Network Models 1.3.1 Client-Server, Peer-to-Peer, Hybrid networks 1.4 Data Communication Basics 1.4.1 Signals, Bandwidth, Frequency									

	1.4.2 Transmission modes: Simplex, Half-duplex, Full-duplex 1.4.3 Multiplexing techniques (FDM, TDM, WDM) 1.5 Basic Networking Commands (In Linux) 1.5.1 ping, traceroute/tracert, netstat, ipconfig/ifconfig, nslookup 1.5.2 Case Study: Troubleshooting network connectivity issues Unit 2: OSI Model & Network Infrastructure 2.1 OSI Model & Functions of Each Layer 2.2 Physical and Data Link Layer 2.2.1 MAC & LLC sublayers 2.2.2 CSMA/CD, CSMA/CA 2.2.3 IEEE 802 Standards 2.2.4 Transmission media (wired & wireless) 2.2.5 Devices: NIC, Repeaters, Hubs, Bridges 2.3 Network and Transport Layer 2.3.1 Logical addressing, IPv4 vs IPv6 2.3.2 Switching techniques (Circuit, Packet, Message switching) 2.3.2 Routing Basics (Static vs Dynamic) 2.3.3 Layer 2 & Layer 3 switches, Routers 2.4 Application & Upper Layers 2.4.1 Session Layer: Session management, Remote procedure calls 2.4.2 Presentation Layer: Encryption & Compression techniques 2.4.3 Application Layer: FTP, NFS, Proxy, Gateway 2.5 Case Study & Commands (In Linux) 2.5.1 arp, route, ip route, netsh 2.5.2 Case Study: Packet Capture Analysis using Wireshark Unit 3: TCP/IP & Network Security 3.1 TCP/IP Protocol Suite 3.1.1 Comparison of OSI and TCP/IP models 3.2 IP Addressing & Routing 3.2.1 IPv4/IPv6, Subnetting, Supernetting 3.2.2 CIDR & VLSM 3.2.3 Routing types (Static, Dynamic – RIP, OSPF, BGP) 3.3 Data Transmission Methods 3.3.1 Unicast, Broadcast, Multicast, Anycast 3.4 Protocols & Network Communication 3.4.1 ICMP, ARP, RARP 3.4.2 Ports & Sockets 3.4.3 TCP vs UDP (Features, Flow control, Congestion control) 3.5 Security & Network Attacks 3.5.1 Common threats: Man-in-the-Middle (MITM), DoS, DDoS 3.5.2 Firewalls & Packet Filtering 3.5.2 IDS & IPS Overview Unit 4: Internet Technologies & Advanced Topics 4.1 DNS & Name Resolution 4.1.1 DNS namespace, Resource records, Query resolution, Name servers 4.2 Web Technologies 4.2.1 HTTP/HTTPS Protocols, Web Services, API Calls 4.3 Email Technologies & Protocols 4.3.1 SMTP, POP3, IMAP 4.4 Modern Networking Concepts
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	4.4.1 Cloud Networking & Edge Computing 4.4.2 SDN (Software-Defined Networking) 4.4.3 IoT Networking
Reference Books	1. Computer Networks, Andrew S. Tanenbaum and David J. Wetherall, Pearson Education, ISBN: 9780132126953 2. Data Communications and Networking, Behrouz A. Forouzan, McGraw-Hill Education, ISBN: 9780073376226 3. Computer Networking: A Top-Down Approach, James F. Kurose and Keith W. Ross, Pearson Education, ISBN: 9780133594140 4. Data and Computer Communications, William Stallings, Pearson Education, ISBN: 9780133506488 5. Computer Networks and Internets, Douglas E. Comer, Pearson Education, ISBN: 9780136060129 6. Internetworking with TCP/IP (Volume 1), Douglas E. Comer, Pearson Education, ISBN: 9780136085306 7. TCP/IP Illustrated, Volume 1: The Protocols, W. Richard Stevens, Addison-Wesley, ISBN: 9780201633467 8. Network Security Essentials: Applications and Standards, William Stallings, Pearson Education, ISBN: 9780134527338 9. Networking Essentials, Jeffrey S. Beasley and Piyasat Nilkaew, Pearson Education, ISBN: 9780134527338 10. Computer Networking and the Internet, Fred Halsall, Addison-Wesley, ISBN: 9780201398274
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	Internal Assessment : - Continuous evaluation, Assignment, Attendance - 50% weightage External Assessment : - Theory exam - 50% weightage

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT B.Sc.(Data Science) (Semester-5) SYLLABUS DS-503: Fundamentals of Machine Learning										
Program Name	Bachelors of Science in Data Science									
Semester	5									
NCrF Credit Level	5.5									
Course Type	Minor									
Course Subtype	Employability									
Subject Type	Discipline Specific									
Course Code	DS-503									
Course Level	400-499									
Course Title	Fundamentals of Machine Learning									
Credit	4 Credit									
Effective From	Academic Year : 2027-2028									
Course Outcomes	CO1: Explain the fundamental concepts of unsupervised learning and identify its applications in data science and real-world data analysis. CO2: Apply clustering techniques such as K-Means, Hierarchical Clustering, and DBSCAN to discover patterns and group similar data in large datasets. CO3: Analyze high-dimensional datasets using dimensionality reduction techniques such as Principal Component Analysis (PCA) for improved data visualization and model efficiency. CO4: Describe and interpret the working principles of Artificial Neural Networks (ANN) including neurons, layers, activation functions, and learning processes. CO5: Implement basic unsupervised learning models and simple neural network structures using Python and Scikit-learn libraries for data analysis tasks.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	UNIT 1: Introduction to Unsupervised Learning 1.1 Fundamentals of Unsupervised Learning 1.1.1 Definition and characteristics of unsupervised learning 1.1.2 Difference between supervised and unsupervised learning 1.1.3 Applications of unsupervised learning (customer segmentation, anomaly detection, recommendation systems) 1.2 Types of Unsupervised Learning Techniques 1.2.1 Clustering techniques 1.2.2 Association rule learning 1.2.3 Dimensionality reduction (basic idea)									

	1.3 Clustering Concepts and Terminology 1.3.1 Similarity and distance measures 1.3.2 Euclidean distance and Manhattan distance 1.3.3 Cluster formation and cluster evaluation concepts 1.4 Tools and Environment for Unsupervised Learning 1.4.1 Overview of Python libraries used in unsupervised learning 1.4.2 Introduction to clustering modules in Scikit-learn 1.4.3 Loading datasets and preparing data for clustering UNIT 2: Clustering Algorithms 2.1 K-Means Clustering 2.1.1 Concept and working of K-Means algorithm 2.1.2 Selecting number of clusters (K value) 2.1.3 Advantages and limitations of K-Means 2.2 Implementation of K-Means 2.2.1 Using K-Means module in Scikit-learn 2.2.2 Training clustering models 2.2.3 Visualizing clusters using matplotlib 2.3 Hierarchical Clustering 2.3.1 Concept of hierarchical clustering 2.3.2 Agglomerative and divisive clustering approaches 2.3.3 Dendrogram representation and interpretation 2.4 Density Based Clustering 2.4.1 Concept of density-based clustering 2.4.2 DBSCAN algorithm (basic idea) 2.4.3 Identifying noise and outliers in datasets UNIT 3: Dimensionality Reduction Techniques 3.1 Need for Dimensionality Reduction 3.1.1 Problems caused by high-dimensional data 3.1.2 Curse of dimensionality (basic idea) 3.1.3 Benefits of dimensionality reduction in ML models 3.2 Principal Component Analysis (PCA) 3.2.1 Concept of principal components 3.2.2 Variance and dimensionality reduction process 3.2.3 PCA implementation using Scikit-learn 3.3 Feature Selection Techniques 3.3.1 Importance of selecting relevant features 3.3.2 Basic feature selection methods 3.3.3 Impact of feature selection on model performance 3.4 Visualization of High Dimensional Data 3.4.1 Visualizing reduced datasets 3.4.2 Scatter plots for cluster visualization 3.4.3 Interpreting clustering and dimensionality reduction results UNIT 4: Introduction to Artificial Neural Networks 4.1 Fundamentals of Neural Networks 4.1.1 Biological inspiration of neural networks 4.1.2 Artificial neuron model 4.1.3 Input layer, hidden layer, and output layer 4.2 Neural Network Architecture 4.2.1 Weights, bias, and activation functions
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	4.2.2 Common activation functions (Sigmoid, ReLU, Tanh) 4.2.3 Feedforward neural networks 4.3 Training of Neural Networks 4.3.1 Concept of loss function 4.3.2 Gradient descent optimization (basic idea) 4.3.3 Backpropagation (conceptual overview) 4.4 Implementation Basics 4.4.1 Introduction to neural network libraries in Python 4.4.2 Simple neural network model using Keras/TensorFlow (conceptual demonstration) 4.4.3 Applications of neural networks in classification and prediction tasks
Reference Books	1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media, ISBN: 9781492032649. 2. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing, ISBN: 9781789955750. 3. Machine Learning with Python Cookbook, Chris Albon, O'Reilly Media, ISBN: 9781491989388. 4. Introduction to Machine Learning with Python, Andreas C. Müller and Sarah Guido, O'Reilly Media, ISBN: 9781449369415. 5. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, ISBN: 9780387310732. 6. Neural Networks and Deep Learning, Charu C. Aggarwal, Springer, ISBN: 9783319944630. 7. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, ISBN: 9780262035613. 8. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, ISBN: 9780262018029. 9. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media, ISBN: 9781492041139. 10. Practical Machine Learning with Python, Dipanjan Sarkar, Apress, ISBN: 9781484232066.
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignment, continuous evaluation and Internal Practicals.
Evaluation Method	Internal Assessment : - Continuous evaluation, Assignment, Attendance - 50% weightage for Practical and Theory exams External Assessment : - Theory exam - Practical exam - 50% weightage for Practical and Theory exams

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT B.Sc.(Data Science) (Semester-5) SYLLABUS DS-504: Advanced Data Visualization and Dashboard Development										
Program Name	Bachelors of Science in Data Science									
Semester	5									
NCrF Credit Level	5.5									
Course Type	Major									
Course Subtype	Employability									
Subject Type	Discipline Specific									
Course Code	DS-504									
Course Level	400-499									
Course Title	Advanced Data Visualization and Dashboard Development									
Credit	4 Credit									
Effective From	Academic Year : 2027-2028									
Course Outcomes	CO1: Explain advanced concepts of data modeling and DAX functions in Power BI for performing analytical calculations and data transformations. CO2: Apply advanced data visualization techniques in Power BI to create interactive dashboards using filters, slicers, drill-down, and custom visuals. CO3: Analyze datasets using appropriate visualization methods to identify trends, patterns, and insights relevant to data-driven decision making. CO4: Design effective analytical dashboards and data stories using visualization best practices for communicating insights clearly. CO5: Develop interactive reports and dashboards using Power BI and Tableau tools and demonstrate the ability to publish and share them for real-world analytical applications.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	UNIT-1: Advanced Data Modeling and DAX in Power BI 1.1 Advanced Data Modeling Concepts 1.1.1 Star schema and snowflake schema 1.1.2 Fact tables and dimension tables 1.1.3 Designing efficient data models for analytics 1.2 Advanced Relationships and Model Optimization 1.2.1 Managing multiple relationships between tables 1.2.2 Active vs inactive relationships 1.2.3 Resolving relationship ambiguity 1.3 Introduction to DAX (Data Analysis Expressions)									

- 1.3.1 What is DAX and its role in Power BI
- 1.3.2 Difference between calculated columns and measures
- 1.3.3 Basic DAX syntax and expressions
- 1.4 Commonly Used DAX Functions
 - 1.4.1 Aggregation functions: SUM(), AVERAGE(), COUNT(), DISTINCTCOUNT()
 - 1.4.2 Logical functions: IF(), SWITCH()
 - 1.4.3 Time-based calculations (basic concepts)

UNIT-2: Advanced Data Visualization Techniques

- 2.1 Principles of Data Visualization
 - 2.1.1 Importance of visualization in Data Science
 - 2.1.2 Choosing appropriate charts for different datasets
 - 2.1.3 Avoiding misleading visualizations
- 2.2 Advanced Visualizations in Power BI
 - 2.2.1 Creating dashboards with multiple visuals
 - 2.2.2 Drill-down and drill-through analysis
 - 2.2.3 Creating hierarchical visuals
- 2.3 Interactive Data Visualization
 - 2.3.1 Using slicers for interactive reports
 - 2.3.2 Applying filters and cross-filtering
 - 2.3.3 Tooltips and dynamic highlighting
- 2.4 Custom Visuals and Advanced Chart Types
 - 2.4.1 Using marketplace visuals in Power BI
 - 2.4.2 Maps and geographical visualizations
 - 2.4.3 KPI cards and gauge charts

UNIT-3: Dashboard Design and Storytelling with Data

- 3.1 Designing Analytical Dashboards
 - 3.1.1 Understanding dashboard components
 - 3.1.2 Designing dashboards for business decision making
 - 3.1.3 Layout and alignment techniques
- 3.2 Data Storytelling Techniques
 - 3.2.1 Presenting insights through visual narratives
 - 3.2.2 Highlighting trends and patterns in data
 - 3.2.3 Communicating insights effectively
- 3.3 Dashboard Performance Optimization
 - 3.3.1 Managing large datasets efficiently
 - 3.3.2 Reducing report load time
 - 3.3.3 Best practices for visualization performance
- 3.4 Case Studies in Data Visualization
 - 3.4.1 Sales performance dashboard
 - 3.4.2 Customer segmentation visualization
 - 3.4.3 Trend analysis using dashboards

UNIT-4: Advanced Visualization Tools and Deployment

- 4.1 Introduction to Tableau for Data Visualization
 - 4.1.1 Overview of Tableau Desktop interface
 - 4.1.2 Connecting datasets to Tableau
 - 4.1.3 Comparison between Power BI and Tableau
- 4.2 Building Visualizations in Tableau
 - 4.2.1 Creating charts and graphs in Tableau
 - 4.2.2 Filters, parameters, and calculated fields

	4.2.3 Interactive dashboards in Tableau 4.3 Publishing and Sharing Reports 4.3.1 Publishing reports to Power BI Service 4.3.2 Sharing dashboards with users 4.3.3 Managing permissions and access 4.4 Applications of Data Visualization in Data Science 4.4.1 Visualizing machine learning results 4.4.2 Data-driven decision making 4.4.3 Real-world use cases of BI dashboards
Reference Books	1. Data Visualization with Microsoft Power BI: How to Design Savvy Dashboards, Alex Kolokolov and Maxim Zelensky, ISBN: 9781098152789 2. Power BI Data Analysis and Visualization, Suren Machiraju and Suraj Gaurav, ISBN: 9781547400720 3. Microsoft Power BI Complete Reference: Bring Your Data to Life with the Powerful Features of Microsoft Power BI, Devin Knight, Brian Knight, Mitchell Pearson, Manuel Quintana and Brett Powell, ISBN: 9781789955637 4. Tableau: Creating Interactive Data Visualizations, Jen Stirrup, Ashutosh Nandeshwar, Ashley Ohmann and Matt Floyd, ISBN: 9781784395296 5. Storytelling with Data: A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, ISBN: 9781119002253 6. The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios, Steve Wexler, Jeffrey Shaffer and Andy Cotgreave, ISBN: 9781119282716 7. Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master, Ryan Sleeper, ISBN: 9781491977316 8. Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software, Daniel G. Murray, ISBN: 9781118612040 9. Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures, Claus O. Wilke, ISBN: 9781492031086 10. Data Visualization: A Practical Introduction, Kieran Healy, ISBN: 9780691181622
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignment, continuous evaluation and Internal Practicals.
Evaluation Method	Internal Assessment : - Continuous evaluation, Assignment, Attendance - 50% weightage for Practical and Theory exams External Assessment : - Theory exam - Practical exam - 50% weightage for Practical and Theory exams

