BCA – 6th Semester (AI & ML)

Sr. No.	Course Category	Course Code	Course Title	Teaching Load			Credits	Examination Marks			
				L	T	P		Internal	Theory	Practical	Total
1.	Core	BCA-601	R Programming	3	-	-	3.0	40	60	-	100
2.	Core	BCA-602	R Programming Lab.	-	-	2	1.0	60	-	40	100
3.	Discipline Specific Elective		Elective-III	3	1	-	4.0	40	60	-	100
4.	Specialization	BCA-605	Project-III	-	-	2	1.0	60	-	40	100
5.	Specialization	BCA-606	Machine Learning	3	-	-	3.0	40	60	-	100
6.	Specialization	BCA-607	Machine Learning Lab.	-	-	2	1.0	60	-	40	100
7.	Activity	CUL-002/SPO-002/HLY-002	Cultural/ Sports/ Health & Yoga	-	-	2	1.0	100	-	-	100
8.	Mandatory Course	BCT- II	Cognitive Skills Training - II	-	-	2	0.0	60	-	40	100
			Total	**9**	**1**	**10**	**14.0**	**460**	**180**	**160**	**800**

Note: Student can replace two subjects in a semester from the MOOC courses (SWAYAM) with the same credits and course category of the replaced subject.

Student can choose any one of the following electives:

Elective – III

i) BCA-603: Cloud Computing

iii)BCA-610: Cyber Security

OR

Sr. No.	Course Category	Course Code	Course Title	Teaching Load			Credits	Examination Marks			
				L	T	P		Internal	Theory	Practical	Total
1.	Specialization	BCA-613	Industrial Project	-	-	-	14.0	100	-	200	300
			Total	**-**	**-**	**-**	**14.0**	**100**	**-**	**200**	**300**

BCA – 601 R Programming

Continuous evaluation: 40	**L T P**	**Credits: 3.0**
End semester exam: 60	**3 - -**	**Maximum Time: 3 Hrs.**
Total marks: 100		

Course Objective:

- To understand basics of R programming, syntax and semantics.
- To understand the control structure in R.
- Covers practical issues in statistical computing and analysis which includes programming in R, reading and writing data into R and handling missing data.
- Writing R functions, debugging, organizing and commenting R code as well the concept of object-oriented programming.
- To create and customize various graphs in R.

Unit - I (10 Lectures)

Introduction: Overview and History of R, R and RStudio set-up, basic syntax, Running R Programs, Data Types, variables, operators, Subsetting, Vectorized Operations, NA and NULL values, Coding Standards.

Unit - II (10 Lectures)

Control Structures: Control statements: If Statements, If else Statements. Loops: for loop, while loop, repeat loop. Scoping Rules, apply () family, split (), Time, Date and Sleep, Debugging Utilities.

Unit - III (12 Lectures)

Data with R: Reading and writing data, saving data, generating data, Regular sequences, Random sequences, Handling missing data.

Objects and Classes: Manipulating objects, creating objects, Accessing the values of an object, the indexing system, S3, S4 and Reference Classes. Arithmetic's and simple functions.

Unit - IV (10 Lectures)

Graphics with R: Creating Graphs, Customizing Graph, saving graphs to files, Creating 2D and 3D plots.

Statistical analyses with R: A simple example of analysis of variance (One way ANOVA), Linear Regression.

Course Outcome:

CO1	Learn basics of R Programming with Vector, List, Matrices, Data Frame, etc..
CO2	Design and interpret programs involving decision structures, loops, functions, arrays and strings.
CO3	Design and Apply programs in various applications.
CO4	Analysis on datasets with various graphical functions in R.
CO5	Able to apply R programming from a statistical perspective and use of various visualization tools.

Instructions for Paper setter: All Questions are compulsory. The Question paper is divided in to four sections A, B, C and D. Section A is compulsory and comprises of 12 questions of one mark each, 3 from each unit. The questions shall be asked in such a manner that there are no direct answers including one word answer, fill in the blanks or multiple choice questions. Section B comprises of 4 questions of 2 marks each, one from each unit. Section C Comprises of 4 questions of 4 marks each, one from each unit. Section D Comprises of 4 questions of 6 marks each, one from each unit. There is no overall choice, however each

question in section C and D shall have two alternatives, out of which student will be required to attempt one question.

