DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

FACULTY OF ENGINEERING AND TECHNOLOGY

UNIVERSITY OF LUCKNOW

Course Structure and Syllabus

For

BACHELOR OF COMPUTER APPLICATION (BCA)

3rd Year

as per

NEP-2020

(To be effective from the session 2025-2026)

BACHELOR OF COMPUTER APPLICATION (BCA)

YEAR: THIRD, SEMESTER-VI

(To be effective from the session 2025-2026)

S. No.	Paper Code	Subject	Periods			Evaluation Scheme				Sub Total	Credit
						Sessional Exam			Exam		
			L	T	P	CT	TA	Total	ESE		
1.	NBCA-601	Machine Learning	3	1	0	20	10	30	70	100	4
2.	NBCA-602	Multimedia System	3	1	0	20	10	30	70	100	4
3.	NBCA-603	Software Project Management	3	0	0	20	10	30	70	100	3
4.	NBCA-604X	Departmental Elective-II	3	0	0	20	10	30	70	100	3
Practical											
5.	NBCA-605P	Machine Learning Lab	0	0	3		20	20	30	50	2
6.	NBCA-606P	Seminar	0	0	3		20	20	30	50	2
7.	NBCA-607P	Project Phase-II	0	0	9		50	50	100	150	6
8.	NBCA-GP	General Proficiency	-	-	-		-	--	-	50	
		Total	12	2	15					650	24

Departmental Elective-II

NBCA-6041	Open Source Software
NBCA-6042	Mobile Computing
NBCA-6043	Cryptography
NBCA-6044	Cyber Forensic Analytics

Note: If the student leaves the Programme after completing Semester-VI successfully, student will be awarded a **Bachelor Degree in Computer Application.**

NBCA-601

MACHINE LEARNING

L	T	P
3	1	0

Course Outcomes (COs):

After the completion of this course, students will be able to

- Explain the fundamental usage of the concept Machine Learning system
- Demonstrate on various regression Technique
- Analyse the Ensemble Learning Methods
- Illustrate the Clustering Techniques and Dimensionality Reduction Models in Machine Learning.
- Discuss the Neural Network Models and Fundamentals concepts of Deep Learning

Unit-I **8**

Introduction: Artificial Intelligence, Machine Learning, Types of Machine Learning Systems, Challenges of Machine Learning. Statistical Learning: Introduction, Supervised and Unsupervised Learning, Training and Test Loss, Tradeoffs in Statistical Learning, Estimating Risk Statistics, Sampling distribution of an estimator.

Unit-II **8**

Supervised Learning: Basic Methods: Distance based Methods, Nearest Neighbours, Decision Trees, Naive Bayes, Linear Models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Binary Classification.

Unit-III **8**

Ensemble Learning: Introduction, Voting Classifiers, Bagging and Pasting, Random Forests, Boosting, Stacking. Support Vector Machine: Linear SVM Classification, Nonlinear SVM Classification SVM Regression, and Naïve Bayes Classifiers.

Unit-IV **8**

Unsupervised Learning: Clustering, K-Means, Limits of K-Means, Using Clustering for Image Segmentation, Using Clustering for Preprocessing, Using Clustering for Semi-Supervised Learning, DBSCAN, Gaussian Mixtures. Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, and PCA.

Unit-V **8**

Neural Networks: Introduction to Artificial Neural Networks with Keras, Implementing MLPs with Keras, TensorFlow, Loading and Preprocessing Data with TensorFlow.

Text Books:

1. Alpaydin, E. 'Introduction to machine learning', MIT press.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019
3. Data Science and Machine Learning Mathematical and Statistical Methods,Dirk P. Kroese, ZdravkoI. Botev, Thomas Taimre, Radislav Vaisman,25th November 2020

Reference Books:

1. Mitchell, T.M. 'Machine Learning', McGraw-Hill
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, 'Deep Learning', MIT Press.
3. Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani 'An Introduction to Statistical Learning', Springer.
4. Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, 2012.

NBCA-602

MULTIMEDIA SYSTEM

L	T	P
3	1	0

Course Outcomes (COs):

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

- Describe the types of media and define multimedia system.
- Describe the process of digitizing (quantization) of different analog signals (text, graphics, sound and video).
- Use and apply tools for image processing, video, sound and animation.
- Apply methodology to develop a multimedia system.
- Apply acquired knowledge in the field of multimedia in practice and independently continue to expand knowledge in this field.