[Subject code for Theory-2611001305033001]

[Subject code for Practical-2611001305033002]

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B.Sc.(Data Science) (Semester-5)
SYLLABUS

DS-505: Big Data Handling and Management for Machine Learning Applications

Program Name	Bachelors of Science in Data Science								
Semester	5								
NCrF Credit Level	5.5								
Course Type	Major								
Course Subtype	Employability								
Subject Type	Discipline Specific								
Course Code	DS-505								
Course Level	400-499								
Course Title	Big Data Handling and Management for Machine Learning Applications								
Credit	4 Credit								
Effective From	Academic Year : 2027-2028								
Course Outcomes	CO1: Explain the fundamental concepts of Big Data and identify the need for handling large datasets in Machine Learning and AI applications. CO2: Apply Python libraries such as NumPy and Pandas to load, explore, and manage large datasets using essential data processing functions. CO3: Demonstrate the use of PySpark to perform distributed data processing and execute basic operations on large datasets. CO4: Apply data preprocessing and feature engineering techniques to prepare large datasets for Machine Learning models using Scikit-learn. CO5: Analyze and implement basic text data processing and simple LLM-based applications using Python and pretrained APIs.								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit – 1: Introduction to Big Data and Large Dataset Handling 1. Big Data Fundamentals 1.1 Introduction to Big Data 1.1.1 Definition and characteristics of Big Data (Volume, Velocity, Variety) 1.1.2 Need for Big Data in Machine Learning and AI applications 1.1.3 Examples of large datasets (social media, sensor data, text datasets) 1.2 Working with Large Datasets using Python								

1.2.1 Loading large datasets using Python
1.2.2 Working with CSV, JSON, and Excel datasets
1.2.3 Memory management concepts while handling large datasets
1.3 Essential Python Libraries
1.3.1 Introduction to NumPy and Pandas for large dataset processing
1.3.2 DataFrames and Series concepts
1.3.3 Data exploration techniques
1.4 Practical Commands and Functions
1.4.1 Pandas Functions : read_csv(), read_json(), head(), tail(), info(), describe(), shape, columns
1.4.2 Data Handling functions: drop(), dropna(), fillna(), rename()
Unit – 2: Big Data Processing using PySpark
2.1 Distributed Data Processing
2.2 Introduction to Distributed Processing
2.2.1 Limitations of traditional data processing
2.2.2 Concept of distributed data processing
2.2.3 Introduction to Apache Spark
2.3 Apache Spark Basics
2.3.1 Spark architecture overview
2.3.2 Spark DataFrames
2.3.3 Advantages of Spark for large datasets
2.4 Working with PySpark
2.4.1 Installing PySpark using pip
2.4.2 Creating Spark sessions
2.4.3 Loading large datasets
2.5 Practical Commands and Functions
[Unit-2: Suggested practical : Students should practice: Installation of spark session, ,load dataset and practic Basic operations like: df.show(), df.printSchema(), df.select(), df.filter(), df.groupBy(), df.count()]
Unit – 3: Preparing Big Data for Machine Learning
3. Data Preparation for ML
3.1 Data Cleaning
3.1.1 Handling missing values
3.1.2 Removing duplicate records
3.1.3 Data normalization and scaling
3.2 Feature Engineering
3.2.1 Selecting relevant features
3.2.2 Encoding categorical data
3.2.3 Splitting datasets for training and testing
3.3 Working with Machine Learning Libraries
3.3.1 Introduction to Scikit-learn
3.3.2 Using datasets for ML models
3.4 Practical Commands and Functions
3.4.1 Scikit-learn Functions:train_test_split(),StandardScaler(), LabelEncoder() fit(), predict()
3.4.2 Example Models
3.4.3 LinearRegression
3.4.4 DecisionTreeClassifier
3.4.5 KNeighborsClassifier
Unit – 4: Introduction to Large Language Models and Big Data Applications
4.1 Introduction to LLM
4.1.1Concept of Large Language Models
4.1.2 Examples of LLM applications (chatbots, text summarization)

	4.1.3 Importance of large datasets for LLM training 4.2 Text Data Processing 4.2.1 Working with large text datasets 4.2.2 Tokenization and text cleaning 4.2.3 Basic Natural Language Processing concepts 4.3 Using Pretrained LLM APIs 4.3.1 Introduction to HuggingFace models 4.3.2 Using APIs for text generation 4.3.3 Ethical considerations in AI systems 4.4 Practical Implementation and important Functions 4.4.1 Installation of transformers 4.4.2 Text Processing using Python : split(), lower(), replace(), count() [Tools recommended : Python, NumPy, Pandas, PySpark, Scikit-learn, HuggingFace Transformers, Google Colab / Jupyter Notebook]
Reference Books	1. Big Data: Principles and Best Practices of Scalable Real-Time Data Systems, Nathan Marz and James Warren, ISBN: 9781617290341 2. Hadoop: The Definitive Guide, Tom White, ISBN: 9781491901632 3. Learning Spark: Lightning-Fast Data Analytics, Jules S. Damji, Brooke Wenig, Tathagata Das and Denny Lee, ISBN: 9781492050049 4. Python for Data Analysis, Wes McKinney, ISBN: 9781491957660 5. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, ISBN: 9781492032649 6. Data Science from Scratch: First Principles with Python, Joel Grus, ISBN: 9781492041139 7. Machine Learning with PySpark, Tomasz Drabas and Denny Lee, ISBN: 9781784390796 8. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra and Thomas Wolf, ISBN: 9781098103247 9. Mastering Large Datasets with Python, John Wolohan, ISBN: 9781617295285 10. Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis, Mohammed Guller, ISBN: 9781484206487
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignment, continuous evaluation and Internal Practicals.
Evaluation Method	Internal Assessment : - Continuous evaluation, Assignment, Attendance - 50% weightage for Practical and Theory exams External Assessment : - Theory exam - Practical exam - 50% weightage for Practical and Theory exams

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B.Sc.(Data Science) (Semester-5)
DS-506: Ethics of Data Science
SYLLABUS

Program Name	Bachelors of Science in Data Science									
Semester	5									
NCrF Credit Level	5.5									
Course Type	SEC (Skill Enhancement Course)									
Course Subtype	Skill Development									
Subject Type	Intra-disciplinary									
Course Code	DS-506									
Course Level	200-299									
Course Title	Ethics of Data Science									
Credit	2 Credits									
Effective From	Academic Year : 2027-2028									
Course Outcomes	CO1: Understand the fundamental concepts of data ethics, ethical frameworks, responsible data usage, and the role of data scientists in society. CO2: Explain data security and privacy principles, identify types of data breaches, and understand data protection techniques and privacy regulations. CO3: Analyze the social impact of big data and AI technologies, including issues related to algorithmic bias, fairness, accountability, and automated decision-making. CO4: Evaluate real-world case studies of data misuse and ethical failures, and apply tools and methods to audit bias and fairness in machine learning models. CO5: Apply ethical principles and data governance practices while collecting, processing, and managing data in data science projects. CO6: Develop awareness of legal, social, and professional responsibilities in handling sensitive data and deploying data-driven systems.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
	CO6									
Course Content	Unit-1: Data Ethics Foundations 1.1 Introduction to Ethics in Data Science 1.2 Moral Principles and Ethical Frameworks 1.3 Ethical Issues in Data Collection and Analysis 1.4 Responsible Use of Data 1.5 Bias and Fairness in Algorithms 1.6 Role of Data Scientists in Society 1.7 Case Studies of Data Misuse and Ethical Failures Unit-2: Data Security and Privacy 2.1 Importance of Data Security in Data Science									

	2.2 Types of Data Breaches 2.3 Data Privacy Principles 2.4 Data Protection Techniques 2.5 Methods to Detect, Measure, and Mitigate Bias 2.6 Data Privacy Regulations (GDPR and Indian Data Protection Act) 2.7 Secure Handling of Sensitive Data Unit–3: Social Impact and Accountability 3.1 Impact of Big Data on Society 3.2 Addressing Societal Consequences of Data Technologies 3.3 Algorithmic Colonialism 3.4 Interpreting Model Outcomes 3.5 Accountability in Automated Decision-Making Unit–4: Case Studies 4.1 Analysis of Real-World Data Ethics Cases 4.2 Facebook Data Controversy Case Study 4.3 Ethical Failures in AI and Data Systems 4.4 Toolkit for Auditing Bias and Fairness in Machine Learning Models
Reference Books	1. Michael Kearns, Aaron Roth, The Ethical Algorithm: The Science of Socially Aware Algorithm Design, Oxford University Press, ISBN: 9780190948207. 2. Cathy O’Neil, Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy, Crown Publishing, ISBN: 9780553418811. 3. Solon Barocas, Moritz Hardt, Arvind Narayanan, Fairness and Machine Learning: Limitations and Opportunities, MIT Press, ISBN: 9780262047074. 4. Helen Nissenbaum, Privacy in Context: Technology, Policy, and the Integrity of Social Life, Stanford University Press, ISBN: 9780804772891. 5. Neil M. Richards, Woodrow Hartzog, Privacy’s Blueprint: The Battle to Control the Design of New Technologies, Harvard University Press, ISBN: 9780674976009. 6. Cathy O’Neil, Rachel Schutt, Doing Data Science: Straight Talk from the Frontline, O’Reilly Media, ISBN: 9781449358655. 7. Virginia Eubanks, Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor, St. Martin’s Press, ISBN: 9781250074317. 8. 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. 9. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O’Reilly Media., “Doing Good Data Science”
Teaching Methodology	Interactive lectures, Case study discussions, Real-life incident analysis, Student presentations, Scenario-based learning.
Evaluation Method	Internal Assessment (50%) : - Presentation / Seminar - Class-participation, Attendance External Assessment (50%) : - Presentation on any 1 Case study selected by the student, generation of reports, preparation and presentation of documentation and seminar/viva-voce.

T.Y.B.Sc.(DATA SCIENCE)
(SEM – 6)
(w.e.f. Academic Year June, 2027-2028)

Structure of Program (Semester-6)

Course Category	Course Code	Course Title	Marksheet Title in English	Level of Course	Teaching Hours/ Week		Exam Duration		Credit	Internal Marks		External Marks		Total Marks
					TH	PR	TH	PR		TH	PR	TH	PR	
MINOR	DS-601-01	E-Commerce & Cyber Security	E-Commerce & Cyber Security	300-399	4	-	2	-	4	50	-	50	-	100
	DS-601-02	Computer Graphics	Computer Graphics											
MAJOR	DS-602	Advanced Machine Learning Models and Neural Networks	Advanced Machine Learning Models and Neural Networks	300-399	4	-	2	-	4	50	-	50	-	100
MAJOR	DS-603	Big Data and Cloud-Based Machine Learning	Big Data and Cloud-Based Machine Learning	400-499	2	4	1	2	4	25	25	25	25	100
MAJOR	DS-604	PROJECT	PROJECT	400-499	-	-	-	2	4	-	50	-	50	100
AEC	DS-605	Project and Interview Presentation Soft Skills [Ability Enhancement Course] (AEC)	Project and Interview Presentation Soft Skills [Ability Enhancement Course] (AEC)	200-299	-	2	-	2	2	-	25	-	25	50
INTERNSHIP	DS-606	INTERNSHIP	INTERNSHIP	400-499	-	-	-	-	4	-	50	-	50	100

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
T.Y.B.Sc.(DATA SCIENCE)
(SEM – 6)
(w.e.f. Academic Year June, 2027-2028)
601-01: E-Commerece and Cyber Security

PROGRAM NAME	Bachelors of Science in Data Science									
Semester	VIth									
NCrFr Credit Level	5.5									
Course Type	MINOR									
Course Subtype	Employability									
Subject Type	Minor Discipline Specific									
Course Code	601-01									
Course Level	300-399									
Course Title	E-Commerce and Cyber Security									
Credit	4 Credits									
Effective From	Academic Year : 2027-2028									
Course Outcomes	CO1: Understand the fundamental concepts and framework of e-Commerce and m-Commerce. CO2: Explain the network infrastructure, payment methods, and associated security issues in e-Commerce. CO3: Identify various types of cybercrimes and their technical aspects. CO4: Describe key concepts, terminologies, and threats related to cyber security. CO5: Differentiate between types of hackers and understand common system vulnerabilities.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	Unit 1: Introduction to Electronic Commerce 1.1 Concepts of e-Commerce 1.2 Aims of e-Commerce 1.3 e-Commerce Framework 1.4 e-Commerce Consumer Applications 1.5 e-Commerce Organizational Applications 1.6 Introduction to m-Commerce Unit 2: Network Infrastructure of e-Com , Payment and Security: 2.1. Concepts of Information Way 2.2. Components of I-Way 2.2.1. Network Access Equipment									