Text Books:

1. William N. Venables and David M. Smith, An Introduction to R, Network Theory Limited, 2nd ed., 2009.
2. Sandip Rakshit, R Programming For Beginners, McGraw-Hill India, 1st ed., 2017.
3. Gardener Mark, Beginning R: The Statistical Programming Language - The Statistical Programming Language, Wiley India Pvt. Ltd., 2012.

Reference Books:

1. Garrett Grolemund, Hands-On Programming with R: Write Your Own Functions and Simulations, O'Reilly Media, Inc., 2014.
2. John Verzani, Using R for Introductory Statistics, Chapman & Hall, CRC, 2004.
3. Hadley Wickham, Advanced R, CRC Press, 2019.

BCA–606 Machine Learning

Continuous evaluation: 40	**L T P**	**Credits: 3.0**
End semester exam: 60	**3 - -**	**Maximum Time: 3 Hrs.**
Total marks: 100		

Course Objective:

- Understand about the basic learning algorithm and techniques of Machine Learning (ML).
- To develop the skills for selecting an algorithm and model parameters.
- To apply them for designing optimized machine learning algorithms.

Unit - I (10 Lectures)

Introduction to Machine Learning (ML): History and features of ML, working of ML, Classification of ML.
Data Pre-Processing: Data Frame Basics, CSV File, Libraries for Pre-processing, Handling Missing data, Encoding Categorical data, Feature Scaling, Handling Time Series data.
Feature Extraction: Overview of Feature Selection and Feature Extraction Techniques; Data Transformation, Data Normalization.

Unit - II (12 Lectures)

Data Visualization: Different types of plots, Plotting fundamentals using Matplotlib, Plotting fundamentals using Seaborn.
Supervised Learning Techniques: Regression: Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression; Regularization: Ridge Regression, Lasso Regression. Classification: Binary Classification and Multi-Class Classification, Support Vector Machine, K-Nearest Neighbours, Naive Bayes classifier, Decision Trees, Random Forest.

Unit - III (12 Lectures)

Unsupervised Learning Techniques: Clustering: Centroid-Based Clustering: K- Means Clustering; Density-Based Clustering: DBSCAN Clustering Algorithm; Distribution-Based Clustering and Hierarchical Clustering.
Association Rule Learning: Overview of the Association based Clustering and its Algorithms, Applications and Advantages of Association Rule Learning.

Unit - IV (10 Lectures)

Reinforcement Learning: Types of Reinforcement learning, Key Features of Reinforcement Learning, Elements of Reinforcement Learning, Applications of Reinforcement Learning.
Performance Metrics: Performance Metrics for Regression: Mean Absolute Error, Mean Squared Error, Root Mean Squared Error, R-Squared; Performance Metrics for Classification: Confusion Matrix, Accuracy, Precision, Recall, F1 score.

Course Outcome:

CO1	Learn about the introduction, data pre-processing and feature extraction techniques of ML
CO2	Describe and apply various visualization techniques on the dataset.
CO3	Develop supervised and unsupervised learning techniques and to implement these to solve real life problems.
CO4	Learn and understand the association rule learning and reinforcement learning.
CO5	Analyze the performance of machine learning models on different performance metrics.

Instructions for Paper setter: All Questions are compulsory. The Question paper is divided in to four sections A, B, C and D. Section A is compulsory and comprises of 12 questions of one mark each, 3 from each unit. The questions shall be asked in such a manner that there are no direct answers including one word answer, fill in the blanks or multiple choice questions. Section B comprises of 4 questions of 2 marks each, one from each unit. Section C Comprises of 4 questions of 4 marks each, one from each unit. Section D Comprises of 4 questions of 6 marks each, one from each unit. There is no overall choice, however each question in section C and D shall have two alternatives, out of which student will be required to attempt one question.