Unit-I **09**

Introduction: Multimedia, multimedia information, multimedia objects, multimedia in business and work, convergence of computer, communication and entertainment products, stages of multimedia projects, multimedia hardware, memory & storage devices, communication devices, multimedia software's, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools.

Unit-II **06**

Multimedia Building Blocks: Text, sound MIDI, digital audio, audio file formats, MIDI under windows environment, audio & video capture.

Unit-III **09**

Data Compression: Huffman coding, Shannon Fano algorithm, Huffman algorithms, adaptive coding, arithmetic coding, higher order modelling, finite context modelling, dictionary based compression, sliding window compression, LZ77, LZW compression, compression ratio, lossless & lossy compression.

Unit-IV **06**

Speech Compression & Synthesis: Digital audio concepts, sampling variables, lossless compression of sound, lossy compression & silence compression.

Unit-V **10**

Images: Multiple monitors, bitmaps, vector drawing, lossy graphic compression, image file format animations, images standards, JPEG compression, Zig-Zag coding, multimedia database, content based retrieval for text and images. Video: Video representation, colors, video compression, MPEG standards, and MHEG standard video streaming on net.

Text Books:

1. Tay Vaughan "Multimedia, Making IT Work" Osborne McGraw Hill.
2. Buford "Multimedia Systems" Addison Wesley.
3. Agrawal & Tiwari "Multimedia Systems" Excel.

Reference Books:

1. Mark Nelson "Data Compression Book" BPB.
2. David Hillman "Multimedia technology and Applications" Galgotia Publications.
3. Rosch "Multimedia Bible" Sams Publishing.
4. Sleinreitz "Multimedia System" Addison Wesley.

NBCA-603

SOFTWARE PROJECT MANAGEMENT

L	T	P
3	0	0

Course Outcomes (COs):

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

- Successful development of the project's procedures of initiation, planning, execution, regulation and closure.
- Guidance of the project team's operations towards achieving all the agreed upon goals within the set scope, time, quality and budget standards.
- Project plans that address real-world management challenges.
- Develop the skills for tracking and controlling software deliverables.

Unit-I **08**

Introduction: Fundamentals of software project management, need identification, vision and scope document, project management cycle, SPM objectives, management spectrum, SPM framework, software project planning, planning objectives, project plan, types of project plan, structure of a software project management plan, software project estimation, estimation methods, estimation models, and decision process.

Unit-II **08**

Project Organization and Scheduling: Project elements, work breakdown structure, Types of WBS, functions, activities and tasks, project life cycle and product life cycle, ways to organize personnel, project schedule, scheduling objectives, building the project schedule, scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar charts, Milestone charts, and Gantt charts.

Unit-III **08**

Project Monitoring and Control: Dimensions of project monitoring & control, earned value analysis, earned value indicators: budgeted cost for work schedule, cost variance, schedule variance, cost performance index, schedule performance index, interpretation of earned value indicators, error tracking, software reviews, types of review.

Unit-IV **08**

Software Quality Assurance and Testing: Testing objectives, testing principles, test plans, test cases, types of testing, levels of testing, test strategies, program correctness, program verification & validation, testing automation & testing tools, concept of software quality, software quality attributes, software quality metrics and indicators, the SEI capability maturity model, SQA activities, formal SQA approaches.

Unit-V **08**

Project Management: Software configuration management: software configuration items and tasks, baselines, plan for change, change control, change requests management, version control, risk management: risks and risk types, risk breakdown structure, risk management process: risk identification, risk analysis, risk planning, risk monitoring, cost benefit analysis, software project management tools.

Text Books:

1. M. Cotterell, Software Project Management, Tata McGraw Hill Publication.
2. S. A. Kelkar, Software Project Management, PHI Publication.

Reference Books:

1. Royce, Software Project Management, Pearson Education
2. Kieron Conway, Software Project Management, Dreamtech Press

NBCA-6041

OPEN SOURCE SOFTWARE

L	T	P
3	0	0

Course Outcomes (COs):

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

- Understand the concepts, strategies, and methodologies related to open source software development.
- Be familiar with open source software products and development tools currently available on the market.
- To utilize open source software for developing a variety of software applications, particularly Web applications.
- Understand the open source operating system and implement the open source database and programming languages.