	2.2.2. Local on-ramps 2.2.3. Global Information Distribution Network 2.3. Transaction Models 2.4 e-Commerce Payments and Security Issues 2.4.1. e-Commerce Payment Systems 2.4.2. Debit Card Based, Credit Card Based,. Risks & EPS 2.4.3. e-Cash, e-Cheque, e-wallet 2.5. Security on Web, SSL Unit-3: Introduction to Cyber Crimes: 3.1 Category of Cyber Crimes 3.2 Technical Aspects of Cyber Crimes 3.2.1 Unauthorized access & Hacking 3.2.2 Trojan, Virus and Worm Attacks 3.2.3 E-Mail related Crimes: Spoofing, Spamming, Bombing 3.2.4 Denial of Service Attacks 3.2.5 Distributed Denial of Service Attack 3.3 Various crimes : 3.3.1 IPR Violations (Software piracy, Copyright Infringement, Trademarks Violations, Theft of Computer source code, Patent Violations) 3.3.2 Cyber Squatting, Cyber Smearing, Cyber Stacking 3.3.3 Financial Crimes: (Banking, credit card, Debit card related) Unit-4: Cyber Security Fundamentals: 4.1 Concepts of Cyber Security: 4.1.1 Types of Threats 4.1.2 Advantages of Cyber Security 4.2 Basic Terminologies: 4.2.1 IP Address, MAC Address 4.2.2 Domain name Server(DNS) 4.2.3 DHCP, Router, Bots 4.3 Common Types of Attacks: 4.3.1 Distributed Denial of Service 4.3.2 Man in the Middle, Email Attack 4.3.3 Password Attack, Malware 4.4 Hackers: 4.4.1 Various Vulnerabilities: 4.4.1.1 Injection attacks, Changes in security settings 4.4.1.2 Exposer of Sensitive Data 4.4.1.3 Breach in authentication protocol 4.4.2 Types of Hackers: White hat and Black hat [All Units carry Equal Weightage]
Reference Books	1. Frontiers of Electronic Commerce, Ravi Kalakota and Andrew Whinston, Addition Wesley 2. Electronic Commerce: A Managerial Perspective, Efraim turban, Jae Lee, David King, H. Michel Chung, Addition Wesley 3. E-Commerce: An Indian Perspective, Joseph, PHI 4. E-Mail Hacking, Ankit Fadia, Vikas Publishing House Pvt. Ltd. 5. E-Commerce Concept, Models Strategies, G.V.S. Murthy, Himalaya Publisher 6. Cyber Crime in India, Dr M Dasgupta, Centax Publications Pvt Ltd 7. Cyber Laws and Crimes, Barkha U, Rama Mohan, Universal Law Publishing Co. Pvt Ltd. 8. Cyber Crime, Bansal S.K., A.P.H. Publishing Corporation 9. Cyber Security Understanding Cyber Crime, Computer Forensic and Legal Perspectives, Nina Godbole, Sunit Belapur, Willey India Publication

Teaching Methodology	Class Work, Discussion, Experimental work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment. - Unit Tests, continuous assessment 50% External assessment. - Written Theory exam

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
T.Y.B.Sc.(DATA SCIENCE)
(SEM – 6)
(w.e.f. Academic Year June, 2027-2028)
601-02: Computer Graphics

PROGRAM NAME	Bachelors of Science in Data Science								
Semester	VIth								
NCrF Credit Level	5.5								
Course Type	MINOR								
Course Subtype	Employability								
Subject Type	Minor Discipline Specific								
Course Code	601-02								
Course Level	300-399								
Course Title	Computer Graphics								
Credit	4 Credits								
Effective From	Academic Year : 2027-2028								
Course Outcomes	CO1:Remembering: Recall the application areas, file formats, and graphic standards used in computer graphics systems. CO2:Understanding: Describe the architecture and functioning of various display devices, scan methods, and graphic object types. CO3:Applying: Implement standard line drawing algorithms such as DDA and Bresenham for rendering basic graphic primitives. CO4:Analyzing: Analyze the behavior and effects of geometric transformations like scaling, rotation, translation, reflection, and shearing on 2D objects. CO5:Creating: Construct and manipulate graphical objects by integrating transformations and rendering techniques for simple graphic applications.								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1. Introduction 1.1 Application areas of Graphics Systems 1.1.1. Presentation Graphics 1.1.2. Entertainment 1.1.3. Education and Training 1.1.4. Image Processing 1.2 Computer Graphics Files 1.3 Introduction to graphic standards Unit 2. Graphics Systems 2.1. Video Display Devices								

	2.1.1. Refresh CRT 2.1.2. Color CRT 2.1.3. LCD 2.1.4. Direct View Storage Tube 2.2. Raster scan and Random Scan Display 2.3. Raster Graphics and Vector Graphics 2.4. Concepts of various objects: Point, Line, Circle, Ellipse and Polygons Unit 3. Line generation 3.1. Geometry of line 3.2. Frame Buffer 3.3. Line Drawing Algorithms 3.3.1. DDA Algorithm 3.3.2. VECGEN 3.3.3. Bresnahan 3.4. Line Styles 3.4.1. Thick line 3.4.2. Line caps and joint Unit 4. Geometric Transformations 4.1 Basic Transformations 4.1.1 Scaling 4.1.2 Translation 4.1.3 Rotation 4.1.3.1 Rotation about origin 4.1.3.2 Rotation about Homogeneous Coordinates 4.2 Other transformations 4.2.1 Reflection 4.2.2 Shearing
Reference Books	1. Computer Graphics - second edition, Donald Hearn & M. Pauline Baker – Tata McGraw Hill Pub. 2. Computer Graphics, Harrington S. -Tata McGraw Hill. 3. Computer Graphics, Desai A. A. –PHI. 4. Computer Graphics: Algorithms & Implementations, Mukherjee & Jana – PHI. 5. Interactive Computer Graphics, Giloi W. K. –Prentice Hall India. 6. Principles of Interactive Computer Graphics, New Man W. & Sproul P. F.McGraw 7. Procedural Elements for Computer Graphics, Rogers D. F. – McGraw Hill. 8. Computer Graphics with OpenGL, Donald Hearn, M. Pauline Baker, Warren Carithers, Pearson Education, 9780136053583 9. Computer Graphics: Principles and Practice, John F. Hughes, Andries van Dam, Morgan McGuire, David Sklar, Addison-Wesley, 9780321399526 10. Interactive Computer Graphics, Edward Angel, Dave Shreiner, Pearson Education, 9780132545235 11. Fundamentals of Computer Graphics, Peter Shirley, Steve Marschner, A K Peters / CRC Press, 9781482229394
Teaching Methodology	Class Work, Discussion, Experimental work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment. - Unit Tests, Continuous assessment 50% External assessment. - Written Theory exam

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
T.Y.B.Sc.(DATA SCIENCE)
(SEM – 6)

(w.e.f. Academic Year June, 2027-2028)

602: Advanced Machine Learning Models and Neural Networks

PROGRAM NAME	Bachelors of Science in Data Science								
Semester	VIth								
NCrF Credit Level	5.5								
Course Type	MAJOR								
Course Subtype	Employability								
Subject Type	Major Discipline Specific								
Course Code	602								
Course Level	400-499								
Course Title	Advanced Machine Learning Models and Neural Networks								
Credit	4 Credits								
Effective From	Academic Year : 2027-2028								
Course Outcomes	CO1: Explain the concepts of advanced machine learning models, kernel methods and ensemble techniques used in data science applications. (<i>Understand</i>) CO2: Apply machine learning libraries such as NumPy, Pandas and Scikit-learn to implement and evaluate machine learning models on real datasets. (<i>Apply</i>) CO3: Analyze the structure and working of Artificial Neural Networks and deep learning architectures for solving classification and prediction problems. (<i>Analyze</i>) CO4: Develop and train neural network and deep learning models using frameworks such as TensorFlow or Keras. (<i>Apply/Create</i>) CO5: Design and implement Convolutional Neural Network (CNN) models for practical data science tasks such as image classification and pattern recognition. (<i>Create</i>)								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	UNIT 1: Advanced Machine Learning Models 1.1 Overview of Advanced Machine Learning 1.1.1 Review of supervised and unsupervised learning concepts 1.1.2 Need for advanced machine learning models in Data Science 1.1.3 Applications of ML models in real-world data science problems 1.2 Support Vector Machines (SVM) 1.2.1 Concept of hyperplane and margin 1.2.2 Kernel trick and types of kernels (Linear, Polynomial, RBF) 1.2.3 Advantages and limitations of SVM								

1.3 Ensemble Learning Methods
1.3.1 Concept of ensemble learning
1.3.2 Bagging and Random Forest
1.3.3 Boosting concepts and Gradient Boosting (basic idea)
1.4 Practical Implementation using Python
1.4.1 Important libraries: NumPy, Pandas, Scikit-learn
1.4.2 Implementing SVM using sklearn.svm
1.4.3 Implementing Random Forest using sklearn.ensemble
1.4.4 Model evaluation using accuracy, confusion matrix, and cross-validation
UNIT 2: Advanced Artificial Neural Networks
2.1 Review of Neural Network Fundamentals
2.1.1 Structure of artificial neurons
2.1.2 Layers in neural networks (input, hidden, output)
2.1.3 Role of activation functions in neural networks
2.2 Deep Neural Networks
2.2.1 Concept of deep learning and deep neural networks
2.2.2 Multiple hidden layers and representation learning
2.2.3 Applications of deep neural networks
2.3 Training Deep Neural Networks
2.3.1 Gradient descent and optimization techniques
2.3.2 Loss functions for classification and regression
2.3.3 Regularization techniques: dropout and early stopping
2.4 Implementation using Python Libraries
2.4.1 Introduction to TensorFlow and Keras frameworks
2.4.2 Building simple neural network models using Keras
2.4.3 Model compilation, training, and evaluation
UNIT 3: Deep Learning Techniques
3.1 Introduction to Deep Learning Frameworks
3.1.1 Overview of TensorFlow, Keras, and PyTorch
3.1.2 Setting up deep learning environment in Python
3.1.3 Working with datasets for deep learning models
3.2 Neural Network Design and Implementation
3.2.1 Creating sequential models in Keras
3.2.2 Adding dense layers and activation functions
3.2.3 Compiling and training models
3.3 Model Evaluation and Optimization
3.3.1 Evaluating deep learning models using validation datasets
3.3.2 Accuracy, loss curves, and model performance analysis
3.3.3 Hyperparameter tuning concepts
3.4 Practical Applications in Data Science
3.4.1 Predictive analytics using deep learning models
3.4.2 Classification problems using neural networks
3.4.3 Regression tasks using deep learning models
UNIT 4: Convolutional Neural Networks (CNN) and Applications
4.1 Introduction to Convolutional Neural Networks
4.1.1 Motivation for CNN in deep learning
4.1.2 Difference between ANN and CNN
4.1.3 Applications of CNN in image and pattern recognition
4.2 CNN Architecture
4.2.1 Convolution layers and filters
4.2.2 Pooling layers and feature extraction

	4.2.3 Fully connected layers and output layer 4.3 Training CNN Models 4.3.1 Preparing image datasets for CNN models 4.3.2 Data augmentation techniques 4.3.3 Model training and validation 4.4 Practical Implementation using Python 4.4.1 Implementing CNN using TensorFlow/Keras 4.4.2 Image classification using CNN models 4.4.3 Evaluating CNN performance and interpreting results
Reference Books	1. Machine Learning, Tom M. Mitchell, McGraw-Hill Education, ISBN: 978-0070428072 2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, ISBN: 978-0387310732 3. Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, Aurélien Géron, O'Reilly Media, ISBN: 978-1492032649 4. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, ISBN: 978-0262035613 5. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing, ISBN: 978-1789955750 6. Deep Learning with Python, François Chollet, Manning Publications, ISBN: 978-1617296864 7. Introduction to Machine Learning with Python, Andreas C. Müller and Sarah Guido, O'Reilly Media, ISBN: 978-1449369415 8. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson Education, ISBN: 978-0134610993 9. The Hundred-Page Machine Learning Book, Andriy Burkov, Andriy Burkov Self-Published, ISBN: 978-1999579500 10. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, ISBN: 978-0262018029
Teaching Methodology	Class Work, Discussion, Experimental work, Self-Study, Seminars and/or Assignments
Evaluation Method	Internal Assessment : - Continuous evaluation, Assignment, Attendance - 50% weightage for Practical and Theory exams External Assessment : - Theory exam - Practical exam - 50% weightage for Practical and Theory exams

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**T.Y.B.Sc.(DATA SCIENCE)****(SEM – 6)****(w.e.f. Academic Year June, 2027-2028)****603: Big Data and Cloud-Based Machine Learning**

PROGRAM NAME	Bachelors of Science in Data Science								
Semester	VIth								
NCrF Credit Level	5.5								
Course Type	MAJOR								
Course Subtype	Employability								
Subject Type	Major Discipline Specific								
Course Code	603								
Course Level	400-499								
Course Title	Big Data and Cloud-Based Machine Learning								
Credit	4 Credits								
Effective From	Academic Year : 2027-2028								
Course Outcomes	CO1: Explain the concepts of cloud computing and cloud storage used for handling and managing large datasets in data science applications. (Understand) CO2: Apply cloud-based environments such as Google Colab to access and process large datasets stored on cloud platforms. (Apply) CO3: Implement techniques for saving, loading and deploying machine learning models using tools such as Pickle and Joblib. (Apply) CO4: Integrate deployed machine learning models with large datasets stored on cloud platforms to perform prediction and analysis tasks. (Analyze / Apply) CO5: Develop simple API-based applications to access machine learning models and generate predictions for real-world data science problems. (Create)								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit – 1: Cloud Platforms and Big Data Storage 1. Cloud Computing for Data Science 1.1 Introduction to Cloud Computing 1.1.1 Concept of cloud computing 1.1.2 Advantages of cloud for Big Data and Machine Learning 1.1.3 Examples of cloud platforms (AWS, Google Cloud, Microsoft Azure) 1.2 Cloud Storage for Large Datasets 1.2.1 Concept of cloud storage and distributed storage 1.2.2 Storing large datasets on cloud platforms 1.2.3 Data access from cloud environments								

- 1.3 Working with Cloud-based Notebooks
 - 1.3.1 Introduction to Google Colab and cloud notebooks
 - 1.3.2 Mounting and accessing cloud storage
 - 1.3.3 Managing datasets stored on cloud platforms
- 1.4 Practical Commands and Functions
 - 1.4.1 Mounting Google Drive: `drive.mount()`
 - 1.4.2 File access commands: `os.listdir()`, `open()`
 - 1.4.3 Loading datasets from cloud using Pandas: `read_csv()`, `read_json()`

Unit – 2: Deploying Machine Learning Models

- 2. Model Deployment Concepts
 - 2.1 Introduction to Model Deployment
 - 2.1.1 Need for deployment in real-world applications
 - 2.1.2 Difference between training and deployment
 - 2.1.3 Overview of ML deployment workflow
 - 2.2 Model Serialization Techniques
 - 2.2.1 Concept of model saving and loading
 - 2.2.2 Model serialization using Pickle
 - 2.2.3 Model serialization using Joblib
 - 2.3 Deploying Models using Python
 - 2.3.1 Saving trained machine learning models
 - 2.3.2 Loading models for prediction tasks
 - 2.3.3 Using deployed models with new datasets
 - 2.4 Practical Commands and Functions
 - 2.4.1 Pickle Functions: `pickle.dump()`, `pickle.load()`
 - 2.4.2 Joblib Functions: `joblib.dump()`, `joblib.load()`
 - 2.4.3 Scikit-learn prediction: `predict()`, `predict_proba()`

Unit – 3: Integrating ML Models with Cloud Data

- 3. Working with Cloud-based Datasets
 - 3.1 Accessing Large Datasets from Cloud
 - 3.1.1 Loading datasets from Google Drive or cloud storage
 - 3.1.2 Working with datasets stored in remote locations
 - 3.1.3 Managing large datasets in cloud environments
 - 3.2 Data Processing for Prediction
 - 3.2.1 Data preprocessing for deployed models
 - 3.2.2 Feature transformation and scaling
 - 3.2.3 Preparing new data for predictions
 - 3.3 Using Deployed Models with Cloud Data
 - 3.3.1 Fetching stored models
 - 3.3.2 Running predictions on large datasets
 - 3.3.3 Storing prediction results
 - 3.4 Practical Commands and Functions
 - 3.4.1 Pandas functions: `read_csv()`, `to_csv()`, `apply()`
 - 3.4.2 Feature scaling: `StandardScaler().transform()`
 - 3.4.3 Prediction functions: `predict()`

Unit – 4: Model Access through APIs and Cloud Applications

- 4. ML Model Access and Applications
 - 4.1 Introduction to APIs for Machine Learning
 - 4.1.1 Concept of APIs in ML systems
 - 4.1.2 Role of APIs in accessing ML models
 - 4.1.3 Examples of ML services using APIs

	4.2 Creating Simple ML APIs 4.2.1 Introduction to API frameworks 4.2.2 Using Flask for simple ML APIs 4.2.3 Handling requests and responses 4.3 Integrating APIs with Cloud Data 4.3.1 Sending data to ML models through APIs 4.3.2 Receiving prediction outputs 4.3.3 Applications of deployed ML services 4.4 Practical Commands and Functions 4.4.1 Flask functions: Flask(), route(), request, jsonify() 4.4.2 Sending requests using Python: requests.get(), requests.post() 4.4.3 Running applications: app.run() [Suggested Tools: Python, Pandas, Scikit-learn, Pickle, Joblib, Flask, Google Colab, Cloud Storage (Google Drive / AWS S3 / Azure Blob)].
Reference Books	1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media, ISBN: 978-1492032649 2. Machine Learning with PySpark, Tomasz Drabas and Denny Lee, O'Reilly Media, ISBN: 978-1491972953 3. Learning Spark: Lightning-Fast Big Data Analysis, Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia, O'Reilly Media, ISBN: 978-1449358624 4. Deep Learning with Python, François Chollet, Manning Publications, ISBN: 978-1617296864 5. Python for Data Analysis, Wes McKinney, O'Reilly Media, ISBN: 978-1491957660 6. Practical MLOps: Operationalizing Machine Learning Models, Noah Gift and Alfredo Deza, O'Reilly Media, ISBN: 978-1098103019 7. Designing Data-Intensive Applications, Martin Kleppmann, O'Reilly Media, ISBN: 978-1449373320 8. Cloud Computing: Concepts, Technology and Architecture, Thomas Erl, Ricardo Puttini and Zaigham Mahmood, Pearson Education, ISBN: 978-0133387520 9. Building Machine Learning Powered Applications, Emmanuel Ameisen, O'Reilly Media, ISBN: 978-1492045113 10. Data Science on the Google Cloud Platform, Valliappa Lakshmanan, O'Reilly Media, ISBN: 978-1491974568
Teaching Methodology	Class Work, Discussion, Experimental work, Self-Study, Seminars and/or Assignments
Evaluation Method	Internal Assessment : - Continuous evaluation, Assignment, Attendance - 50% weightage for Practical and Theory exams External Assessment : - Theory exam - Practical exam - 50% weightage for Practical and Theory exams

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
T.Y.B.Sc.(DATA SCIENCE)
(SEM – 6)
(w.e.f. Academic Year June, 2027-2028)
604: PROJECT

COURSE NANME	PROJECT									
Semester	VI th									
NCrF Credit Level	5.5									
Course Type	MAJOR									
Course Subtype	Employability And Skill oriented									
Subject Type	Major Discipline Specific									
Course Code	604									
Course Level	400-499									
Course Title	Project									
Credit	4 Credits									
Effective From	Academic Year : 2027-2028									
Course Outcomes	CO1: Analyze: Students will be able to analyze project requirements, identify suitable tools, and prepare an implementation strategy. CO2: Create: Students will develop full-fledged applications using relevant web, mobile, or hybrid technologies. CO3: Apply: Students will gain experience in applying the Software Development Life Cycle (SDLC) to real-world problems. CO4: Create: Students will prepare and submit a comprehensive project report that meets academic and professional standards. CO5: Evaluate: Students will present their project solutions confidently and clearly to technical and non-technical audiences.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	Final Semester Project, aligned with the subjects they studied such as: • Python Programming • Data Analysis (NumPy, Pandas) • Data Visualization (Power BI / Tableau) • Machine Learning • Big Data Handling (PySpark) • Cloud-based ML and Big Data Applications • LLM basics and NLP STEP – 1: Project Planning and Problem Definition 1.1 Understanding Problem Statement 1.1.1 Identification of real-world data science problem									

	1.1.2 Defining objectives of the project 1.1.3 Identifying type of problem (Prediction, Classification, Clustering, Recommendation, NLP, etc.) 1.2 Feasibility Study and Requirement Analysis 1.2.1 Technical feasibility (tools, libraries, computing resources) 1.2.2 Availability of datasets (public datasets, cloud datasets, APIs) 1.2.3 Identifying input data and expected outputs 1.3 Technology Stack Selection 1.3.1 Programming tools: Python, Jupyter Notebook, Google Colab 1.3.2 Data science libraries: NumPy, Pandas, Matplotlib, Seaborn, Scikit-learn 1.3.3 Big data tools: PySpark 1.3.4 Visualization tools: Power BI / Tableau 1.3.5 Cloud tools: Google Colab / Google Drive / Cloud storage 1.4 Project Scheduling and Team Role Allocation 1.4.1 Preparing project timeline and milestones 1.4.2 Assigning roles in team (data collection, preprocessing, modelling, visualization, documentation) 1.4.3 Weekly progress monitoring and reporting STEP – 2: Data Science Project Design 2.1 System Design and Architecture 2.1.1 Overview of the data science workflow 2.1.2 Designing architecture for data collection, processing and modelling 2.1.3 Data pipeline planning 2.2 Dataset Design and Data Understanding 2.2.1 Identifying data sources (CSV, JSON, APIs, cloud datasets) 2.2.2 Understanding dataset structure and attributes 2.2.3 Exploratory Data Analysis (EDA) 2.3 Data Visualization and Interface Design 2.3.1 Planning dashboards and visual reports 2.3.2 Designing charts, graphs and visual insights 2.3.3 Dashboard layout planning using Power BI / Tableau 2.4 Data Flow and Model Architecture 2.4.1 Data Flow Diagram (DFD) for data processing 2.4.2 Model architecture diagram 2.4.3 System workflow representation STEP – 3: Project Development and Implementation 3.1 Data Collection and Preprocessing 3.1.1 Data loading using Pandas / PySpark 3.1.2 Data cleaning and missing value handling 3.1.3 Feature engineering and data transformation 3.2 Machine Learning Model Development 3.2.1 Selecting suitable ML algorithms 3.2.2 Training machine learning models 3.2.3 Model evaluation and performance analysis 3.3 Big Data and Cloud Integration 3.3.1 Handling large datasets using PySpark 3.3.2 Using cloud storage for datasets 3.3.3 Deploying trained models and fetching predictions 3.4 Testing and Validation 3.4.1 Testing model accuracy and reliability
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	3.4.2 Validation using test datasets 3.4.3 Result analysis and performance improvement STEP – 4: Documentation, Deployment and Presentation 4.1 Project Documentation Preparation 4.1.1 Software Requirement Specification (SRS) 4.1.2 Design and implementation documentation 4.1.3 User manual and installation guide 4.2 Deployment of Data Science Project 4.2.1 Deployment on cloud platforms (Google Colab / cloud hosting) 4.2.2 Creating dashboards or web interfaces 4.2.3 Demonstration of prediction system 4.3 Project Report Writing 4.3.1 Writing final project report in standard academic format 4.3.2 Including methodology, datasets, models and results 4.3.3 Preparing result analysis and conclusion 4.4 Project Presentation and Demonstration 4.4.1 Preparing presentation slides 4.4.2 Demonstration of project working 4.4.3 Final viva-voce evaluation [Project Guidelines: • Students will submit E-Document of the Project Report. • One internal guide will be allocated for every ten groups. • All groups must meet their internal guide once a week to report project progress. • Project should involve data analysis, machine learning or big data applications using the tools studied in the program.]																		
Project Evaluation Scheme	<table><tr><th>Component</th><th>Marks</th></tr><tr><td>Problem Definition and Planning</td><td>10%</td></tr><tr><td>Design and Architecture</td><td>15%</td></tr><tr><td>Implementation and Functionality</td><td>30%</td></tr><tr><td>Testing and Deployment</td><td>15%</td></tr><tr><td>Documentation</td><td>10%</td></tr><tr><td>Final Presentation & Viva</td><td>20%</td></tr><tr><td>Total</td><td>100%</td></tr></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%	Total	100%		
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%																		
Total	100%																		
Teaching Methodology	Discussion, Experimental work, Project work, Self-Study, Seminars and/or Assignments.																		
Evaluation Method	50% Internal assessment. - Attendance and reporting to internal guides - Internal project presentation and demonstration, project documentation. 50% External assessment. - Project presentation and demonstration, viva-voce and e-project report.																		

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
T.Y.B.Sc.(DATA SCIENCE)
(SEM – 6)

605: Project and Interview Presentation Soft Skills (A.E.C.)
(w.e.f. Academic Year June, 2027-2028)

COURSE NAME	Project and Interview Presentation Soft Skills								
Semester	VIth								
NCrF Credit Level	5.5								
Course Type	AEC (Ability Enhancement Course)								
Course Subtype	Soft Skills								
Subject Type	Intra Disciplinary								
Course Code	605								
Course Level	200-299								
Course Title	Project and Interview Presentation Soft Skills								
Credit	2 Credits								
Effective From	Academic Year : 2027-2028								
Course Outcomes	CO1:(Understand): Explain the essential components of professional project documentation and communication in the software and IT industry. CO2:(Apply): Demonstrate the ability to present project concepts clearly using structured presentation techniques and visual aids relevant to IT solutions. CO3:(Analyze): Evaluate the technical and soft skill requirements of various IT job roles and align personal project work and presentation accordingly. CO4:(Create): Develop a mini-project or prototype by integrating appropriate software tools and technologies and document it as per standard industry practices. CO5:(Evaluate): Justify design choices, tool selection, and development approach during interviews or viva presentations using logical reasoning and industry-specific language.								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Communication and Presentation Skills in the IT Industry 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 1.2.1 Creating Technical Presentations 1.2.2 Using Tools like PowerPoint, Canva, Prezi 1.2.3 Speaking with Confidence in Team and Client Meetings 1.3 Email and Technical Writing Etiquette								

	1.3.1 Writing Clear Technical Emails 1.3.2 Preparing Professional Reports and Documentation Unit 2: Project Documentation and Reporting 2.1 Understanding Software Development Life Cycle (SDLC) 2.1.1 Role of Documentation at Each Phase 2.1.2 Agile Documentation vs Traditional Models 2.2 Technical Project Documentation 2.2.1 Problem Statement and Requirements 2.2.2 Design Diagrams: UML, ER Diagrams 2.2.3 Testing and Deployment Documentation 2.3 Final Report Writing and Formatting 2.3.1 Structuring a Complete Project Report 2.3.2 IEEE/ACM Style Guidelines and Referencing 2.3.3 Common Errors to Avoid in Technical Reports Unit 3: Interview Readiness and Soft Skills for Developers 3.1 Resume and LinkedIn Profile Building 3.1.2 Components of a Tech Resume 3.1.3 Tailoring Resumes for Software Roles 3.2 Interviewing Skills for IT Roles 3.2.1 Understanding the Interview Process in Software Companies 3.2.2 Technical Round vs HR Round Expectations 3.2.3 STAR Method for Behavioural Interview Questions 3.3 Mock Interview Sessions 3.3.1 Self-Introduction Practice 3.3.2 Group Feedback and Interview Etiquette Unit 4: Final Project Presentation and Seminar 4.1 Project Showcase Guidelines 4.1.1 Preparing for Project Presentation 4.1.2 Demonstrating Code, UI, and Deployment 4.2 Seminar and Peer Review 4.2.1 Presentation to Class and Faculty Panel 4.2.2 Peer Evaluation Criteria 4.3 Soft Skill Reflection and Final Assessment 4.3.1 Student Reflections on Soft Skills Gained 4.3.2 Final Grading and Suggestions for Improvement [One topic will be allocated to every students. The student will prepare a seminar and presentation along with a documentation.]
Reference Books	1. Technical Communication: Principles and Practice, Meenakshi Raman & Sangeeta Sharma, Oxford University Press India, ISBN: 9780195695747 2. Soft Skills: Know Yourself and Know the World, Dr. Alex K., S. Chand Publishing, ISBN: 9789352534357 3. Communication Skills for Engineers, Sunita Mishra & C. Muralikrishna, Pearson Education India, ISBN: 9788131733844 4. Business Communication, P.D. Chaturvedi & Mukesh Chaturvedi, Pearson Education India, ISBN: 9788131733585 5. Developing Soft Skills, Gajendra Singh Chauhan, Wiley India, ISBN: 9788126577500 6. The Quick and Easy Way to Effective Speaking, Dale Carnegie, Simon & Schuster, ISBN: 9780743528322

	7. Cracking the Coding Interview, Gayle Laakmann McDowell, CareerCup, ISBN: 9780984782857 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
Teaching Methodology	Class Work, Discussion, Presentation, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit Tests (Seminar). - Internal presentations, documentation, viva-voce and Seminar 50% External assessment. - Presentation, documentation and Viva-voce.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
T.Y.B.Sc.(DATA SCIENCE)
(SEM – 6)
606: INTERNSHIP
 (w.e.f. Academic Year June, 2027-2028)

COURSE NAME	INTERNSHIP
Semester	VIth
NCrF Credit Level	5.5
Course Type	Skill Enhancement and Employment Oriented
Course Subtype	Technical and Soft Skills
Subject Type	Subject Specific
Course Code	606
Course Level	400-499
Course Title	INTERNSHIP
Credit	4 Credits
Effective From	Academic Year : 2027-2028
Minimum Hours/Semester	120 hours of internship work (Including Direct interaction, interactive sessions, applied/training work, Task works, Evaluation, Preparation etc.)
Purpose of Course	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.
Course Objective	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.
Course Outcomes	CO1 (Apply): Apply programming, development, or analytical skills gained in the classroom to solve real-world computing problems during the internship. CO2 (Analyze): Analyze the architecture, workflow, and practices of the host organization to understand the integration of computer systems in business or technical environments. CO3 (Evaluate): Evaluate project requirements, software tools, and technologies used during the internship to recommend improvements or alternative approaches.

	CO4 (Create): Create a structured technical report and project documentation summarizing the tasks, challenges, and outcomes of the internship. CO5 (Present): Present the project findings and experience effectively using professional communication and presentation skills tailored to the IT/software industry.		
Internship Structure and Deliverable by Students:	Duration: 120 Hours Mode: Offline / Online / Hybrid Location: Industry, business firms, IT companies, local government offices, health organizations, media, artisans, etc. Deliverables by Student: 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		
Course Evaluation	Component	Marks/Weightage	
	Attendance and Participation	20%	
	Weekly Progress Logbook	20%	
	Final Internship Report	30%	
	Presentation & Viva Voce	30%	
	Total	100%	
Internship Report Template	INTERNSHIP REPORT TEMPLATE (to be submitted after internship completion)		
	Front Page		
	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:			
1. Acknowledgment			
A short paragraph acknowledging the guidance and support of the organization and faculty mentor.			
2. Certificate			
Internship Completion Certificate (copy from organization)			
3. Declaration			
Declaration by the student that the report is original and submitted for academic purposes.			
4. Internship Details			
Name and Address of Organization			
Nature of Business/Services			
Department/Team worked in			
Name and Designation of Industry Supervisor			
5. Objectives of Internship			
What you aimed to learn and accomplish.			
6. Description of Work Done			
Overview of the tasks and responsibilities handled			
Description of technologies/tools used			
Screenshots, flowcharts, or diagrams (if applicable)			

	7. Learning Outcomes Skills developed, software or tools learned, industry exposure gained. 8. Challenges and Solutions Mention any problems faced and how you solved them. 9. Weekly Summary Brief of what was done in each week (can be derived from the logbook). 10. Conclusion Summary of overall experience, learning, and impact on career development. 11. References Any websites, books, or resources referred to during the internship.
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INTERNSHIP LOGBOOK FORMAT (to be maintained weekly)

Week No.	Date (From–To)	Tasks Assigned	Tasks Completed	Tools/Technologies Used	Remarks by Internship Guide
Week 1	01/06/2026 – 07/06/2026	Task 1 description	Task 1 completed	e.g., HTML, Python, MySQL	Signature & comments
Week 2					
...					
Week N					

Note: 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. In case of the online internship, the consolidated Logbook should be submitted at the end of the successful completion of the Internship.



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.

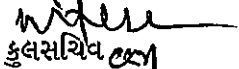
Tel : +91 - 261 - 2227141 to 2227146, Toll Free : 1800 2333 011, Digital Helpline No.- 0261 2388888
E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

-: પરિપત્ર :-

યુનિવર્સિટી સંલગ્ન કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા હેઠળની તમામ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૬-૨૭ થી અમલમાં આવનાર સ્નાતક કક્ષાના વિવિધ વિષયોના સેમેસ્ટર-૧, ૩, ૪ અને ૫ ના Skill Enhancement Course (SEC)ના પેટાસમિતિ દ્વારા તૈયાર કરવામાં આવેલ અભ્યાસક્રમો કોમ્પ્યુટર સાયન્સ વિષયની અભ્યાસ સમિતિના ચેરમેનશ્રીએ અભ્યાસ સમિતિવતી અને કોમ્પ્યુટર સાયન્સ ફેકલ્ટીના ઈ.ચા.ડી.નશ્રીએ ફેકલ્ટીવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૦૭/૦૫/૨૦૨૬ ની સભાનાં ઠરાવ ક્રમાંક: ૬૬ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક:ઓથો./પરિપત્ર/૧૦૦૮૧/૨૦૨૬
તા.૧૨/૦૫/૨૦૨૬


કુલસચિવ

પ્રતિ,

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

SKILL ENHANCMENT COURSE (SEC)

FOR

**SEM-1 , SEM-2, SEM-3, SEM-4 AND
SEM-5**

FOR

**B.C.A. , B.SC.(COMPUTER SCIENCE),
B.SC.(C.A.), B.VOC.(I.T.) AND**

ALL B.C.A. SPECIALISED PROGRAMS (
A.I.& DATA ANALYTICS, DATASCIENCE,
CYBER SECURITY)
B.Sc. (Data Science)

SEMESTER- 3

Course Title: EDA using Python

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science)/B.Sc. (Data Science)								
Semester	3								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	306-01								
Course Level	200-299								
Course Title	EDA using Python								
Credit	2 (2 theory)								
Effective From	A.Y. 2026 - 27								
CourseOutcomes	1. Understand different types of data and sources 2. Identify and handle data errors effectively 3. Use Python libraries for data cleaning and analysis 4. Create meaningful visualizations 5. Perform complete EDA on real-world datasets								
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Data and Data Sources 1.1 Types of Data 1.1.1 Structured, Semi-structured, and Unstructured Data 1.1.2 Qualitative vs Quantitative Data 1.1.3 Discrete vs Continuous Data 1.1.4 Time-series and Cross-sectional Data 1.2 Data Sources 1.2 .1 Primary vs Secondary Data 1.2.2 Open data sources (government portals, APIs) 1.2.3 Web scraping basics 1.3 Types of Databases 1.3.1Relational Databases (RDBMS) 1.3.2 NoSQL Databases (MongoDB, Cassandra) 1.3.3 Data Warehouses and Data Lakes 1.3 Types of Data Files 1.4.1 CSV, Excel, JSON, XML, TXT 1.4.2. Differences and use cases 1.4.3 File handling basics in Python 1.5 Introduction to Python for EDA 1.5.1 Python environment setup (Anaconda/Jupyter Notebook) 1.5.2 Basic syntax and data structures (lists, dictionaries, tuples)								

Unit 2: Data Quality, Errors, and Cleaning

2.1 Common Errors in Data

- 2.1.1 Missing values (NaN, NULL)
- 2.1.2 Duplicate data
- 2.1.3 Inconsistent formats (date, text, units)
- 2.1.4 Outliers and noise
- 2.1.5 Typographical errors

2.2 Disadvantages of Poor Data Quality

2.3 Importance of Data Cleaning

2.4 Data Cleaning Techniques

- 2.4.1 Handling missing values (imputation, deletion)
- 2.4.2 Removing duplicates
- 2.4.3 Data type conversion
- 2.4.4 String cleaning and formatting
- 2.4.5 Outlier detection and treatment

Unit 3: Python Libraries for Data Cleaning and Analysis

3.1 Introduction to Key Libraries

- 3.1.1 NumPy (numerical operations)
- 3.1.2 Pandas (data manipulation)

3.2 Pandas Functions for Data Cleaning

- 3.2.1 read_csv(), read_excel()
- 3.2.2 info(), describe()
- 3.2.3 isnull(), dropna(), fillna()
- 3.2.4 duplicated(), drop_duplicates()
- 3.2.5 astype()
- 3.2.6 apply(), map()

3.3 Data Transformation

- 3.3.1 Filtering and sorting data
- 3.3.2 Grouping (groupby())
- 3.3.3 Merging and joining datasets
- 3.3.4 Feature creation and modification

3.4 Introduction to Data Analysis

- 3.4.1 Descriptive statistics
- 3.4.2 Correlation and covariance
- 3.4.3 Aggregation techniques

Unit 4: Data Visualization Techniques in Python

4.1 Importance of Data Visualization

4.2 Visualization Libraries

- 4.2.1 Matplotlib
- 4.2.2 Seaborn
- 4.2.3 Plotly (basic introduction)

4.3 Types of Visualizations

- 4.3.1 Line charts
- 4.3.2 Bar charts
- 4.3.3 Histograms
- 4.3.4 Scatter plots
- 4.3.5 Box plots
- 4.3.5 Heatmaps

Reference Books	Sr. No.	Book Name	Author(s)	Publication	ISBN
	1	<i>Python for Data Analysis</i>	Wes McKinney	O'Reilly Media	978-1491957660
	2	<i>Data Science from Scratch</i>	Joel Grus	O'Reilly Media	978-1492041139
	3	<i>Practical Statistics for Data Scientists</i>	Peter Bruce, Andrew Bruce	O'Reilly Media	978-1492072942
	4	<i>Hands-On Data Analysis with Pandas</i>	Stefanie Molin	Packt Publishing	978-1789615326
	5	<i>Data Wrangling with Python</i>	Jacqueline Kazil, Katharine Jarmul	O'Reilly Media	978-1491948811
	6	<i>Python Data Science Handbook</i>	Jake VanderPlas	O'Reilly Media	978-1491912058
	7	<i>Think Stats</i>	Allen B. Downey	O'Reilly Media	978-1491907337
	8	<i>Introduction to Data Science</i>	Laura Igual, Santi Seguí	Springer	978-3319500164
	9	<i>Applied Data Science with Python</i>	Alex Galea	Packt Publishing	978-1786468253
	10	<i>Mastering Pandas</i>	Femi Anthony	Packt Publishing	978-1789343236
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments				
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level				

Course Code: 306-02
Course Title: Fundamentals of Android

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)								
Semester	3								
NCrF Credit Level	4.5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	306-02								
Course Level	200 - 299								
Course Title	Fundamentals of Android								
Credit	2 (2 Theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	CO1 : Explain Android architecture, features, and application framework. CO2 : Develop simple Android applications using Android Studio and basic knowledge of XML CO3 : Design user interfaces using various layouts and widgets. CO4 : Implement event handling for UI components like buttons and checkboxes. CO5 : Create interactive applications using dialogs, list views, and image views. Use intents to navigate between different application components.								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit - 1: Android OS Architecture & Features 1.1 History, concepts and Features of Android 1.2 Concepts of API framework 1.3 Kernel Native Libraries& DVM (Dalvik Virtual Machine) 1.4 Application Framework Unit – 2: XML Introduction 2.1 Characteristics of XML 2.2 XML Declaration, Tags and elements 2.3 Root element 2.4 XML documents Unit - 3: Android widgets and its implementation 3.1 First Android Project 3.2 Title Bar 3.3 Screen Orientation (Portrait, Landscape) 3.4 Android Layouts 3.4.1 Constraint Layout 3.4.2 Linear Layout 3.4.3 Table Layout 3.4.4 Grid View 3.5 Text Field, Button, Checkbox, Radiobutton 3.5.1 Event Handling on Button, Checkbox, Radiobutton								

	3.6 ToggleButton 3.7 Toast Unit - 4: Android Widgets 4.1 Alert Dialog Box 4.2 List View 4.3 Custom Listview 4.4 ImageView, Image Slider 4.5 Search View 4.6 Intent
Reference Books	1) Android Programming for Beginners - Second Edition, Author: John Horton, Publisher: Image Short ISBN: 978-1789538502 2) Android 9 Development Cookbook, Author: Rick Boyer, Publisher: Packet Publishing, ISBN: 978-1788991216 3) Android Application Development (With Kitkat Support), Author: Pradeep Kothari, Publisher: DreamTech Press., ISBN: 978-9351194095 4) Android Studio 4.0 Development Essentials – Kotlin Edition, Author – Neil Smyth, Publisher: Payload Media, ISBN – 13: 978 – 1951442194 5) Head First Android Development - 3rd Edition, Author: Dawn Griffiths, David Griffiths, Publisher: O'Reilly Media, ISBN: 9781492076522 6) Android Application Development Black Book, Author: Pradeep Kothari, Publisher: Dreamtech Press, ISBN: 9789351194095 7) Professional Android (4th Edition), Author: Reto Meier, Ian Lake, Publisher: Wiley, ISBN: 9781118949527 8) Programming Android: Java Programming for the New Generation of Mobile Devices, Author: Zigurd Mednieks, Publisher: O'Reilly Media, ISBN: 9781449316648 9) Learning Android Application Development, Author: Wallace Jackson, Publisher: Apress, ISBN: 9781484217848 10) Beginning Android Programming with Android Studio, Author: Jerome (J.F.) DiMarzio, Publisher: Wiley, ISBN: 9781118705598
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars, Assignments, Viva-Voce/ Presentation
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level

Course Code: 306-03

Course Title: Fundamentals of Graphic Design with designing software

[illegible]

Course content	Unit 1: Introduction 1.1 What is Graphics Design? 1.2 Applications of Graphics Design 1.3 Basic shapes of Graphics 1.4 Overview of Canva 1.5 Exploration of Canva Dashboard Unit 2: Canva Editing Basics and Social Media 2.1 Fonts & texts 2.2 Colors& Combination 2.3 The taskbar: Effects, Filters, Crop, Rotate, position and transparency 2.4 Zooming, pages and notes 2.5 Animation for text and images 2.6 Background removal 2.7 Downloading, copying and sharing 2.8 Business cards 2.9 Instagram post 2.10 Instagram reel video 2.11 Creating Youtube Thumbnail Unit 3: Canva for Presentation 3.1 Overview of Canva presentation 3.2 Using Canva Default templates 3.3 Ways to present Canva presentation 3.4 Record your presentations with audio and image in Canva Unit 4: Canva Design for Enterprise and Business 4.1 Personalised flyer for event 4.2 Infographics 4.3 Resume 4.4 Websites
Reference Books	1. Design with Canva: A step by step guide on how to use Canva by LateefahRaji –Independently published 2. Design Better and Build Your Brand in Canva: A beginner's guide to producing professional branding, marketing, and social content for businesses by Laura Goodsell – Packt 3. The A to Z Field Guide to Canva: A User's Companion to Canva Terms and Features by Amanda Fox – TeacherGoals 4. Canva Tips and Tricks Beyond The Limits by Koushik K - Draft2Digital 5. Ready, Set, Brand!: The Canva for Work Quickstart Guide by Lisa Larson-Kelley - Beginners Brain 6. Graphic Design School: The Principles and Practice of Graphic Design by David Dabner, Sandra Stewart, Eric Zempel - Wiley 7. Graphic Design Theory by Helen Armstrong - Princeton Architectural Press
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments

Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level
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- 1.1.1.2 Temperature sensor
- 1.1.1.3 Motion sensor (PIR)
- 1.1.2 Reading sensor values
 - 1.1.2.1 Analog input basics
 - 1.1.2.2 Digital input basics
 - 1.1.2.3 Continuous data reading
- 1.1.3 Understanding sensor output
 - 1.1.3.1 Raw values
 - 1.1.3.2 Range of values
 - 1.1.3.3 Simple interpretation
- 1.2 Serial Communication Basics
 - 1.2.1 Introduction to serial communication
 - 1.2.1.1 What is communication?
 - 1.2.1.2 Data transfer concept
 - 1.2.2 Serial Monitor usage
 - 1.2.2.1 Displaying data
 - 1.2.2.2 Reading output
 - 1.2.2.3 Debugging using Serial Monitor
 - 1.2.3 Data formatting
 - 1.2.3.1 Text display
 - 1.2.3.2 Numeric display
 - 1.2.3.3 Structured output

Unit-2:

- 2.1 Introduction to IoT Communication
 - 2.1.1 Concept of data transmission
 - 2.1.2 Wired vs Wireless communication
- 2.2 Introduction to Wi-Fi Module
 - 2.2.1 Basic idea of Wi-Fi module
 - 2.2.2 Sending simple data
- 2.3 IoT Platforms
 - 2.3.1 Introduction to ThingSpeak
 - 2.3.2 Creating account and channel
 - 2.3.3 Sending data to cloud

Unit-3: Data Visualization and Simple Dashboard

- 3.1 Data Visualization Basics
 - 3.1.1 Why visualization is needed
 - 3.1.2 Graphs and charts
- 3.2 Viewing IoT Data
 - 3.2.1 Real-time data display
 - 3.2.2 Graph plotting
- 3.3 Basic Dashboard
 - 3.3.1 Creating simple dashboards
 - 3.3.2 Monitoring sensor data

Unit-4: Smart IoT Systems (Applied)

- 4.1 Data-Based Decision Systems
 - 4.1.1 Threshold-based decision
 - 4.1.2 If-Else logic in IoT
- 4.2 Smart Monitoring Systems
 - 4.2.1 Environment monitoring system
 - 4.2.2 Light/temperature monitoring
- 4.3 Mini Projects

	4.3.1 Data logging system 4.3.2 Smart alert system 4.3.3 Student-defined project [Students are expected to work on following suggested Practicals during Lab- hours : 1. Continuous sensor data reading ,2. Serial monitor data formatting, 3.Sending sensor data via communication module , 4. Upload data to cloud platform, 5. Create graph of sensor data, 6. Build simple dashboard, 7. Threshold-based alert system, 8. Multi-sensor data monitoring , 9. Real-time data visualization, 10. Mini IoT project] [Suggested components for lab : (One set per 10 students): (i) Arduino Uno – 1, (ii) Breadboard – 1, (iii) USB Cable – 1 (iv) LEDs –10nos. (v) Resistors – Assorted (vi) Jumper wires – Set (vii) Push buttons –3nos. (viii) LDR sensor – 1nos. (ix) Temperature sensor – 1nos., (x) PIR sensor – 2 nos. (xi) Buzzer – 2 nos., (xii) Wi-Fi Module (basic) (xiii) Jumper wires (xiv) USB cable]
Reference Books	1. Getting Started with Arduino (3rd Edition), 978-9352139819, Massimo Banzi, Maker Media 2. Arduino Cookbook, 978-1449313876, Michael Margolis, O'Reilly Media 3. Programming Arduino: Getting Started with Sketches, 978-0071784229, Simon Monk, McGraw-Hill Education 4. Exploring Arduino: Tools and Techniques for Engineering Wizardry, 978-1119405373, Jeremy Blum, Wiley 5. Internet of Things: A Hands-On Approach, 978-0996025515, Arshdeep Bahga and Vijay Madisetti, Universities Press 6. Learning Internet of Things, 978-1788399119, Peter Waher, Packt Publishing 7. Beginning Arduino, 978-1430232401, Michael McRoberts, Apress 8. Make: Electronics (2nd Edition), 978-1680450260, Charles Platt, Maker Media 9. Practical Electronics for Inventors (4th Edition), 978-1259587549, Paul Scherz and Simon Monk, McGraw-Hill Education 10. Hands-On Internet of Things with MQTT, 978-1789341780, Agus Kurniawan, Packt Publishing
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Practical Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Practical Exam, viva-voce, E-Journal

SEMESTER – 4

Course Title: Introduction to Machine Learning

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)								
Semester	4								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	406-01								
Course Level	200-299								
Course Title	Introduction to Machine Learning								
Credit	2 (2 theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	1. Explain the basic concepts and evolution of Machine Learning. 2. Classify Machine Learning approaches such as supervised, unsupervised, and reinforcement learning. 3. Apply appropriate Machine Learning techniques to different problem domains. 4. Describe the complete Machine Learning workflow from data collection to model evaluation. 5. Compare various ML techniques based on performance, complexity, and applicability.								
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Machine Learning 1.1 History and Evolution of Machine Learning 1.1.1 Early developments and milestones 1.1.2 Evolution from Artificial Intelligence to Machine Learning 1.2 Importance of Machine Learning 1.2.1 Role in modern technology 1.2.2 Impact on industries (healthcare, finance, retail, etc.) 1.3 Why Machine Learning is Required 1.3.1 Limitations of traditional programming 1.3.2 Need for automation and intelligent systems 1.4 Basic Concepts 1.4.1 Data, features, labels 1.4.2 Training and testing datasets								

Unit 2: Types of Machine Learning and Use Cases

2.1 Types of Machine Learning

- 2.1.1 Supervised Learning
- 2.1.2 Unsupervised Learning
- 2.1.3 Semi-Supervised Learning
- 2.1.4 Reinforcement Learning

2.2 Common Algorithms (Overview)

- 2.2.1 Regression (Linear Regression)
- 2.2.2 Classification (Decision Trees, KNN)
- 2.2.3 Clustering (K-Means)

2.3 Use Cases of Machine Learning

- 2.3.1 Recommendation systems
- 2.3.2 Fraud detection
- 2.3.3 Image and speech recognition
- 2.3.4 Predictive analytics

2.4 Application of Machine Learning

- 2.4.1 Business applications
- 2.4.2 Healthcare systems
- 2.4.3 Smart systems and automation

Unit 3: Machine Learning Process (Lifecycle)

3.1 Steps in Machine Learning Process

- 3.1.1 Data collection
- 3.1.2 Data preprocessing
- 3.1.3 Feature selection and engineering
- 3.1.4 Model selection
- 3.1.5 Training and testing
- 3.1.6 Evaluation and validation

3.2 Model Evaluation Techniques

- 3.2.1 Accuracy, precision, recall
- 3.2.2 Confusion matrix
- 3.2.3 Overfitting and underfitting

3.3 Tools and Platforms (Overview)

- 3.3.1 Python libraries (Scikit-learn, Pandas, NumPy)
- 3.3.2 ML development environments

Unit 4: Advantages, Disadvantages, and Characteristics of ML Techniques

4.1 Advantages of Machine Learning

4.2 Disadvantages of Machine Learning

4.3 Characteristics of ML Techniques

- 4.3.1 Supervised Learning: labeled data, predictive models
- 4.3.2 Unsupervised Learning: pattern discovery
- 4.3.3 Reinforcement Learning: reward-based learning

4.4 Comparison of Techniques

- 4.4.1 Strengths and weaknesses
- 4.4.2 Suitable scenarios for each method

Reference Books	Sr. No.	Book Name	Author(s)	Publication	ISBN
	1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	978-0262018029
	2	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer	978-0387310732
	3	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow	Aurélien Géron	O'Reilly Media	978-1492032649
	4	Introduction to Machine Learning with Python	Andreas C. Müller, Sarah Guido	O'Reilly Media	978-1449369415
	5	Machine Learning	Tom M. Mitchell	McGraw-Hill	978-0070428072
	6	Python Machine Learning	Sebastian Raschka, Vahid Mirjalili	Packt Publishing	978-1789955750
	7	Understanding Machine Learning: From Theory to Algorithms	Shai Shalev-Shwartz, Shai Ben-David	Cambridge University Press	978-1107057135
	8	Applied Machine Learning	M. Gopal	McGraw-Hill Education	978-0070703698
	9	Machine Learning for Absolute Beginners	Oliver Theobald	Scatterplot Press	978-1530839407
	10	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	978-0262035613
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments				
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level				

Course Code: 406 - 02
Course Title: Data Analysis and Dashboard Reporting using Worksheet

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)								
Semester	4								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	406-02								
Course Level	200 - 299								
Course Title	Data Analysis and Dashboard Reporting using Worksheet								
Credit	2 (2 Theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	CO1 : Manage and clean data efficiently CO2 : Apply formulas and functions CO3 : Create reports using Power BI CO4 : Design dashboards CO5 : Present data insights								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Power BI 1.1 Power BI environment 1.2 Data entry and formatting 1.3 Data cleaning 1.4 Sorting and filtering 1.5 Uploading CSV 1.6 Creating reports Unit 2: Visualization Techniques 2.1 Create and format visuals 2.2 Charts and graphs 2.3 Map and gauge visuals 2.4 Slicers and filters Unit 3: Reports and Dashboard 3.1 Create and modify reports 3.2 Dashboard creation 3.3 Power BI Q&A 3.4 Sharing and publishing Unit 4: DAX Functions 4.1 Date and time 4.2 Filter functions 4.3 Logical functions 4.4 Math & Trig 4.5 Text functions								

Reference Books	1) Microsoft Power BI Data Analyst Guide, Author: Daniil Maslyuk, Publisher: Packt Publishing, ISBN: 9781803232057 2) Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics, Author: Dan Clark, Publisher: Apress, ISBN: 9781484236238 3) Microsoft Power BI Cookbook, Author: Brett Powell, Publisher: Packt Publishing, ISBN: 9781788290141 4) Pro Power BI Desktop, Author: Adam Aspin, Publisher: Apress, ISBN: 9781484234760 5) Mastering Microsoft Power BI, Author: Brett Powell, Publisher: Packt Publishing, ISBN: 9781801811483 6) Analyzing Data with Power BI and Power Pivot for Excel, Author: Alberto Ferrari, Marco Russo, Publisher: Microsoft Press, ISBN: 9781509302764 7) Data Visualization: A Practical Introduction, Author: Kieran Healy, Publisher: Princeton University Press, ISBN : 9780691181621 8) Fundamentals of Business Intelligence, Author: Wilfried Grossmann, Stefanie Rinderle-Ma, Publisher: Springer, ISBN: 9783662574836 9) Dashboarding and Reporting with Power BI, Author: Kasper de Jonge, Publisher: Microsoft, ISBN: 9781509308025 The Definitive Guide to DAX, Author: Marco Russo, Alberto Ferrari, Publisher: Microsoft Press, ISBN: 9781509306977
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars, Assignments, Viva-Voce/ Presentation
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level

Course Code: 406 - 03**Course Title: Data Science with Python**

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science)									
Semester	4 / B.Sc. (Data Science)									
NCrF Credit level	5									
Course Type	SEC									
Course Subtype	Skill Enhancement Course (SEC)									
Subject Type	Intra-Discipline									
Course Code	406-03									
Level of Course	200-299 (Foundation/Introductory)									
Course Title	Data Science with Python									
Credits	2 Credits (30 hours of Practical/Applied knowledge)									
Implementation Year	2026-27									
Purpose of the Course	The primary purpose of this course is to provide students with a strong foundational understanding of Data Science using Python, enabling them to handle real-world data and extract meaningful insights. It aims to: • Build conceptual clarity in Data Science and its applications across industries. • Develop programming skills in Python, specifically tailored for data analysis tasks. • Equip students with data handling abilities using libraries like Pandas, including cleaning, transforming, and managing datasets. • Enhance analytical thinking by teaching how to explore and interpret data effectively. • Enable data visualization skills using tools like Matplotlib, Seaborn, and Plotly to communicate insights clearly. • Introduce core Machine Learning concepts, including supervised and unsupervised learning, and fundamental techniques like classification, regression, and clustering.									
Course Objective	(1) Provide Practical knowledge and practice of Python (2) Provide fundamental knowledge about Data Science									
Pre-requisite	Basic knowledge of Python									
Course Outcome	After successful completion of the course a student will be CO1: Able to understand about need of data science CO2: Able to work on data with visualization CO3: Able to understand how python is important in data science CO4: Able to understand about machine learning and libraries used to work in it.									
Mapping Between COs and PSOs	COs / PSOs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	

	CO1 CO2 CO3 CO4
Course content	Unit 1: Overview 1.1 Introduction to Data Science 1.2 Introduction to Python programming 1.3 Setting up Python environment (Google Colab) Unit 2: Data Manipulation with Pandas 2.1 Introduction to Pandas Library 2.2 Data Cleaning and manipulation with Pandas 2.3 Handling missing data 2.4 Grouping, aggregating, merging and joining data frames Unit 3: Data Visualization with Matplotlib and Seaborn 3.1 Introduction to data visualization 3.2 Plotting and customization with Matplotlib 3.3 Seaborn for statistical visualization 3.4 Creating interactive visualization with Plotly Unit 4: Fundamentals of Machine learning 4.1 Introduction to machine learning 4.2 Supervised and unsupervised learning 4.3 Classification, Regression and Clustering
Reference Books	- Sharma, R.K., Nandi. G (2020). Data Science fundamentals and practical approaches: Understand why data science is the Next, India: BPB Publications. ISBN: 9789389845662, 9389845661 - Mulla, R. (2019) Data Science with Python: For complete Beginners - VanderPlas, J., Python Data Science Handbook, O'Reilly - Foundations of Data Science with Python, John M. Shea, CRC Press, 9781032350424, 2024 - From Concepts to Code: Introduction to Data Science, Adam P. Tashman, CRC Press, 9781032517957, 2024 - Software Engineering for Data Scientists, Catherine Nelson, O'Reilly Media, 9781098136208, 2024 - Linear Algebra in Data Science, Peter Zizler & Roberta La Haye, Springer, 9783031549076, 2024 - Graph Algorithms for Data Science, Tomaž Brataniz, Manning Publications, 9781617299469, 2024 - Data Science for Decision Makers, Erik Herman, Independently Published, 9781501520648, 2024 - AI Snake Oil: What Artificial Intelligence Can Do, What It Can't, and How to Tell the Difference, Arvind Narayanan & Sayash Kapoor, Princeton University Press, 9780691249131, 2024
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments

Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level
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	1.1.2.1 Rule-based systems 1.1.2.2 Intelligent systems 1.2 Introduction to Machine Learning 1.2.1 What is Machine Learning? 1.2.1.1 Learning from data 1.2.1.2 Examples 1.2.2 Types of learning 1.2.2.1 Supervised learning 1.2.2.2 Unsupervised learning 1.3 IoT Data for AI 1.3.1 Source of IoT data 1.3.2 Data collection from sensors 1.3.3 Preparing data for analysis Unit-2: Basic Data Analysis using Python 2.1 Introduction to Python for Data 2.1.1 Basic Python concepts 2.1.2 Reading data 2.2 Data Handling 2.2.1 Introduction to Pandas 2.2.1.1 DataFrame concept 2.2.1.2 Reading CSV data 2.2.2 Data cleaning 2.2.2.1 Missing values 2.2.2.2 Formatting data 2.3 Data Visualization 2.3.1 Introduction to Matplotlib 2.3.2 Plotting simple graphs 2.3.3 Understanding trends Unit-3: Simple Machine Learning Models 3.1 Introduction to ML Tools 3.1.1 Introduction to Scikit-learn 3.1.2 Basic workflow 3.2 Classification 3.2.1 Concept of classification 3.2.2 Example: Temperature → Normal / High 3.2.3 Using simple classification models 3.2.4 Simple Prediction-based Model 3.2.5 Using data to predict output Unit-4: Unit-4: AI-Based IoT Applications (Projects) 4.1 Smart Decision Systems 4.1.1 Sensor data → decision 4.1.2 Intelligent alert systems 4.2 AI-Based Mini Applications 4.2.1 Smart temperature monitoring 4.2.2 Smart light control system 4.2.3 Basic anomaly detection 4.3 Mini Projects 4.3.1 Data collection + analysis 4.3.2 Model application
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	4.3.3 Output decision system [Students are expected to work on following suggested Practicals during Lab- hours : 1. Collect IoT data and save as CSV, 2. Load data using Python, 3. Clean and preprocess data , 4. Plot sensor data graph, 5. Simple classification example, 6. Apply KNN model (basic), 7. Threshold-based prediction, 8. Build simple decision system, 9. Combine IoT + ML, 10. Final mini project] [Suggested components for lab : (One set per 10 students): (i) Arduino Uno – 1, (ii) Breadboard – 1, (iii) USB Cable – 1 (iv) LEDs –10nos. (v) Resistors – Assorted (vi) Jumper wires – Set (vii) Push buttons –3nos. (viii) LDR sensor – 1nos. (ix) Temperature sensor – 1nos., (x) PIR sensor – 2 nos. (xi) Buzzer – 2 nos., (xii) Wi-Fi Module (basic) (xiii) Jumper wires (xiv) USB cable]
Reference Books	1. Getting Started with Arduino (3rd Edition), 978-9352139819, Massimo Banzi, Maker Media 2. Arduino Cookbook, 978-1449313876, Michael Margolis, O'Reilly Media 3. Programming Arduino: Getting Started with Sketches, 978-0071784229, Simon Monk, McGraw-Hill Education 4. Exploring Arduino: Tools and Techniques for Engineering Wizardry, 978-1119405373, Jeremy Blum, Wiley 5. Internet of Things: A Hands-On Approach, 978-0996025515, Arshdeep Bahga and Vijay Madisetti, Universities Press 6. Learning Internet of Things, 978-1788399119, Peter Waher, Packt Publishing 7. Beginning Arduino, 978-1430232401, Michael McRoberts, Apress 8. Make: Electronics (2nd Edition), 978-1680450260, Charles Platt, Maker Media 9. Practical Electronics for Inventors (4th Edition), 978-1259587549, Paul Scherz and Simon Monk, McGraw-Hill Education 10. Hands-On Internet of Things with MQTT, 978-1789341780, Agus Kurniawan, Packt Publishing
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Practical Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Practical Exam, viva-voce, E-Journal