Text Books:

1. Tom.M. Mitchell, Machine Learning, McGraw Hill, International Edition, 2018
2. Ethern Alpaydin, Introduction to Machine Learning, Eastern Economy Edition, Prentice Hall of India, 2015.
3. Andreas C. Miller, Sarah Guido, Introduction to Machine Learning with Python, O'REILLY (2018).

Reference Books:

1. Sebastian Raschka, Vahid Mirjalili, Python Machine Learning, Packt Publisher (2019).
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Wiley, 2nd Edition, 2022.
3. Christopher Bishop, Pattern Recognition and Machine Learning, Illustrated Edition, Springer, 2016.

BCA – 603 Cloud Computing

Continuous evaluation: 40	**L T P**	**Credits: 4.0**
End semester exam: 60	**3 1 -**	**Maximum Time: 3 Hrs.**
Total marks: 100		

Course Objective:

- Understand the various computing paradigms and their applications in real-world scenarios.
- Describe the evolution, characteristics, and architecture of cloud computing.
- Implement comprehensive cloud storage strategies ensuring interoperability and security.
- Analyze the role and impact of virtualization in cloud computing environments.

Unit - I (10 Lectures)

Cloud Computing Fundamentals: Introduction to various computing paradigms like Multitasking, Multiprocessing, Client Server Computing, Grid Computing, Utility Computing, Distributed Computing, Parallel Computing, Collaborative Computing, Peer to Peer Computing, Cluster Computing, Virtualization, Cloud Computing, Applications using all these Computing Technologies.
Migrating into a Cloud: Introduction, Broad approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud.

Unit - II (10 Lectures)

Introduction: Objectives, Evolution of Cloud Computing, Characteristics of Cloud computing, Architecture of cloud computing, Cloud, Types of Clouds-Private, Public and Hybrid Clouds.
Cloud Services: Software as a Service (SaaS), Platform as a Service (PaaS). Infrastructure as a Service (IaaS).
Service Management in Clouds: Service Level Agreements (SLAs), Types of SLA, SLA Management in Cloud.

Unit - III (12 Lectures)

Virtualization: Virtualized environments, Characteristics of Virtualized environments, Advantages and Disadvantages of virtualization. Hypervisor, types of Virtualizations, Virtual Private Network, Role of Virtualization in Cloud Computing.
Cloud Enablers: Business Intelligence on Cloud, Big Data Analytics on Cloud, Cloud focus on Industry domains viz. (social networking, Banking sector, Education, telecom and financial sector.)

Unit - IV (12 Lectures)

Cloud Security: Security Challenges and Risks in Cloud, Security Reference Model, Data Security, Application Security, Virtual Machine Security, Network Security, introduction to different vendor's offerings security in clouds, Data Loss or Leakage, Account or Service Hijacking, Unknown Risk Profile, Introduction to the different vendors offering/services for Security in public and private cloud.

Cloud Storage: Provisioning Cloud Storage, Virtual storage containers, Cloud Storage Interoperability (CDMI, OCCI), Database Storage.

Course Outcome:

CO1	Remember the basics concept of Cloud Computing and their applications.
CO2	Solve and evaluate the role and impact of virtualization in cloud computing and its architecture.
CO3	Learn and understand the migration strategies for transitioning to the cloud environment.
CO4	Examine the secure cloud solutions and effective storage strategies for different industry domains.

Instructions for Paper setter: All Questions are compulsory. The Question paper is divided in to four sections A, B, C and D. Section A is compulsory and comprises of 12 questions of one mark each, 3 from each unit. The questions shall be asked in such a manner that there are no direct answers including one word answer, fill in the blanks or multiple choice questions. Section B comprises of 4 questions of 2 marks each, one from each unit. Section C Comprises of 4 questions of 4 marks each, one from each unit. Section D Comprises of 4 questions of 6 marks each, one from each unit. There is no overall choice, however each question in section C and D shall have two alternatives, out of which student will be required to attempt one question.

Text Books:

1. B. Raj Kumar, B. James, G.M. Andrezei, Cloud Computing: Principles and Paradigms, Wiley Publication, reprint 2015.
2. T. Velte, Toby J. Velte and Robert Elsenpeter, Cloud Computing: A Practical Approach, McGraw Hill, 2010.
3. Krutz, Ronald L Vines, Russell Dean, Cloud Security, A Comprehensive Guide to Secure Cloud Computing, Wiley India, 2012.
4. Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt. Ltd, ISBN-13: 978-81-265- 2980-3, New Delhi, India, 2011.

Reference Books:

1. H. Judith, B. Robin, K. Marcia and H. Fern, Cloud Computing for Dummies, John Wiley & Sons, IBM Limited edition, 2009.
2. K. Saurabh, Cloud Computing, Wiley India, 2nd ed., reprint 2012.
3. B. Raj Kumar, V. Christian, S. Thamarai Selvi, Mastering Cloud Computing, McGraw Hill Education, Reprint 2013.
4. Dr. Saurabh Kumar, Cloud Computing: Insights into New-Era Infrastructure, Wiley India Pvt. Ltd, ISBN-13: 978-8-12-6528837, New Delhi, India, 2011

BCA – 610 Cyber Security

Continuous evaluation: 40	**L T P**	**Credits: 4.0**
End semester exam: 60	**3 1 -**	**Maximum Time: 3 Hrs.**
Total marks: 100		

Course Objective:

- To understand the basic concepts and importance of cyber security.
- To monitor and analyzing network activities to detect potential security breaches.
- Apply network security measures to protect against common network attacks.
- Implement cryptographic techniques and authentication protocols to ensure secure communications.

Unit - I (10 Lectures)

Security Fundamentals: Principles of Security, Basic security components. Fundamentals of Cyber Crime, Types of Cyber Crime: crime against individual, Crime against property, Cyber extortion, Drug trafficking, cyber terrorism. Cybercrime issues.
Security Threats: Attacks, Phishing, Password Cracking, Key-loggers and Spywares, Virus, Worms, DoS and DDoS, SQL injection, Buffer Overflow, Spyware, Adware and Ransom ware. Pornography, IPR violations: Software Piracy, Copyright infringement, Patent & Trademarks violations, Cyber Squatting, Cyber smearing, Cyber stacking, Credit card related crimes.

Unit - II (12 Lectures)

Cryptography: Classical encryption techniques, Block and Chain ciphers, Data Encryption Standard, Advanced Encryption Standard, RC5.
Advanced Cryptography: Chinese Remainder Theorem and its implication in Cryptography, Diffie-Hellman key exchange algorithm, RSA algorithm, Message Digest and Cryptographic Hash Functions, MD5 and SHA-1, Digital Signatures: Digital Signatures, authentication Protocol: Kerberos, LDAP, OAuth2, SAML(Security Assertion Markup Language), RADIUS - digital signature standards (DSS) .

Unit - III (12 Lectures)

Key Management and Secure Communication: Public Key Infrastructure (PKI), X.509 Certificate, Needham Schroeder algorithm. IP Security: IPv6 and IPSec, Web Security: HTTPS, Mail Security: PGP, S/MIME.
Firewall: Introduction, Types of Firewall, Design Principle of Firewall, SSL.

Unit – IV (10 Lectures)

Digital Forensics: Introduction to Digital Forensics, historical background of digital forensics, Forensic Software and Hardware, need for computer forensics science, special tools and techniques digital forensic life cycle, challenges in digital forensic.
Issues in Security Management and Cyber Laws: Risk identification, Risk Assessment, Risk Control Strategies, Quantitative vs. Qualitative Risk Control Practices. Risk Management.
Laws and Ethics in Information Security: Codes of Ethics, Protecting programs and data.

Course Outcome:

CO1	Understand the principles and basic components of security.
CO2	Identify different types of cyber-crimes and security threats.
CO3	Evaluate the design principles of firewalls and other security mechanisms.
CO4	Develop digital forensic techniques to investigate cyber incidents.
CO5	Assess risk management strategies and cyber laws to ensure effective security management.

Instructions for Paper setter: All Questions are compulsory. The Question paper is divided in to four sections A, B, C and D. Section A is compulsory and comprises of 12 questions of one mark each, 3 from each unit. The questions shall be asked in such a manner that there are no direct answers including one word answer, fill in the blanks or multiple choice questions. Section B comprises of 4 questions of 2 marks each, one from each unit. Section C Comprises of 4 questions of 4 marks each, one from each unit. Section D Comprises of 4 questions of 6 marks each, one from each unit. There is no overall choice, however each question in section C and D shall have two alternatives, out of which student will be required to attempt one question.

Text Books:

1. Mark S Merkow and Jim Breithaupt, Information Security Principles and Practices, Prentice Hall, 2nd Ed, 2016
2. Nina Godbole and Sunit Belapure, Cyber Security Understanding cyber Crime, Computer Forensics and Legal Perspectives, Willey Publication, 1st ed., 2011.
3. Pavan Duggal, Ransomware and Cyber Law, Saakshar Law Publications, 2009
4. Thomas J. Holt, Adam M. Bossler, and Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, 2nd ed, 2017

Reference Books:

1. Bill Nelson, Amelia Phillips and Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage Learning, 5th ed., 2014.
2. Bernadette H Schell and Clemens Martin, Cybercrime, ABC – CLIO, 1st ed., 2004.
3. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security with MindTap, Cengage Publications, 6th ed., 2018.

MCT- II Career Skills Training- II

Continuous evaluation: 60	**L T P**	**Credits: 0.0**
End semester exam: 40	**- - 2**	**Maximum Time: 3 Hrs.**
Total marks: 100		

Course Objective:

- Equip students with essential technical, soft skills, logical reasoning, and quantitative aptitude necessary for success in academic and professional Interface.
- Provide comprehensive training that covers a wide range of skills to ensure holistic development and preparedness for diverse challenges in Interview.
- Foster a learning environment that encourages curiosity, critical thinking, and continuous improvement in various skill domains.
- Empower students with the confidence and competence to navigate complex tasks and become ready for Corporate Interview.

Unit-I: Quantitative Aptitude & Logical Reasoning

Simple Interest, Compound Interest, Ratio & Proportion,, Time & Work, Time Speed Distance, Data Interpretation, .Non-verbal reasoning, Sitting Arrangement, Statement and Course of action, Cubes and Dices, Game Based Aptitude, Calender.

Unit-II: Soft Skills & Verbal Ability

Personal Branding and elevator pitch, Dress to success, Paragraph writing, reading comprehension I, LinkedIn Profiling, Blog writing reading comprehension II, Para jumbles, Leadership skills, Team building skills, Debate, Video analysis, Mock GD, Mock PI

Unit-III: Technical Ability

Linear Data Structures
Linked Lists: Singly linked list, Doubly linked list, Circular linked list, Operations: insertion, deletion, reversal, finding middle, etc.
Stacks: Implementation (array-based and linked-list-based), Applications (expression evaluation, syntax parsing, etc.), Problems (balanced parentheses, postfix/prefix conversion, etc.)
Queues: Implementation (array-based, linked-list-based, circular queue, deque), Applications (scheduling, buffering, etc.), Problems (sliding window maximum, etc.)

Course Outcomes:

CO1	Demonstrate proficiency in technical, soft skills, logical reasoning, and quantitative aptitude, showcasing a well-rounded skill set.
CO2	Through practical application and experiential learning, students will develop competence in utilizing acquired skills to tackle real-world problems effectively.
CO3	The training will cultivate a mindset of adaptability and resilience, enabling students to thrive in dynamic and rapidly changing environments.
CO4	Possess the capabilities and confidence to clear the campus Placement Process.

Reference Books:

1. Quantitative Aptitude for Competitive Examinations by R.S.Aggarwal, S.Chand.
2. Magical Book on Quicker Maths by M.Tyra, BSC Publishing Co. Pvt. Ltd.
3. A Modern Approach to Logical Reasoning by R.S. Aggarwal, S.Chand.
4. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Aggarwal, S.Chand.
5. From Plinth to Paramount by Neetu Singh, K.D.Publication.
6. High school English grammar and composition-Wren & Martin.
7. Soft skills for everyone- Jeff Butterfield Cengage Learning.
8. Patrick Naughton, Herbert, Schild, The Complete reference Java 2, Tata Mc-Graw Hill.
9. Hareliy Hahn, Teacher the Internets, P.H.I.