Unit-I **08**

Introduction- Introduction to open sources, need of open sources, advantages of open sources and application of open sources.

Unit-II **08**

Open Source Operating Systems: LINUX- Introduction, general overview, kernel mode and user mode, process, advanced concepts, scheduling, personalities, cloning and signals.

Unit-III **08**

Open Source Database: MySQL- Introduction - setting up account-starting, terminating and writing your own SQI programs, record selection technology, working with strings - date and time, sorting query results.

Unit-IV **08**

Open Source Programming Languages: PHP- Introduction - programming in web environment, variables, constants, datatypes, operators, statements, functions, arrays and OOP - string manipulation and regular expression.

Unit-V **08**

Perl: Introduction, background, Perl overview, Perl parsing rules, variables and data -statements and control structures, subroutines, packages, and modules- working with files and data manipulation.

Text Book:

1. Martin C. Brown, "Perl: The Complete Reference", Tata McGraw-Hill Publishing Company Limited, Indian Reprint
2. Vikram Vaswani, "MYSQL: The Complete Reference", Tata McGraw -Hill Publishing Company Limited, Indian Reprint.
3. Paul Kavanagh, "Open Source Software: Implementation and Management", Elsevier.

Reference Books:

1. Rasmus Lerdorf and Levin Tatroe, "Programming PHP", O'Reilly.
2. Wesley J. Chun, "Core Phython Programming", Prentice Hall.
3. Steven Holzner, "PHP: The Complete Reference", Tata McGraw-Hill Publishing Company Limited, Indian Reprint.

NBCA-6042

MOBILE COMPUTING

L	T	P
3	0	0

Course Outcomes (COs):

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

- Explain the principles and theories of mobile computing technologies.
- Describe infrastructures and technologies of mobile computing technologies.
- Learn the concept of cellular network and GSM.
- List out the data management issues in mobile computing.
- Understand the concept of Ad-hoc Network and Routing Protocols.

Unit-I **08**

Introduction: Issues in mobile computing, characteristics of mobile computing, structure of mobile computing and overview of wireless telephony: cellular concept.

Unit-II **08**

Evaluation of Mobile System and Wireless Network: GSM, CDMA, FDMA, TDMA; Wireless networking: Wireless LAN overview, Bluetooth, wireless multiple access protocols, TCP over wireless, wireless applications, data broadcasting, mobile IP and WAP.

Unit-III **08**

Data Management Issues: Management issues, hoarding techniques, data replication for mobile computers, adaptive clustering for mobile wireless networks and file system.

Unit-IV **08**

Mobile Agents: Introduction, type, need, mobile agent, features of mobile agents, life cycle of mobile agents, security and fault tolerance, and transaction processing in mobile computing environment.

Unit-V **08**

Mobile Adhoc Networks (MANETs): Introductions, features, and applications of MANETs, Routing protocols, Global State Routing (GSR), Destination Sequenced Distance Vector routing (DSDV) and Dynamic Source Routing (DSR) and Ad Hoc On-demand Distance Vector routing (AODV).

Text Book:

1. Jochen Schiller, "Mobile Communications", Addison-Wesley.
2. Raj Kamal, "Mobile Computing", Oxford University Press.
3. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing, Technology Applications and Service Creation", Mc Graw Hill.

Reference Books:

1. Charles Perkins, "Mobile IP", Addison Wesley.
2. Charles Perkins, "Ad hoc Networks", Addison Wesley.
3. Upadhyaya, "Mobile Computing", Springer.

NBCA-6043

CRYPTOGRAPHY

L	T	P
3	0	0

Course Outcomes (COs):

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

- Learn the basic concepts of security threats, mechanisms and symmetric cryptography.
- Understand the conventional encryption algorithms.
- Understand modern block cipher and public key encryption techniques analysis.
- Understand the concept of Hash functions and message authentication.

Unit-I **08**

Introduction: Security attacks and cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers.

Unit-II **08**

Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, Fiestal structure, DES, strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, and random number generation.