SEMESTER – 5

Course Title: Working with AI Based Software

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)									
Semester	5									
NCrF Credit Level	5.5									
Course Type	SEC									
Course Subtype	Skill Development									
Subject Type	Discipline Specific, Emerging Technology									
Course Code	506-01									
Course Level	200 - 299									
Course Title	Working with AI based Software									
Credit	2 (2 Theory)									
Effective From	A.Y. 2026 - 27									
Course Outcomes	CO1 : Understand the core concepts and architecture of AI. CO2 : Identify and apply free AI tools for academic, research, and creative tasks. CO3 : Use AI tools to automate writing, video creation, and presentation design. CO4 : Create engaging academic content with minimal effort using AI platforms. CO5 : Make informed and ethical decisions while using AI in their academic journey.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	Unit 1: Introduction to Artificial Intelligence (7.5 Hours) 1.1. Definition and history of AI 1.2. Types of AI: Narrow, General, and Super AI 1.3. Applications of AI in education, healthcare, and daily life 1.4. Ethical concerns and responsible AI usage 1.5. AI vs Human intelligence: Myths and facts Unit 2: Architecture of AI Systems (7.5 Hours) 2.1 AI System components: Input, Processing, Output 2.2 Basic structure of AI algorithms and models 2.3 Role of data, training, and feedback loops in AI 2.4 Concept of Machine Learning, Deep Learning, and Natural Language Processing 2.5 AI workflow: From problem to solution Unit 3: Free AI Tools for Academic Tasks (7.5 Hours) 3.1 List and demo of AI tools for: 3.1.1 Writing & summarizing (e.g., Grammarly, Quillbot, ChatGPT) 3.1.2 Presentation generation (e.g., Beautiful.ai, Tome.app)									

	3.1.3 Research assistance (e.g., Elicit.org, Semantic Scholar, Research Rabbit) 3.2 Benefits and limitations of each tool 3.3 AI tools for document formatting and language translation Unit 4: AI for Multimedia, Video Creation & Study Support (7.5 Hours) 4.1 AI tools for video making (e.g., Pictory, Lumen5, Animoto) 4.2 Text-to-speech and voiceover tools (e.g., ElevenLabs, Natural Readers) 4.3 Image generation tools (e.g., Canva AI, Craiyon, Bing Image Creator) 4.4 AI chatbots as study companions (e.g., Socratic, ChatGPT, You.com) 4.5 Mini-project: Create a study video or presentation using AI tools 4.6 Mini-project: Create website or python project using AI tool.
Reference Books	1. Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, Pearson Education, ISBN-13: 978-0134610993 2. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, Apress, ISBN-13: 978-1484235155 3. Machine Learning for Absolute Beginners, Oliver Theobald, CreateSpace, ISBN - 978-1520951400 4. ChatGPT for Beginners, Pam Baker, Wiley, ISBN - 978-1394203783 5. Ethics of Artificial Intelligence, Mark Coeckelbergh, MIT Press, ISBN - 978-0262538190 6. "Artificial Intelligence: A Guide for Thinking Humans", Melanie Mitchell, Farrar, Straus and Giroux (US), ISBN-978-1250758040 7. "AI Basics for anyone", Dale Lane, ISBN - 978-1718500563 8. "Hands-On Artificial Intelligence for Beginners", Patrick D. Smith, Packt Publishing Ltd, ISBN - 978-1788991063 9. Generative AI Basics & Beyond, Tom Taulli, Apress, 9781484293538 10. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, Apress, 9781484233572
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars, Assignments, Viva-Voce/ Presentation
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level

[Subject code-2511000905060180]

Course Code: 506-02

Course Title: Fundamentals of Software Engineering

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)
Semester	5
NCrF Credit level	5
Course Type	SEC
Course Subtype	Skill Enhancement Course (SEC)
Subject Type	Intra-Discipline
Course Code	506-02
Level of Course	200-299
Course Title	Fundamental of Software Engineering
Credits	2 Credits (30 hours of Practical/Applied knowledge)
Implementation Year	2026-27
Purpose of Course	The purpose of this course is to provide students with a comprehensive understanding of Software Engineering principles and practices, enabling them to systematically develop high-quality software systems. It aims to: • Introduce fundamental concepts of software and software engineering, including types of software and their characteristics. • Develop knowledge of software development life cycle (SDLC) and various process models such as Waterfall, Prototype, Incremental, and Spiral. • Build analytical skills to study existing systems, identify limitations, and prepare structured Software Requirement Specifications (SRS). • Equip students with modeling techniques like DFD and UML diagrams (Use Case, Activity, Sequence) for clear system representation. • Enhance design capabilities by understanding key principles, concepts, cohesion, and coupling for creating efficient system architectures. • Provide knowledge of software testing practices, including test case design, types of testing, and handling security and system limitations. • Enable practical application of concepts through real-world case studies like College Management Systems and other domain-based systems.
Course Objective	(1) Provide knowledge and practice of Software Engineering phases like analysis, design and testing (2) Provide fundamental knowledge about Software Requirement Specification and Software Process Model
Pre-requisite	Basic understanding of Problem Solving
Course Outcome	After successful completion of this course, students will be able to: CO1: Understand and explain fundamental concepts of software, software engineering, and various software process models.

	CO2: Analyze existing systems, identify their limitations, and prepare a structured Software Requirement Specification (SRS). CO3: Apply modeling techniques such as DFD and UML diagrams (Use Case, Activity, Sequence) to represent system requirements effectively. CO4: Design software systems using appropriate design principles, concepts, and by applying cohesion and coupling. CO5: Develop and evaluate test cases, understand different testing techniques, and identify security issues and system limitations. CO6: Apply software engineering concepts to real-world case studies like College Management System and other domain-based applications.																																																															
Mapping Between COs and PSOs	<table><tr><th>COs</th><th>PSO 1</th><th>PSO 2</th><th>PSO 3</th><th>PSO 4</th><th>PSO 5</th><th>PSO 6</th><th>PSO 7</th><th>PSO 8</th></tr><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></table>	COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	CO1									CO2									CO3									CO4									CO5									CO6								
COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8																																																								
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CO2																																																																
CO3																																																																
CO4																																																																
CO5																																																																
CO6																																																																
Course content	Unit 1: Software and Software Engineering 1.1 Concepts of Software 1.2 Software characteristics 1.3 Types of Software 1.4 Overview of Software Engineering 1.5 Software Process Model 1.5.1 Waterfall Model 1.5.2 Prototype Model 1.5.3 Incremental Model 1.5.4 Spiral Model Unit 2: Analysis Report 2.1 Fact Finding: Current System and its limitations 2.2 Introduction to SRS and its characteristics 2.3 Proposed System and its advantages 2.4 Elements of Analysis Model 2.5 DFD, PSPEC, DD 2.6 Unified Modeling Language (UML) 2.6.1 UML Diagrams 2.6.1.1 Use Case Diagram 2.6.1.2 Activity Diagram 2.6.1.3 Sequence Diagram Unit 3: Design Report and Testing Report 3.1 Design Principles 3.2 Design Concepts 3.3 Overview: Cohesion and Coupling 3.4 Overview: Testing and its types 3.5 Test Case Design 3.6 Testing issues 3.7 Security Issue 3.8 Limitations of proposed system 3.7 Future Enhancement																																																															

	Unit 4: Case Study 4.1 College Management System 4.2 Self study: Online Shopping System 4.3 Self study: Tours and Travels Management System
Reference Books	11. Software Engineering , A Practitioners Approach , Roger Pressman 2018, Mc Graw Hill Education, ISBN: 978-9353165710 12. Software Engineering with UML, Bhuvan Unhelkar, 2017, CRC Press ISBN : 978-1138297432 13. Grady Booch, James Rumbaugh, Ivar Jacobson Unified Modeling Language User Guide Addison Wesley 14. Engineering Software Products (Global Edition eText), Ian Sommerville, Pearson, 9781292474601, 2024 15. Software Engineering (10th Edition – updated digital/global), Ian Sommerville, Pearson, 9781292443157, 2023 16. Software Engineering (Global Edition eText), Ian Sommerville, Pearson, 9781292770680, 2026 (latest update, based on 2023 edition) 17. Software Engineering at Google: Lessons Learned from Programming Over Time, Titus Winters, Tom Manshreck & Hyrum Wright, O'Reilly Media, 9781492082798, 2020 18. Modern Software Engineering: Doing What Works to Build Better Software Faster, David Farley, Addison-Wesley, 9780137314911, 2021 19. Software Engineering for Data Scientists, Catherine Nelson, O'Reilly Media, 9781098136208, 2024
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level

	1.1.3.2 Actuators 1.1.3.3 Controller 1.2 Basic Electronic Components 1.2.1 LED (Light Emitting Diode) 1.2.1.1 Structure and polarity 1.2.1.2 Applications 1.2.2 Resistor 1.2.2.1 Purpose of resistor 1.2.2.2 Basic idea of resistance 1.2.3 Jumper wires and connectors 1.2.4 Power supply (Battery / USB) 1.3 Breadboard and Circuit Basics 1.3.1 Introduction to breadboard 1.3.2 Internal connections of breadboard 1.3.3 Basic circuit building concepts 1.4 Introduction to Arduino 1.4.1 What is Arduino? 1.4.2 Purpose and importance 1.4.3 Overview of Arduino board components Unit 2 : Understanding Arduino and Basic Programming 2.1 Arduino Fundamentals 2.1.1 Introduction to Arduino (with reference to Arduino Uno) 2.1.2 Role of Arduino as controller 2.1.3 Basic architecture (simple explanation) 2.2 Arduino Pins and Connections 2.2.1 Digital pins 2.2.2 Power pins (5V, GND) 2.2.3 Input and Output concept 2.3 Arduino Software Setup 2.3.1 Installation of Arduino IDE 2.3.2 Connecting Arduino to computer 2.3.3 Uploading first program 2.4 Basic Programming Structure 2.4.1 Structure of Arduino program 2.4.1.1 setup() function 2.4.1.2 loop() function 2.4.2 Basic commands (digitalWrite, delay) 2.4.3 Understanding program flow Unit-3 : Interfacing Input and Output Devices 3.1 Output Devices 3.1.1 LED as output device 3.1.2 Controlling LED using Arduino 3.2 Input Devices 3.2.1 Push button 3.2.2 Working principle of switch 3.2.3 Reading input from button 3.3 Input–Process–Output Concept 3.3.1 Basic system model 3.3.2 Real-life examples 3.4 Practical Interfacing 3.4.1 LED blinking program
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	3.4.2 Button-controlled LED 3.4.3 Changing delay and behavior Unit-4: Introduction to Sensors and Basic IoT Applications 4.1 Introduction to Sensors 4.1.1 What is a sensor? 4.1.2 Types of sensors (basic overview) 4.2 Common Sensors 4.2.1 Light sensor (LDR) 4.2.1.1 Working principle 4.2.1.2 Applications 4.2.2 Temperature sensor 4.2.2.1 Basic concept 4.2.2.2 Applications 4.3 Sensor Data Handling 4.3.1 Reading sensor values 4.3.2 Serial Monitor usage 4.3.3 Displaying output 4.4 Basic IoT Applications 4.4.1 Concept of smart devices 4.4.2 Simple automation idea 4.4.3 Introduction to real-world applications 4.4.3.1 Smart lighting 4.4.3.2 Temperature monitoring [Students are expected to work on following suggested Practicals during Lab- hours : 1. Identification of electronic components, 2. LED circuit using battery, 3. Breadboard circuit setup, 4. Arduino LED blinking program, 5. Changing LED blinking speed, 6. Button-controlled LED, 7. Multiple LED blinking, 8. LDR sensor reading, 9. Temperature sensor reading, 10. Display output on Serial Monitor] [Suggested components for lab : (One set per 10 students): (i) Arduino Uno – 1, (ii) Breadboard – 1, (iii) USB Cable – 1 (iv) LEDs –10nos. (v) Resistors – Assorted (vi) Jumper wires – Set (vii) Push buttons –3nos. (viii) LDR sensor – 1nos. (ix) Temperature sensor – 1nos.]
Reference Books	1. Getting Started with Arduino (3rd Edition), 978-9352139819, Massimo Banzi, Maker Media 2. Arduino Cookbook, 978-1449313876, Michael Margolis, O'Reilly Media 3. Programming Arduino: Getting Started with Sketches, 978-0071784229, Simon Monk, McGraw-Hill Education 4. Exploring Arduino: Tools and Techniques for Engineering Wizardry, 978-1119405373, Jeremy Blum, Wiley 5. Internet of Things: A Hands-On Approach, 978-0996025515, Arshdeep Bahga and Vijay Madisetti, Universities Press 6. Learning Internet of Things, 978-1788399119, Peter Waher, Packt Publishing 7. Beginning Arduino, 978-1430232401, Michael McRoberts, Apress 8. Make: Electronics (2nd Edition), 978-1680450260, Charles Platt, Maker Media 9. Practical Electronics for Inventors (4th Edition), 978-1259587549, Paul Scherz and Simon Monk, McGraw-Hill Education 10. Hands-On Internet of Things with MQTT, 978-1789341780, Agus Kurniawan, Packt Publishing
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments

Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Practical Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Practical Exam, viva-voce, E-Journal
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Course Code: 306-01
Course Title: EDA using Python

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)								
Semester	3								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	306-01								
Course Level	200-299								
Course Title	EDA using Python								
Credit	2 (2 theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	6. Understand different types of data and sources 7. Identify and handle data errors effectively 8. Use Python libraries for data cleaning and analysis 9. Create meaningful visualizations 10. Perform complete EDA on real-world datasets								
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Data and Data Sources 1.2 Types of Data 1.2.1 Structured, Semi-structured, and Unstructured Data 1.2.2 Qualitative vs Quantitative Data 1.2.3 Discrete vs Continuous Data 1.2.4 Time-series and Cross-sectional Data 1.3 Data Sources 1.4 .1 Primary vs Secondary Data 1.2.2 Open data sources (government portals, APIs) 1.2.3 Web scraping basics 1.3 Types of Databases 1.3.1 Relational Databases (RDBMS)								

1.3.2 NoSQL Databases (MongoDB, Cassandra)
1.3.3 Data Warehouses and Data Lakes
1.5 Types of Data Files
1.4.2 CSV, Excel, JSON, XML, TXT
1.4.2. Differences and use cases
1.5.3 File handling basics in Python
1.6 Introduction to Python for EDA
1.5.2 Python environment setup (Anaconda/Jupyter Notebook)
1.5.2 Basic syntax and data structures (lists, dictionaries, tuples)
Unit 2: Data Quality, Errors, and Cleaning
2.3 Common Errors in Data
2.3.1 Missing values (NaN, NULL)
2.3.2 Duplicate data
2.3.3 Inconsistent formats (date, text, units)
2.3.4 Outliers and noise
2.1.5 Typographical errors
2.4 Disadvantages of Poor Data Quality
2.5 Importance of Data Cleaning
2.6 Data Cleaning Techniques
2.6.1 Handling missing values (imputation, deletion)
2.6.2 Removing duplicates
2.6.3 Data type conversion
2.6.4 String cleaning and formatting
2.6.5 Outlier detection and treatment
Unit 3: Python Libraries for Data Cleaning and Analysis
3.5 Introduction to Key Libraries
3.1. 1NumPy (numerical operations)
3.1.2 Pandas (data manipulation)
3.6 Pandas Functions for Data Cleaning
3.6.1 read_csv(), read_excel()
3.6.2 info(), describe()
3.6.3 isnull(), dropna(), fillna()
3.6.4 duplicated(), drop_duplicates()
3.6.5 astype()
3.2.6 apply(), map()
3.7 Data Transformation
3.7.1 Filtering and sorting data
3.7.2 Grouping (groupby())
3.7.3 Merging and joining datasets
3.3.4 Feature creation and modification
3.8 Introduction to Data Analysis
3.8.1 Descriptive statistics
3.8.2 Correlation and covariance
3.4.3 Aggregation techniques
Unit 4: Data Visualization Techniques in Python
4.1 Importance of Data Visualization
4.4 Visualization Libraries
4.4.1 Matplotlib
4.4.2 Seaborn
4.2.3 Plotly (basic introduction)
4.5 Types of Visualizations
4.5.1 Line charts
4.5.2 Bar charts

	4.5.3 Histograms 4.5.4 Scatter plots 4.5.5 Box plots 4.3.5 Heatmaps																																																							
Reference Books	<table><tr><th>Sr. No.</th><th>Book Name</th><th>Author(s)</th><th>Publication</th><th>ISBN</th></tr><tr><td>1</td><td><i>Python for Data Analysis</i></td><td>Wes McKinney</td><td>O'Reilly Media</td><td>978-1491957660</td></tr><tr><td>2</td><td><i>Data Science from Scratch</i></td><td>Joel Grus</td><td>O'Reilly Media</td><td>978-1492041139</td></tr><tr><td>3</td><td><i>Practical Statistics for Data Scientists</i></td><td>Peter Bruce, Andrew Bruce</td><td>O'Reilly Media</td><td>978-1492072942</td></tr><tr><td>4</td><td><i>Hands-On Data Analysis with Pandas</i></td><td>Stefanie Molin</td><td>Packt Publishing</td><td>978-1789615326</td></tr><tr><td>5</td><td><i>Data Wrangling with Python</i></td><td>Jacqueline Kazil, Katharine Jarmul</td><td>O'Reilly Media</td><td>978-1491948811</td></tr><tr><td>6</td><td><i>Python Data Science Handbook</i></td><td>Jake VanderPlas</td><td>O'Reilly Media</td><td>978-1491912058</td></tr><tr><td>7</td><td><i>Think Stats</i></td><td>Allen B. Downey</td><td>O'Reilly Media</td><td>978-1491907337</td></tr><tr><td>8</td><td><i>Introduction to Data Science</i></td><td>Laura Igual, Santi Seguí</td><td>Springer</td><td>978-3319500164</td></tr><tr><td>9</td><td><i>Applied Data Science with Python</i></td><td>Alex Galea</td><td>Packt Publishing</td><td>978-1786468253</td></tr><tr><td>10</td><td><i>Mastering Pandas</i></td><td>Femi Anthony</td><td>Packt Publishing</td><td>978-1789343236</td></tr></table>	Sr. No.	Book Name	Author(s)	Publication	ISBN	1	<i>Python for Data Analysis</i>	Wes McKinney	O'Reilly Media	978-1491957660	2	<i>Data Science from Scratch</i>	Joel Grus	O'Reilly Media	978-1492041139	3	<i>Practical Statistics for Data Scientists</i>	Peter Bruce, Andrew Bruce	O'Reilly Media	978-1492072942	4	<i>Hands-On Data Analysis with Pandas</i>	Stefanie Molin	Packt Publishing	978-1789615326	5	<i>Data Wrangling with Python</i>	Jacqueline Kazil, Katharine Jarmul	O'Reilly Media	978-1491948811	6	<i>Python Data Science Handbook</i>	Jake VanderPlas	O'Reilly Media	978-1491912058	7	<i>Think Stats</i>	Allen B. Downey	O'Reilly Media	978-1491907337	8	<i>Introduction to Data Science</i>	Laura Igual, Santi Seguí	Springer	978-3319500164	9	<i>Applied Data Science with Python</i>	Alex Galea	Packt Publishing	978-1786468253	10	<i>Mastering Pandas</i>	Femi Anthony	Packt Publishing	978-1789343236
	Sr. No.	Book Name	Author(s)	Publication	ISBN																																																			
	1	<i>Python for Data Analysis</i>	Wes McKinney	O'Reilly Media	978-1491957660																																																			
	2	<i>Data Science from Scratch</i>	Joel Grus	O'Reilly Media	978-1492041139																																																			
	3	<i>Practical Statistics for Data Scientists</i>	Peter Bruce, Andrew Bruce	O'Reilly Media	978-1492072942																																																			
	4	<i>Hands-On Data Analysis with Pandas</i>	Stefanie Molin	Packt Publishing	978-1789615326																																																			
	5	<i>Data Wrangling with Python</i>	Jacqueline Kazil, Katharine Jarmul	O'Reilly Media	978-1491948811																																																			
	6	<i>Python Data Science Handbook</i>	Jake VanderPlas	O'Reilly Media	978-1491912058																																																			
	7	<i>Think Stats</i>	Allen B. Downey	O'Reilly Media	978-1491907337																																																			
	8	<i>Introduction to Data Science</i>	Laura Igual, Santi Seguí	Springer	978-3319500164																																																			
	9	<i>Applied Data Science with Python</i>	Alex Galea	Packt Publishing	978-1786468253																																																			
10	<i>Mastering Pandas</i>	Femi Anthony	Packt Publishing	978-1789343236																																																				
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments																																																							
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level																																																							

[Subject code-2611000904060268]

Course Code: 406-1

Course Title: Introduction to Machine Learning

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science)/ B.Sc. (Data Science)									
Semester	4									
NCrF Credit Level	5									
Course Type	SEC									
Course Subtype	Skill Development									
Subject Type	Discipline Specific									
Course Code	406-01									
Course Level	200-299									
Course Title	Introduction to Machine Learning									
Credit	2 (2 theory)									
Effective From	A.Y. 2026 - 27									
Course Outcomes	1. Explain the basic concepts and evolution of Machine Learning. 2. Classify Machine Learning approaches such as supervised, unsupervised, and reinforcement learning. 3. Apply appropriate Machine Learning techniques to different problem domains. 4. Describe the complete Machine Learning workflow from data collection to model evaluation. 5. Compare various ML techniques based on performance, complexity, and applicability.									
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	Unit 1: Introduction to Machine Learning 1.1 History and Evolution of Machine Learning 1.1.1 Early developments and milestones 1.1.2 Evolution from Artificial Intelligence to Machine Learning 1.2 Importance of Machine Learning 1.2.1 Role in modern technology 1.2.2 Impact on industries (healthcare, finance, retail, etc.) 1.3 Why Machine Learning is Required 1.3.1 Limitations of traditional programming 1.3.2 Need for automation and intelligent systems 1.4 Basic Concepts 1.4.1 Data, features, labels 1.4.2 Training and testing datasets Unit 2: Types of Machine Learning and Use Cases 2.1 Types of Machine Learning 2.1.1 Supervised Learning 2.1.2 Unsupervised Learning									

	2.1.3 Semi-Supervised Learning 2.1.4 Reinforcement Learning 2.2 Common Algorithms (Overview) 2.2.1 Regression (Linear Regression) 2.2.2 Classification (Decision Trees, KNN) 2.2.3 Clustering (K-Means) 2.3 Use Cases of Machine Learning 2.3.1 Recommendation systems 2.3.2 Fraud detection 2.3.3 Image and speech recognition 2.3.4 Predictive analytics 2.4 Application of Machine Learning 2.4.1 Business applications 2.4.2 Healthcare systems 2.4.3 Smart systems and automation Unit 3: Machine Learning Process (Lifecycle) 3.1 Steps in Machine Learning Process 3.1.1 Data collection 3.1.2 Data preprocessing 3.1.3 Feature selection and engineering 3.1.4 Model selection 3.1.5 Training and testing 3.1.6 Evaluation and validation 3.2 Model Evaluation Techniques 3.2.1 Accuracy, precision, recall 3.2.2 Confusion matrix 3.2.3 Overfitting and underfitting 3.3 Tools and Platforms (Overview) 3.3.1 Python libraries (Scikit-learn, Pandas, NumPy) 3.3.2 ML development environments Unit 4: Advantages, Disadvantages, and Characteristics of ML Techniques 4.1 Advantages of Machine Learning 4.2 Disadvantages of Machine Learning 4.3 Characteristics of ML Techniques 4.3.1 Supervised Learning: labeled data, predictive models 4.3.2 Unsupervised Learning: pattern discovery 4.3.3 Reinforcement Learning: reward-based learning 4.4 Comparison of Techniques 4.4.1 Strengths and weaknesses 4.4.2 Suitable scenarios for each method				
Reference Books	Sr. No.	Book Name	Author(s)	Publication	ISBN
	1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	978-0262018029

	2	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer	978-0387310732
	3	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow	Aurélien Géron	O'Reilly Media	978-1492032649
	4	Introduction to Machine Learning with Python	Andreas C. Müller, Sarah Guido	O'Reilly Media	978-1449369415
	5	Machine Learning	Tom M. Mitchell	McGraw-Hill	978-0070428072
	6	Python Machine Learning	Sebastian Raschka, Vahid Mirjalili	Packt Publishing	978-1789955750
	7	Understanding Machine Learning: From Theory to Algorithms	Shai Shalev-Shwartz, Shai Ben-David	Cambridge University Press	978-1107057135
	8	Applied Machine Learning	M. Gopal	McGraw-Hill Education	978-0070703698
	9	Machine Learning for Absolute Beginners	Oliver Theobald	Scatterplot Press	978-1530839407
	10	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	978-0262035613
Teaching Methodology		Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments			
Evaluation Method		50% Internal assessment. - Attendance, Class and home Assignment, Unit tests at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level			

[Subject code-2511000905060186]

Course Code: 506-01

Course Title: Working with AI Based Software

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)									
Semester	5									
NCrF Credit Level	5.5									
Course Type	SEC									
Course Subtype	Skill Development									
Subject Type	Discipline Specific, Emerging Technology									
Course Code	506-01									
Course Level	300 - 399									
Course Title	Certificate in Working with AI based Software									
Credit	2 (2 Theory)									
Effective From	A.Y. 2026 - 27									
Course Outcomes	CO1 : Understand the core concepts and architecture of AI. CO2 : Identify and apply free AI tools for academic, research, and creative tasks. CO3 : Use AI tools to automate writing, video creation, and presentation design. CO4 : Create engaging academic content with minimal effort using AI platforms. CO5 : Make informed and ethical decisions while using AI in their academic journey.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	Unit 1: Introduction to Artificial Intelligence (7.5 Hours) 1.6. Definition and history of AI 1.7. Types of AI: Narrow, General, and Super AI 1.8. Applications of AI in education, healthcare, and daily life 1.9. Ethical concerns and responsible AI usage 1.10. AI vs Human intelligence: Myths and facts Unit 2: Architecture of AI Systems (7.5 Hours) 2.6 AI System components: Input, Processing, Output 2.7 Basic structure of AI algorithms and models 2.8 Role of data, training, and feedback loops in AI 2.9 Concept of Machine Learning, Deep Learning, and Natural Language Processing 2.10 AI workflow: From problem to solution Unit 3: Free AI Tools for Academic Tasks (7.5 Hours) 3.4 List and demo of AI tools for: 3.4.1 Writing & summarizing (e.g., Grammarly, Quillbot, ChatGPT) 3.4.2 Presentation generation (e.g., Beautiful.ai, Tome.app) 3.4.3 Research assistance (e.g., Elicit.org, Semantic Scholar, Research Rabbit)									

	3.5 Benefits and limitations of each tool 3.6 AI tools for document formatting and language translation Unit 4: AI for Multimedia, Video Creation & Study Support (7.5 Hours) 4.7 AI tools for video making (e.g., Pictory, Lumen5, Animoto) 4.8 Text-to-speech and voiceover tools (e.g., ElevenLabs, Natural Readers) 4.9 Image generation tools (e.g., Canva AI, Craiyon, Bing Image Creator) 4.10 AI chatbots as study companions (e.g., Socratic, ChatGPT, You.com) 4.11 Mini-project: Create a study video or presentation using AI tools 4.12 Mini-project: Create website or python project using AI tool.
Reference Books	1. Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, Pearson Education, ISBN-13: 978-0134610993 2. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, Apress, ISBN-13: 978-1484235155 3. Machine Learning for Absolute Beginners, Oliver Theobald, CreateSpace, ISBN - 978-1520951400 4. ChatGPT for Beginners, Pam Baker, Wiley, ISBN - 978-1394203783 5. Ethics of Artificial Intelligence, Mark Coeckelbergh, MIT Press, ISBN - 978-0262538190 6. "Artificial Intelligence: A Guide for Thinking Humans", Melanie Mitchell, Farrar, Straus and Giroux (US), ISBN-978-1250758040 7. "AI Basics for anyone", Dale Lane, ISBN - 978-1718500563 8. "Hands-On Artificial Intelligence for Beginners", Patrick D. Smith, Packt Publishing Ltd, ISBN - 978-1788991063 9. Generative AI Basics & Beyond, Tom Taulli, Apress, 9781484293538 10. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, Apress, 9781484233572
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars, Assignments, Viva-Voce/ Presentation
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level