Unit-III **08**

Finite Fields: Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's algorithm, Chinese remainder theorem, discrete logarithms. principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffie-Hellman key exchange algorithm.

Unit-IV **08**

Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, secure hash algorithm(SHA).

Unit-V **08**

Digital Signatures: Digital signatures, authentication protocols, digital signature standards (DSS), and proof of digital signature algorithm. Authentication Application: Kerberos, directory authentication service, electronic mail security-pretty good privacy (PGP), and S/MIME.

Text Book:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Pearson.
2. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag.
3. Bruce Schiener, "Applied Cryptography", Wiley.

Reference Books:

1. Oded Goldreich ,"Foundations of Cryptography" , Cambridge University Press.
2. Alfred J. Menezes, Paul C. Van Oorschot, Scott A. Vanstone "A Handbook of Applied Cryptography", CRC Press.
3. Wembo Mao, "Modern Cryptography: Theory and Practice", Pearson Education.

NBCA-6044

CYBER FORENSIC ANALYTICS

L	T	P
3	0	0

Course Outcomes (COs):

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

- Outline the Cyber crime and its types.
- Explore the Cyber Forensics Techniques.
- Use the Cyber Investigation Techniques.
- Explore the Cyber Evidence Management Techniques.
- Outline the Cyber Laws in India.

Unit-I **08**

Cyber Crime: Cyber Space, Cyber Crime, Criminal Behaviour, Jurisdictional Concerns, Jurisprudential Inconsistency, eCash Security, Prepaid Cards, Stored Values Cards, Mobile Payments, Internet Payment Services, Cyber stalking, Cyber extortion, Cyber terrorism, Cyber warfare, Cyber weapons, ATM frauds.

Unit-II **08**

Cyber Forensics: Digital device, Hard disk, Disk characteristics, Disk imaging, Data Carving, Techniques, commercial piracy, soft lifting, Steganography, Network components, Port scans, Wireshark, PCAP analysis, Trojans and Backdoors, Botnets, DoS, DDoS Attacks, Honey Pots, Malware, Virus and Worms.

Unit-III **08**

Cyber Investigation: Concepts of Investigation, cyber investigation, Network Investigation, Investigating audit logs, Investigating Web attacks, Investigating Computer Intrusions, Profiling, Cyber Criminal profiling, Stylometric Techniques, Warranted searches, Warrantless searches, and Undercover Techniques.

Unit-IV **08**

Evidence Management: Evidence, Digital Evidence, Types, physical evidence, Real evidence, Circumstantial evidence, network evidence, Evidence collection, Evidence Analysis, Contextual Information, Evidence Management, pre search activities, On Scene activities, and Report Preparations.

Unit-V **08**

Cyber Laws and Authorities: Information Technology Act 2000, Digital signature, Electronic Governance, Secure electronic records, Regulation of certifying authorities, CERNTin, Electronic signature certificates, Penalties compensation.

Text Book:

1. Marjie T. Britz, "Computer Forensics and Cyber Crime", Pearson, 2013.
2. Garima Tiwari, "Understanding Laws– Cyber Laws And Cyber Crimes", Lexis Nexis, 2014.

Reference Books:

1. Chuck Easttom, Jeff Taylor, "Computer Crime, Investigation, and the Law", Course Technology, 2018.
2. Eoghan Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", Eoghan Casey, 2018.

NBCA-605P

MACHINE LEARNING LAB

L	T	P
0	0	3

Course Outcomes (COs):

At the end of this course students will be able to:

- Implement procedures for the machine learning algorithms
- Design and develop python programs for various learning algorithms
- Apply appropriate data sets to the machine learning algorithms
- Develop machine learning algorithms to solve real world problems

LIST OF PRACTICALS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate- Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Exercises to solve the real-world problems using the following machine learning methods: a) Linear Regression b) Logistic Regression c) Binary Classifier
5. Develop a program for Bias, Variance, Remove duplicates , Cross Validation
6. Write a program to implement Categorical Encoding, One-hot Encoding
7. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
8. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.
9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
10. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
11. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
12. Exploratory Data Analysis for Classification using Pandas or Matplotlib.

13. Write a Python program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set
14. Write a program to Implement Support Vector Machines and Principle Component Analysis
15. Write a program to Implement Principle Component Analysis

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner.