VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI
JNANASAGARA CAMPUS, BALLARI-583 105

Department of Studies in Computer Science

SEP: Credits Structure under Choice based Credit System [CBCS]

Syllabus of I & VI Semester

Bachelor of Computer Applications

in

Artificial Intelligence

With effect from 2025-26 Onwards

Approved in the BOS dated ……..

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Jnanasagara campus, Ballari.-583105

Web: www.vskub.ac.in, Email: Phone : 08392-242703 and Fax: 08392-242806

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.C.A. in Artificial Intelligence & Machine Learning (AI & ML) Undergraduate Programme with effect from 2025-26

Semester	Major 1 (A)	Major 2 (B)	Major 3 (C)	Elective /Optional	Language	Compulsory / Skill Courses	Total Credits
1	Descriptive Statistics and probability (L:T:P = 4:0:2=6)	Object Oriented Programming using Java (L:T:P = 4:0:2=6)	Principles of Data Science (L:T:P = 4:0:0=4)	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	Constitutional Values (2) (L:T:P = 3:0:0)	24
2	Python Programming (L:T:P = 4:0:2=6)	Data Structure And Algorithms (L:T:P = 4:0:2=6)	Operating System (L:T:P = 4:0:0=4)	-	L1(3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	Environmental Studies (2) (L:T:P = 3:0:0)	24
3	Data Analytics and Visualization (L:T:P = 4:0:2=6)	Design and Analysis of Algorithms (L:T:P = 4:0:2=6)	Principles of Data Privacy and Security (L:T:P = 4:0:0=4)	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	SEC-1 (2)R-Programming (L:T:P = 1:0:2)	24
4	Database Management Systems (L:T:P = 4:0:2=6)	Principles of AI (L:T:P = 4:0:2=6)	Software Engineering and Testing (L:T:P = 4:0:0)	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	SEC-2 (2) ETL Tool (L:T:P = 1:0:2)	24
5	AI in Healthcare (L:T:P = 4:0:2=6)	Fundamentals of Machine Learning (L:T:P = 4:0:2=6)	Big Data Analytics (L:T:P = 4:0:2=6)	Cyber Security / Information Retrieval System/Internet of Things (L:T:P = 4:0:0=4)	-	SEC-3 (2) Elementary Research Methodology (L:T:P = 2:0:0)	24
6	Neural Network & Deep Learning (L:T:P = 4:0:2=6)	Data Warehousing And Mining (L:T:P = 4:0:2=6)	Cloud Computing (L:T:P = 4:0:0=4)	Bioinformatics/Robotics and Automation/Soft Computing (L:T:P = 4:0:0=4)	-	Internship/ Research Project (4)	24
Total	**36**	**36**	**36**	**04**	**24**	**14**	**144**
						Total 144 Credits	

Note:

1. The curriculum for all Courses except L1, L2, Constitutional Values, Environmental values and Elementary Research Methodology will be framed by the respective Board of Studies (A/B/C). Here for example A – Physics, B – Chemistry and C – Mathematics.

2. The Curriculum for Languages L1 & L2 will be framed by respective Board of Studies (BoS) (Example Kannada/ English/ Hindi/ Sanskrit/ Telugu etc.).

3. The curriculum for Constitutional values will be framed by Board of Studies (BoS) in Political Science.

4. The curriculum for Environmental Science will be framed by special/common Board of Studies (BoS) set up by the University.

5. The curriculum for Elementary Research Methodology will be set by special/common Board of Studies (BoS - Faculty of Science & Applied Science) set up by the University.

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.C.A in AI & ML Undergraduate Programme with effect from 2025-26 (Three Major Combination)

1st Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
25LGCC1L1	Language 1	20	80	100	4	0	0	3	03
25LGCC1L2	Language 2	20	80	100	4	0	0	3	03
25BCAAI1L1	Descriptive Statistics and probability	20	80	100	4	0	0	4	03
25BCAAI1P1	Descriptive Statistics and probability Lab	10	40	50	0	0	4	2	03
25BCAAI1L2	Object Oriented Programming using Java	20	80	100	4	0	0	4	03
25BCAAI1P2	Object Oriented Programming using Java Lab	10	40	50	0	0	4	2	03
25BCAAI1L3	Principles of Data Science	20	80	100	4	0	0	4	03
25CVCM1L	Constitutional Values	10	40	50	3	0	0	2	1.5*
TOTAL		**130**	**520**	**650**	**23**	**0**	**8**	**24**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

25– Year of Curriculum Implementation / Revision
BCA-Bachelor of Computer Applications
AI- Artificial Intelligence
LG – Language, CV – Constitutional Values
CM – Common Course
1 – Semester Number
L – Lecture, P - Practical

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.C.A in AI & ML Undergraduate Programme with effect from 2025-26

2nd Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
25LGCC2L1	Language 1	20	80	100	4	0	0	3	03
25LGCC2L2	Language 2	20	80	100	4	0	0	3	03
25BCAAI2L1	Python Programming	20	80	100	4	0	0	4	03
25BCAAI2P1	Python Programming Lab	10	40	50	0	0	4	2	03
25BCAAI2L2	Data Structures and Algorithms	20	80	100	4	0	0	4	03
25BCAAI2P2	Data Structures and Algorithms Lab	10	40	50	0	0	4	2	03
25BCAAI2L3	Operating System	20	80	100	4	0	0	4	03
25ESCM2L	Environmental Science	10	40	50	3	0	0	2	1.5*
TOTAL		**130**	**520**	**650**	**23**	**0**	**8**	**24**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

25 – Year of Curriculum Implementation / Revision
BCA-Bachelor of Computer Applications
AI- Artificial Intelligence
LG – Language, ES – Environmental Science
AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)
CM – Common Course
2 – Semester Number
L – Lecture, P - Practical

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.C.A in AI & ML Undergraduate Programme with effect from 2025-26

3rd Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
25LGCC3L1	Language 1	20	80	100	4	0	0	3	03
25LGCC3L2	Language 2	20	80	100	4	0	0	3	03
25BCAAI3L1	Data Analytics and Visualization	20	80	100	4	0	0	4	03
25BCAAI3P1	Data Analytics and Visualization Lab	10	40	50	0	0	4	2	03
25BCAAI3L2	Design and Analysis of Algorithms	20	80	100	4	0	0	4	03
25BCAAI3P2	Design and Analysis of Algorithms Lab	10	40	50	0	0	4	2	03
25BCAAI3L3	Principles of Data Privacy and Security	20	80	100	4	0	0	4	03
25SCBCAAI3L1	R-Programming	10	40	50	1	0	2	2	1.5*
TOTAL		**130**	**520**	**650**	**21**	**0**	**10**	**24**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

25 – Year of Curriculum Implementation / Revision
BCA-Bachelor of Computer Applications
AI- Artificial Intelligence
LG – Language
AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)
3 – Semester Number
L – Lecture, P – Practical, S - Skill

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.C.A in AI & ML Undergraduate Programme with effect from 2025-26

4th Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
25LGCC4L1	Language 1	20	80	100	4	0	0	3	03
25LGCC4L2	Language 2	20	80	100	4	0	0	3	03
25BCAAI4L1	Database Management Systems	20	80	100	4	0	0	4	03
25BCAAI4P1	Database Management Systems Lab	10	40	50	0	0	4	2	03
25BCAAI4L2	Principles of AI	20	80	100	4	0	0	4	03
25BCAAI4P2	AI Lab	10	40	50	0	0	4	2	03
25BCAAI4L3	Software Engineering and Testing	20	80	100	4	0	0	4	03
25SCBCAAI4L1	ETL Tool	10	40	50	1	0	2	2	1.5*
TOTAL		**130**	**520**	**650**	**21**	**0**	**10**	**24**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

25 – Year of Curriculum Implementation / Revision
BCA-Bachelor of Computer Applications
AI- Artificial Intelligence
LG – Language
AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)
4 – Semester Number
L – Lecture, P – Practical, S - Skill

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.C.A in AI & ML Undergraduate Programme with effect from 2025-26

5th Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
25BCAAI5L1	AI in Healthcare	20	80	100	4	0	0	4	03
25BCAAI5P1	AI in Healthcare Lab	10	40	50	0	0	4	2	03
25BCAAI5L2	Fundamentals of Machine Learning	20	80	100	4	0	0	4	03
25BCAAI5P2	Fundamentals of Machine Learning Lab	10	40	50	0	0	4	2	03
25BCAAI5L3	Big Data Analytics	20	80	100	4	0	0	4	03
25BCAAI5P3	Big Data Analytics Lab	10	40	50	0	0	4	2	03
25BCAAI5EA1 25BCAAI5EB1 25BCAAI5EC1	Cyber Security Information Retrieval System Internet of Things	20	80	100	4	0	0	3	03
25SCBCAAI5L1	Elementary Research Methodology	10	40	50	2	0	0	2	1.5*
TOTAL		**120**	**480**	**600**	**18**	**0**	**12**	**24**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

 # The curriculum for Elementary Research Methodology will be set by special/common Board of Studies (BOS - Faculty of Science & Applied Science) set up by the University.

Course Code Description:

25 – Year of Curriculum Implementation / Revision
BCA-Bachelor of Computer Applications
AI- Artificial Intelligence
LG – Language, RM – Research Methodology
AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)
BS – Bachelor of Science
4 – Semester Number, L – Lecture, P – Practical, S – Skill, E – Elective Course

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.C.A in AI & ML Undergraduate Programme with effect from 2025-26

6th Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
25BCAAI6L1	Neural Network & Deep Learning	20	80	100	4	0	0	4	03
25BCAAI6P1	Neural Network & Deep Learning Lab	10	40	50	0	0	4	2	03
25BCAAI6L2	Data Warehousing and Mining	20	80	100	4	0	0	4	03
25BCAAI6P2	Data Warehousing and Mining Lab	10	40	50	0	0	4	2	03
25BCAAI6L3	Cloud Computing	20	80	100	4	0	0	4	03
25BCAAI6EA1 25BCAAI6EB1 25BCAAI6EC1	Bioinformatics Robotics and Automation Soft Computing	20	80	100	4	0	0	3	03
25BCAAI6R1	Internship/Research Project	10	40	50	0	0	8	2	03
TOTAL		**110**	**440**	**550**	**16**	**0**	**16**	**24**	**-**

**** Internally conducted based on project report and presentation. The evaluation scheme will be provided by respective BoS.**

Course Code Description:

25 – Year of Curriculum Implementation / Revision
BCA-Bachelor of Computer Applications
AI- Artificial Intelligence
LG – Language, CM – Common Course,
AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)
BS – Bachelor of Science
6 – Semester Number
L – Lecture, P – Practical, E – Elective Course, R – Research Project

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. CBCS is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the university:
   One credit (01) = One Theory Lecture (L) period of one (1) hour;
   One credit (01) = One Tutorial (T) period of one (1) hour;
   One credit (01) = One practical (P) period of two (2) hours.
   One Credit (01) = One Field Study (F) period of one (1) hour
3. Students shall select any two languages during 1-IV semesters.
4. Student shall select Elective course from any one of the major courses opted one in each in 5^{th} and 6^{th} semesters.
5. Elementary Research Methodology Course is common for B.Sc., in Data Science & BCA in AI & ML.
6. Student shall undertake Internship/Research Project in any one of the major courses opted during course.

Abbreviation Explanations:

1. SEC: Skill Enhancement Course;
2. L1: Language One
3. L2: Language One
4. L= Lecture; T= Tutorial; P=Practical; S= Skill; E = Elective; R = Research Project
5. LG – Language
6. RM – Research Methodology
7. CM – Common Course

NOTE:

1. FOR A THEORY COURSE WITH 4 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 52-56 HOURS.
2. FOR A THEORY COURSE WITH 3 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 40-42 HOURS.
3. FOR A THEORY COURSE WITH 2 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 26-28 HOURS.
4. FOR A LAB COURSE/RESEARCH PROJECT WITH 2 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 52-56 HOURS.
5. FOR A SKILL COURSE WITH 1 HOUR THEORY AND 2 HOUR LAB OF 2 CREDITS, SYLLABUS HAS TO BE SET FOR 40-42 HOURS.

Department Name: BCA
Semester – I

Course Title: Descriptive Statistics and Probability	Course Code: 25BCAAI1L1
Total Contact Hours: 56	No. of Credits: 4
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

Upon completion of the course the student should be able to
CO1: Demonstrate the history of statistics, Identify the type of data and present the data in various forms and summarize it using descriptive statistics.
CO2: Understand and apply the concept of correlation, association, regression analysis and infer its results.
CO3: Understand and apply the concept of probability.

Unit	Description	Hours
1	**Organization and Presentation of data** Origin and development of Statistics- Scope- limitations and misuse of statistics. Types of data: primary and secondary data- quantitative and qualitative data. Scales of Measurement: nominal- ordinal-ratio and interval. Discrete and continuous data variables. Presentation of data by tables: construction of frequency distributions for discrete and continuous data- Graphical representation of a frequency distribution by histogram and frequency polygon- cumulative frequency distributions (inclusive and exclusive methods).	12
2	**Descriptive Statistics** Measures of Location or Central Tendency: Arithmetic mean- Median- Mode- Geometric mean- Harmonic mean. Partition values: Quartiles- Deciles and Percentiles. Measures of Dispersion: Range, Mean deviation- Quartile deviation- Standard deviation- Coefficient of variation. Moments: measures of Skewness- Kurtosis. Box plot.	11
3	**Correlation and Regression** Correlation: Scatter plot- Karl Pearson coefficient of correlation- Spearman's rank correlation coefficient-multiple and partial correlations (for 3 variates only). Regression: Concept of errors- Principles of Least Square- Simple linear regression and its properties	11
4	**Basics of Probability** Random experiment- sample point and sample space- event- algebra of events. Definition of Probability: classical-empirical and axiomatic approaches to probability-properties of probability. Theorems on probability- conditional probability and independent events- Laws of total probability- Baye's theorem and its applications	11
5	**Association of Attributes** Relation between class frequencies- consistency of data- independence of attributes- criterion of independence- association of attributes: Yule's Coefficient of association- Yule's coefficient of colligation.	11

References:

1. R.E. Walpole- R.H. Myers and S.L. Myers - Probability and Statistics for Engineers and Scientists- 9th ed. -Pearson- New Delhi- 2017.
2. D.C.Montgomery and G.C. Runger- Applied Statistics and Probability for Engineers-7th ed.- Wiley India- New Delhi-2018.
3. B.L.Agarwal-BasicStatistics-6thed.-NewAge InternationalPublication-2015.
4.V.K. Rohatgi and E. Saleh - An Introduction to Probability and Statistics- 3rd ed.- John Wiley & Sons Inc.- New Jersey- 2015.

Course Title: Descriptive Statistics and Probability Lab	Course Code: 25BCAAI1P1
L:T:P= 0:0:2	No. of Credits: 02
Internal Assessment Marks: 10	
Semester End Exam Marks: 40	Duration of SEE: 03 Hours

Course Outcomes (COs):

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

1. Perform calculations in excel and apply excel functions.
2. Represent data using charts and diagrams
3. Perform exploratory data analysis using Data Analysis Pack(DAP)

List of Experiments / Programs (For a Lab Course)

Sl. No.	Experiment / Program
1	Excel worksheets: add worksheet- rename- save and delete- record worksheet and various operations on worksheet, freezing panes and splitting window
2	Cell referencing, Linking, and conditional formatting.
3	Apply Text to column, Data validation and checks using excel.
4	Creating Pivot table and Pivot chart.
5	Apply formulas like financial, look up, maths, statistics, engineering etc.
6	Apply filter and advanced filter, sorting.
7	Diagrammatic representation and Graphical representation.
8	Descriptive statistics using statistical functions and Data Analysis Pack (DAP).
9	Exercise on correlation, Correlation matrix, partial and multiple correlation coefficient.
10	Draw a scatter plot and fit trend line for a bivariate data set.

Course Title: Object Oriented Programming using Java	Course Code: 25BCAAI1L2
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

Upon completion of the course the student should able to

CO1: Demonstrate their ability to understand the concepts of Object-oriented programming and will model the real-world applications using Object Oriented Programming concepts.

CO2: Apply the concept of Multithreading in concurrent programming.

CO3: Able to design GUI applications using SWING and Event Handling. …

Unit	Description	Hours
1	**Java Fundamentals** Object oriented programming concepts – Benefits of OOPS-The origins of java - java's lineage C and C++ - how java impacted the internet - java bytecode - a first simple program - the java keywords - identifiers in java - the java class libraries. **Introducing data types and operators** Why data types are important - java's primitive types - literals - a closer look at variables - the scope and lifetime of variables - operators - type conversion in assignments - casting incompatible types - operator precedence -expressions. **Program control statements** Input characters from the keyboard - if statement - switch statement - for loop - the enhanced for loop - the while loop - the do-while loop – break – continue - nested loops.	12
2	**Arrays and classes** Arrays One dimensional array - multidimensional arrays - irregular arrays - alternative array declaration syntax - assigning array references - using the length member- the for each style for loop – command line arguments. Class fundamentals - how objects are created - reference variables and assignment - methods returning a value - using parameters - constructors - parameterized constructors - the new operator revisited - garbage collection - this keyword - controlling access to class members - method overloading -overloading constructors - understanding static - introducing nested and inner classes.	11
3	**Inheritance, strings and exception handling Inheritance** Inheritance basic - member access and inheritance - constructors and inheritance - using super to call super class constructors - using super to access super class members - creating a multilevel hierarchy - superclass references and subclass objects - method overriding - using abstract classes -using final - the object class. **Strings** Constructing strings - operating on strings - arrays of strings - strings are immutable - using a string to control a switch statement - different string handling functions. **Exception handling** The exception hierarchy - exception handling fundamentals - the consequences of an uncaught exception - using multiple catch statements - catching subclass exceptions - try blocks can be nested - throwing an exception - using finally - using throws - java's built in exceptions - creating exception subclasses.	11

4	**Interfaces, using I/O and multi-threading** **Packages and Interfaces** Packages - packages and member access - understanding protected members importing packages - Interfaces - implementing interfaces - using interface references - variables in interfaces - interfaces can be extended - default interface methods - use static methods in an interface. **Using I/O** Java's I/O is built upon streams - byte streams and character streams - the byte stream classes -the character stream classes - the predefined streams using the byte streams - reading and writing files using byte streams - reading and writing binary data, using java's character-based streams - file I/O using character streams. **Multithreaded programming** Multithreading fundamentals - the thread class and runnable interface - creating a thread -creating multiple threads - determining when a thread ends -thread priorities - synchronization - suspending, resuming, and stopping threads.	11
5	**Swing** Introducing swing - the origins and design philosophy of swing - components and containers -layout managers - swing event handling - use of JButton -work with JTextField - create a JCheckBox - work with JList. **Self Study** Advanced SWING component	11

References:

1. S. Herbert- Java: The Complete Reference- Tata McGraw- Hill- 10th Ed.-2017.
2. Dr.Rao-Nageswara -Core Java-An Integrated Approach -New Edition Kongent Solutions Inc.- 2009.
3. S. Herbert- Java ™ A Beginner's Guide- McGraw-Hill Education- 8th Ed.- 2017....

Course Title: Object Oriented Programming using Java Lab	Course Code: 25BCAAI1P2
L:T:P= 0:0:2	No. of Credits: 02
Internal Assessment Marks: 10	
Semester End Exam Marks: 40	Duration of SEE: 03 Hours

Course Outcomes (COs):

Upon the completion of this course students will be able to

CO1: Demonstrate their ability to understand the concepts of Object-oriented programming and will model the real-world applications using Object Oriented programming concepts.

CO2: Apply the concept of Multithreading in concurrent programming.

CO3: Able to design GUI applications using SWING .

List of Experiments / Programs (For a Lab Course)

Sl. No.	Experiment / Program
1	To implement different entry controlled and exit controlled looping statements.
2	To Implement nesting of switch statement.
3	To Implement single and multi-dimensional arrays
4	To implement constructor overloading and method overloading
5	To implement static keyword.
6	To Implement multilevel inheritance.
7	To implement super and this keyword.
8	To implement abstract and final keyword
9	To implement methods of String class.
10	To Implement exception handling and custom exceptions..
11	To implement package and interface.
12	To implement File Stream classes
13	To Implement multithreading
14	To implement mouse and keyboard events.
15	To implement different layout managers.
16	To design a customer registration form using advanced swing components

Course Title: Principles of Data Science	Course Code: 25BCAAI1L3
Total Contact Hours: 56	No. of Credits: 04
L:T:P=4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

Upon completion of the course, students will be able to
CO1: Understand the fundamental concepts of data science.
CO2: Evaluate the data analysis techniques for applications handling large data and demonstrate the data science process.
CO3: Understand concept of machine learning used in the data science process.
CO4: Visualize and present the inference using various tools.
CO5: Learn to think through the ethics surrounding privacy, data sharing.

Unit	Description	Hours
1	**Data Evolution:** Data to Data Science – Understanding data: Introduction – Type of Data, Data Evolution – Data Sources. Preparing and gathering data and knowledge - Philosophies of data science - data all around us: the virtual wilderness - Data wrangling: from capture to domestication - Data science in a big data world - Benefits and uses of data science and big data - facets of data.	11
2	**Digital Data-An Imprint:** Introduction to Big Data: - Evolution of Big Data - What is Big Data – Sources of Big Data. Characteristics of Big Data 6Vs – Big Data-Challenges of Conventional Systems- -– Data Processing Models – Limitation of Conventional Data Processing Approaches – Big Data. Big Data Exploration - The Big data Ecosystem and Data science. Overview of the data science process - retrieving data - Cleansing, integrating, and transforming data.	12
3	**Machine learning** – Modelling Process – Training model – Validating model – Predicting new observations –Supervised learning, Unsupervised learning, Semi-supervised learning. Exploratory data analysis.	10
4	**First steps in big data** - Distributing data storage and processing with frameworks - Case study: Assessing risk when loaning money - Join the NoSQL movement - Introduction to NoSQL - Case Study. The rise of graph databases - Introducing connected data and graph databases.	12
5	**Ethics and Data Science-** Doing Good Data Science, Data Ownership, The Five Cs, Implementing the Five Cs, Ethics and Security Training, Developing Guiding Principles, Building Ethics into a Data-Driven Culture, Regulation, Building Our Future, Case Study.	11

References:

1. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015.
2. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
3. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014.
4. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013.

Semester II

Course Title: Python Programming	Course Code: 25BCAAI2L1
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

Upon completion of the course the student should be able to

CO1: To know the basics of algorithmic problem solving

CO2: To develop Python programs with conditionals and loops.

CO3: To use Python data structures - lists- tuples- dictionaries.

CO4: To do input/output with files in Python. …

Unit	Description	Hours
1	**Introduction to Python** Python Introduction- Technical Strength of Python- Introduction to Python Interpreter and program execution- Using Comments- Literals- Constants- Python's Built-in Data types-Numbers (Integers- Floats- Complex Numbers- Real- Sets)- Strings (Slicing- Indexing- Concatenation- other operations on Strings)- Accepting input from Console- printing statements- Simple 'Python' programs.	10
2	**Algorithm Problem Solving** Algorithms- building blocks of algorithms (statements- state- control flow- functions)- notation (pseudo code- flow chart- programming language)- algorithmic problem solving- simple strategies for developing algorithms (iteration- recursion).	10
3	**Operators- Expressions and Python Statements** Assignment statement- expressions- Arithmetic- Relational- Logical- Bitwise operators and their precedence- Conditional statements: if- if-else- if-elif-else; simple programs- Notion of iterative computation and control flow –range function- While Statement- For loop- break statement- Continue Statement- Pass statement- else- asse	12
4	**Sequence Data Types** Lists: list operations- list slices- list methods- list loop- mutability- aliasing- cloning lists- list parameters-Slicing- Indexing- Concatenation- other operations on Sequence data type; Tuples: tuple assignment- tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Examples to include finding the maximum- minimum- mean; linear search on list/tuple of numbers- and counting the frequency of elements in a list using a dictionary	12
5	**File Processing** Concept of Files- File opening in various modes and closing of a file- Reading from a file- Writing onto a file- File functions-open()- close()- read()- readline()-readlines()-write()- writelines()-tell()- seek()- Command Line arguments. **Introduction to Packages** Introduction to NumPy – Ndim – Shape – Size – Dtype – Itemsize - Reshape - Introduction to Pandas, series objects, Data frame Objects, Panel Objects , various functions.	12

References:

1. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition 2017.
2. Y Daniel Liang "Introduction to Programming using Python" Pearson
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python" Pearson
4. Mrak Litz, "Learning Python", O' Reilly.

Course Title: Python Programming Lab	Course Code: 25BCAAI2P1
L:T:P= 0:0:2	No. of Credits: 02
Internal Assessment Marks: 10	
Semester End Exam Marks: 40	Duration of SEE: 03 Hours

Course Outcomes (COs):

Upon completion of the course the student should be able to

CO1: Understand and develop Computational Thinking concepts.

CO2: Describe python programs that appropriately utilize built-in functions and control flow statements

CO3: Represent compound data using Python lists- tuples- dictionaries

CO4: Be able to do input/output with files in Python.

List of Experiments / Programs (For a Lab Course)

Sl. No.	Experiment / Program
1	Write a program to demonstrate basic data type in python.
2	Write a program to implement various operators in python.
3	Write a program to implement various conditional statements in python.
4	Write a program to implement various looping statements in python
5	Write a program to implement various string operations.
6	Write a program to demonstrate list & related functions in python.
7	Write a program to demonstrate tuple & related functions in python
8	Write a program to demonstrate Dictionary & related functions in python
9	Write a program to read and write from a file, and copy a file
10	Write a program to implement numpy and pandas packages.
11	Apply scaling mechanism by considering the employee data (based on the given data set).
12	Demonstrate the normalization process and implement the same with customer data of bank
13	Apply at least 3 sampling techniques to get the best data from the population.
14	Demonstrate the missing value imputations.
15	Demonstrate the usage of outlier detection
16	Apply various data summarization techniques in student data.
17	Demonstrate the techniques to handle the imbalanced data sets.

References:

1. Python Programming using problem solving Approach by Reema Thareja- Oxford University- Higher Education Oxford University Press; First edition 2017.
2. John M. Sewart- “Python for Scientist”- Cambridge Universities Press.
3. Robert Sedgewick- Kevin Wayne- Robert Dondero- “Introduction to Programming in Python” Pearson.
4. Mrak Litz- “ Learning Python”-O’ Reilly.

Course Title: Data Structures and Algorithms	Course Code: 25BCAAI2L2
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

Upon completion of the course the student should
CO1: Understand the need for Data Structures when building applications.
CO2: Design and develop algorithms using relevant data structure operation
CO3: Appreciate the need for an optimized algorithm.

Unit	Description	Hours
1	Introduction Introduction to data structures - Algorithms - Analysing algorithms – Complexity of algorithms- Growth of functions-Asymptotic Notations-Performance measurements-Arrays and Structures: Abstract Data Type-Dynamically Allocated Arrays- Structures-Unions- Polynomial Representation and Additions.	11
2	Linear Data Structures–List Linear Lists: Abstract Data Types (ADTs) – List ADT – array-based implementation linked list implementation—singly linked lists-circularly linked lists-doubly-linked lists–applications of lists –Polynomial Manipulation – All operations.(Insertion, Deletion, Merge, Traversal)	11
3	Linear Data Structures – Stacks, Queues Stack ADT – Operations – Applications – Evaluating arithmetic expressions-Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue- Priority Queue – de Queue – applications of queues	11
4	Searching, Sorting and Hashing Techniques Searching-Linear Search –Binary Search. Sorting –Bubble sort–Selection sort –Insertion sort – Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining- Open Addressing – Rehashing – Extendible Hashing.	11
5	Non-Linear Data Structures –Trees Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees binary search tree ADT–Threaded Binary Trees- AVL Trees– B-Tree- B+Tree –Heap–Applications of heap. Non-Linear Data Structures -Graphs Definition–Representation of Graph–Types of graph–Breadth-first traversal–Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits-Applications of graphs.	12

References:

1. Rance D.Necaise. “Data Structures and Algorithms Using Python” Hamilton Printing Company-2011.
2. Thomas H.Coreman- Charles E. Leiserson and Ronald L. Rivest-“Introduction to Algorithms”-Printice Hall of India, 2001.
3. Aho-Hopcraft-Ullman-“The Design and Analysis of Computer Algorithms” Pearson Education-2008.
4. Horowitz-Sahni-Rajasekaran-Fundamentals of Computer Algorithms-Silicon Pr-2nd Edition-November 2012.

Course Title: Data Structure and Algorithms Lab	Course Code: 25BCAAI2P2
L:T:P= 0:0:2	No. of Credits: 02
Internal Assessment Marks: 10	
Semester End Exam Marks: 40	Duration of SEE: 03 Hours

Course Outcomes (COs):

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

1. Acquire the knowledge to build the logic and develop solution for a problem statement

List of Experiments / Programs (For a Lab Course)

Sl. No.	Experiment / Program
1	Implement creation, insertion, deletion, update in an array.
2	Implement concatenation of arrays, find the length of the arrays.
3	Implementation of Single Linked List performing the following operations (i)Creation (ii) insertion (iii) deletion (iv) traversal
4	Array implementation of Stacks.
5	Array implementation of queues.
6	Implementation of Stack using Linked list.
7	Implementation of Queue using Linked list
8	Implementation of linear search
9	Implementation of Binary Search.
10	Implementation of Insertion sorting.
11	Implementation of selection sorting.
12	Implementation of merge sort.
13	Implementation of Sorting Algorithm - Separate chaining and Open Addressing Hashing Technique
14	Implementation of Binary Search Tree a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre-order, post-order and in- order c. Count the number of nodes in the binary search tree. LIST

Course Title: Operating System	Course Code: 25BCAAI2L3
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

Upon completion of the course the student should be able to

CO1: Understand the basic working process of an operating system.

CO2: Understand the importance of process and scheduling.

CO3: Understand the issues in synchronization and memory management. …

Unit	Description	Hours
1	**Introduction** Categories of Operating Systems- Computer-System Organization- Computer-System Architecture- Operating-System Structure- Operating-System Operations. **System Structures** Operating-System Services- User Operating-System Interface- System Calls- Types of System Calls- System Programs. **Process Management** Process Concept- Process Scheduling- Operations on Processes: process creation and termination - zombie and orphan process- Cooperating Processes- Inter-process Communication- Process related commands	12
2	**Scheduling and Synchronization** CPU Scheduling- Basic Concepts- Scheduling Criteria- Scheduling Algorithms- Thread Scheduling- Multiple-Processor Scheduling - The Critical-Section Problem - Peterson's Solution - Synchronization Hardware - Semaphores - Classic problems of Synchronization - Multithreading models - threading issues.	11
3	**Memory Management Strategies and Deadlocks** System Model- Deadlock Characterization- Methods for handling Deadlocks -Deadlock Prevention- Deadlock avoidance- Deadlock detection- Recovery from Deadlocks – Swapping Contiguous Memory allocation- Paging- Structure of the Page Table- Segmentation.	11
4	**Virtual Memory Management** Demand Paging- Copy-on-Write- Page Replacement- page replacement algorithms- Allocation of frames- Thrashing. **File System:** File Concept- Access Methods- Directory and Disk Structure- File System Mounting- File Sharing- Protection.	10
5	**Implementing File Systems** File System Structure- File System Implementation- Directory Implementation- allocation Methods- Free-space Management. **Secondary Storage Structure** Disk Structure- Disk Attachment- Disk Scheduling- Disk Management and Swap-Space Management. Case study.	12

References:

1. Silberschatz- P.B. Galvin and G. Gagne- Operating System Concepts.9th Edition- New Delhi: Wiley India- 2011

2. Stalling William- Operating Systems: Internals and Design Principles. 7th Edition - Prentice Hall-2011.

Semester III

Course Title: Data Analytics and Visualization	Course Code: 25BCAAI3L1
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:
Upon completion of the course the student should be able to
CO1: Describe Data Analytics fundamentals and Business Intelligence.
CO2: Demonstrate the usage of data warehousing- mining and importance in analytics.
CO3: Applicability of various exploratory data visualization techniques and various interactive methods.

Unit	Description	Hours
1	**Wholeness of the data** Analytics- important of analytics - Business Intelligence- Pattern Recognition- Data Processing Chain- Business Intelligence Concepts and Applications- BI for Better Decisions- BI Tools- BI Skills- BI Applications- Data Analytics Life Cycle- R- Features of R.	10
2	**Sources of Analytics** Data warehousing Architecture- Data Sources- ETL process- Data warehouse Best practices- gathering and selecting the data- data cleansing and preparation- data mining best practices- Types of charts- tips for data visualization.	10
3	**Exploratory data Analysis** Descriptive Analytics- Prescriptive analytics and Predictive Analytics- Feature Selection- Feature Scaling and Normalization techniques- Confusion Matrix- Area Under Curve- Receiver operating characteristic Curve- Statistical methods for Evaluation- Correlation and Regression.	12
4	**Introduction to Data Visualization** Definition – Methodology – Seven Stages of Data Visualization - Data Visualization Tools. Visualizing Data: Mapping Data onto Aesthetics – Visualizing Amounts - Visualizing Distributions: Histograms and Density Plots – Visualizing Propositions: – Visualizing Associations: Among Two or More Quantitative Variables – Visualizing Time Series and Other Functions of an Independent Variable – Trends – Visualizing Geospatial Data.	12
5	**Visualization with Tableau** Tableau Software Ecosystem, Toolbar Icons, Data Window and Aggregation, Connect to Data, Sorting Data, Measure Names, Number of Records & Measures, Cross-tabulation, Heat Maps, Tree maps, Bar Chart, Line Chart, Pie Chart, Scatter Plot, Histogram, Boxplot.	12

References:

Maheshwari- Data Analytics made Accessible-Seattle: Amazon Digital Services- 2015.
EMC Education Services- Data Science and Big Data Analytics: Discovering-
AnalyzingVisualizing and Presenting Data- Wiley- 2015.
Ben Fry, "Visualizing Data: Exploring and Explaining Data with the Processing Environment", O'Reilly, 1st Edition, 2008.
Dan Murray, Christian Chabot," Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software", Wiley 2013.
Granville- Developing Analytic Talent: Becoming a Data Scientist- John Wiley & Sons2014.

Course Title: Design and Analysis of Algorithms	Course Code: 25BCAAI3L2
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE:03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. Apply techniques for designing algorithms to solve problems
2. Analyze the various aspects which contribute to algorithm efficiency
3. Describe the complexity of algorithm using asymptotic notations
4. Classify the complexity of algorithm into different efficiency classes
5. Comprehend different strategies of algorithm design technique

Unit	Description	Hours
1	INTRODUCTION: Introduction, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental Data Structures. FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms.	**11**
2	BRUTE FORCE: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, Exhaustive Search Method, Depth First Search, Breadth First Search. DECREASE AND CONQUER: Insertion Sort, Topological Sorting, Binary Search	**12**
3	DIVIDE AND CONQUER**:** Mergesort, Quicksort, Binary tree traversals and related properties, Multiplication of large integers and Strassen's Matrix Multiplication. TRANSFORM AND CONQUER**:** Presorting, Balanced Search Trees, Heaps and Heapsort, Problem Reduction	**11**
4	SPACE AND TIME TRADEOFFS: Sorting by Counting, Input Enhancement in String Matching, Hashing. DYNAMIC PROGRAMMING: The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms	**10**
5	GREEDY TECHNIQUE: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees. COPING WITH LIMITATIONS OF ALGORITHMIC POWER: P, NP, and NP-complete Problems. Backtracking: n – Queen's problem, Hamiltonian Circuit Problem, Subset- Sum Problem, Branch-and-Bound: Assignment Problem, Knapsack Problem, Traveling Salesperson Problem.	**12**

References:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", (3e), Pearson Education, India, 2011
2. Ellis Horowitz and Sartaj Sahni, "Computer Algorithms/C++", (2e), University Press, India, 2007.
3.Thomas H. Cormen, Charles E. Leiserson, Ronal L, Rivest, Clifford Stein,
4. "Introduction to Algorithms", (2e), PHI, India, 2006

Course Title: Principles of Data Privacy and Security	Course Code: 25BCAAI3L3
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. To learn the basic concepts related to data security and understand the different types of symmetric key ciphers.
2. To understand and apply the concepts of encryption standards
3. To understand hash functions and to learn the basic concepts of hiding data in text and images.

Unit	Description	Hours
1	**Introduction to Security and Ciphers** Introduction: Security goals, Cryptographic Attacks, Services and Mechanism, Techniques. Traditional Symmetric Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers. Introduction to Modern Symmetric-Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers.	10
2	**Symmetric and Asymmetric encryption algorithms** Data Encryption Standard (DES): Introduction, DES Structure, DES Analysis, Multiple DES, Security of DES. Advanced Encryption Standard (AES): Introduction, Transformations, Key Expansion, AES Ciphers, Analysis of AES. Asymmetric-Key Cryptography: Introduction, RSA Cryptosystem.	11
3	**Hash Functions, Digital Signature** Cryptographic Hash Functions: Introduction, Iterated Hash function, SHA-512, Digital Signature: Comparison, Process, Services, Attacks on Digital Signature, Digital Signature Standard. Data Hiding in Text: Basic Features, Applications of Data Hiding, Watermarking, Intuitive Methods, Simple Digital Methods, Data Hiding in Text, Innocuous Text, Mimic Functions.	11
4	**Data Hiding** Data Hiding in Text: Basic Features, Applications of Data Hiding, Watermarking, Intuitive Methods, Simple Digital Methods, Data Hiding in Text, Innocuous Text, Mimic Functions. Data Hiding in Images: LSB Encoding, BPCS Steganography, Lossless Data Hiding, Spread Spectrum Steganography, Data Hiding by Quantization, Patchwork, Signature Casting in Images, Transform Domain Methods, Robust Data Hiding in JPEG Images, Robust Frequency Domain Watermarking, Detecting Malicious Tampering.	12
5	**Privacy, Legal and Ethical Issues** Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, DataMining, Privacy on the Web, E-Mail Security, Impacts on Emerging Technologies. Legal and Ethical Issues in Computer Security: Protecting Programs and Data, Information and the Law, Rights of Employees and employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security.	12

References:

1.Cryptography and Network Security by Behrouz A. Forouzan, Dedeep Mukhopadhyay, TMH, 2nd edition, 2013. (Modules I, II, III)
2. Data Privacy and Security by Salomon, David, Springer, 2003. (Module III)
3. Security in Computing by Charles Pfleeger, Shari Lawrence Pfleeger, 5th Edition, PHI,2015. (Module IV)

Semester IV

Course Title: Database Management Systems	Course Code: 25BCAAI4L1
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

Upon completion of the course the student should be able to
CO1: Apply the fundamental concepts of databases and Entity-Relationship (E-R) model.
CO2: Apply query processing techniques to automate the real time problems of database.
CO3: Compare and contrast different file organization concepts and applying the transaction. management principles on Relational databases.

Unit	Description	Hours
1	**Introduction & DBMS Architecture** Introduction- Data- Database- Database management system- Characteristics of the database approach-Role of Database administrators- Role of Database Designers-End Users-Advantages and limitations of Using a DBMS and When not to use a DBMS. DBMS Architecture – Data Models – Categories of Data models-Schemas-Instance and Database states- DBMS Architecture and Data Independence – The Three schema architecture- Data Independence- DBMS language and interface-Classifications of Database Management Systems.	12
2	**Data Modelling Using Entity-Relationship Model** Using high level conceptual Data models for Database Design- Example Database Applications. Entity types- Entity Sets- Attributes and Keys. Relationships- Relationship types- Roles and Structural constraints. Weak Entity Types and Drawing E- R Diagrams-	12
3	SQL: DDL- DML- DCL TCL. **Database Design** Functional dependencies and Normalization for Relational Databases - Normalization on concepts- first, second, third normal forms-BCNF. PL/SQL: Basics - procedures- functions triggers.	11
4	**Transaction Processing Concepts and Concurrency Control** Transaction and System concepts – Desirable properties of Transactions – Schedules and Recoverability. Lock-Based Protocols – Locks-Granting of Locks and Two- phase locking protocol.	11
5	**Database Connectivity and NoSQL** Introduction and implementation of database connectivity - Introduction to NoSQL - Advantages and disadvantages-Types.	10

References:

1. A. Silberschatz, H. F. Korth, S. Sudarshan- Database System Concepts- 6 Ed.- McGraw Hill- 2011.
2. O. Patricand, and O. Elizabeth- Database Principles, Programming and Performance- 2nd Ed.- Margon Kaufmann Publishers Inc.- 2008.
3. R. Ramakrishnan- Database Management System- Tata McGraw-Hill Publishing Comp.- 2003.

*****

Course Title: Principles of AI	Course Code: 25BCAAI4L2
Total Contact Hours: 56	No. of Credits: 04
L:T:P=4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

Upon completion of the course the student should be able to
CO1: Apply the fundamental concepts of databases and Entity-Relationship (E-R) model.
CO2: Apply query processing techniques to automate the real time problems of database.
CO3: Compare and contrast different file organization concepts and applying the transaction. management principles on Relational databases.

Unit	Description	Hours
1	Overview: Foundations, scope, problems, and approaches of AI; Intelligent agents: Reactive, deliberative, goal- driven, utility-driven, and learning agents; Artificial Intelligence programming techniques.	12
2	Problem-solving through Search: Forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications	12
3	Knowledge Representation and Reasoning: Ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications	11
4	Planning: Planning as search, partial order planning, construction and use of planning graphs; Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications	11
5	Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. learning nearest neighbour, naive Bayes, and decision tree classifiers, Q-learning, Sample Applications of AI	10

References:

1. S. Russell and P. Norvig, Artificial Intelligence A Modern Approach, (4e), Pearson 2020
2. E. Rich et al., Artificial Intelligence, (3e), Tata McGraw Hill, 2017
3. G. Antoniou et al., A Semantic Web Primer, MIT Press, 2012

…

Course Title: Software Engineering and Testing.	Course Code: 25BCAAI4L3
Total Contact Hours: 56	No. of Credits: 04
L:T:P=4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. Students will be able to decompose the given project in various phases of a lifecycle
2. Students will be able to choose appropriate process model depending on the user requirements.
3. Students will be able perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Students can apply the knowledge, techniques, and skills in the development of a software product.

Unit	Description	Hours
1	**Introduction to Software Engineering**: Software: What is software? Types of software Characteristics of Software Attributes of good software .Software Engineering: What is software engineering? Software engineering costs Software Myths What are the key challenges facing software engineering? Software engineering layered approach.	11
2	**Software Development Process Models**: Software Process Software Process activities Umbrella activities Software Development Life Cycle(SDLC) Roles and Responsibility: Role of Software Engineer / Analysts / Users in the various phases of Systems Development Life Cycle. The waterfall model(Linear Sequential model), Incremental Process Model Evolutionary Process Model.	11
3	**Software Design** Design concepts Abstraction, Architecture, Patterns, Modularity, Cohesion, Coupling, Information hiding, Functional independence, Refinement Design of input and Control Design of User Interface design Elements of good design, Design issues, Features of modern GUI - Menus, Scroll bars, windows, Buttons, icons, panels, error Messages etc.	12
4	**Overview** Software Coding & Testing: Coding Standard and coding Guidelines, Code Review, Software Documentation, Testing Strategies Testing Techniques and Test Case Black-box and White-box testing Inspections Level Of Testing Unit testing Integration Testing Interface testing System testing Alpha and beta testing Regression testing Testing Conventional Applications, Testing Object Oriented Applications Testing Web and Mobile Applications, Testing Tools (Win runner, Load runner)	12
5	**Software Maintenance and Configuration** : Types of software Maintenance, software maintenance model: Quick fix Model, taute's maintenance model, Re-Engineering, Reverse Engineering, Forward Engineering, The SCM Process	10

References:

1. Software Engineering: A practitioner's approach by Roger S. Pressman, 7th edition, McGraw-Hill International edition
2. Software Engineering by Ian Sommerville, 7th edition, Addison-Wesley.
3. Fundamentals of Software Engineering by Rajib Mall
4. Roger S.Pressman, Software engineering- A practitioner’s Approach, McGraw-Hill International Editions

Semester - V

Course Title: AI in Healthcare	Course Code: 25BCAAI5L1
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

After studying this course, students will be able:

1. Understand Artificial Intelligence (AI) concepts, techniques, and tools utilized in the field of medical applications, obtain the overview of prominent machine learning and data mining methods.
2. Apply Artificial Neural Network based classifier for Cancer Prediction methodology and understand a system for Melanoma diagnosis based on Data Mining.
3. Evaluate the use of Support Vector Machines and Wavelet Transforms in the field of Electroencephalogram Signal Classification and to build Naïve Bayes classifiers for given data sets.
4. Apply Deep Learning for Semi-automated Analysis of Pap Smears and appreciate clinical decision support in medicine.
5. Evaluate the use of Natural Language Processing in medicine and understand the concept of Intelligent Personal Health Record.

Unit	Description	Hours
1	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND DATA MINING METHODS IN MEDICAL DOMAIN**: Introduction to AI, Machine Learning, Support Vector Machine, Neural Networks, Naïve Bayesian Classifier, Hidden Morkov Models, K Means Clustering, Principal Component Analysis. Overview of Machine Learning and Data Mining, Machine Learning and Data Mining Resources Example of Medical Applications	11
2	**CANCER PREDICTION METHODOLOGY AND SYSTEM FOR MELANOMADIAGNOSIS BASED ON DATA MINING**: Introduction, Review of Related Research on Cancer Prediction, Dominant Gene Prediction Using ANN, Result and Discussion, Introduction to Melanoma Diagnosis, Data Set, Rule Induction and Validation, Optimization of ABCD Formula, Internet Melanoma Diagnosing and Learning System, Synthetic Skin Lesions.	11
3	**INVESTIGATION ON SVM AND WAVELET TRANSFORM IN EEG SIGNAL CLASSIFICATION AND BUILDING NAÏVE BAYES CLASSIFIER FOR LARGE AND SMALL DATASETS :** Introduction, Data Analysis, Support Vector Machine (SVM), Description of Multiclass Methods, Experimental Results, Naïve Bayes Classifier, Experiments, Discussion on Experiments	12
4	**DEEP LEARNING FOR SEMI-AUTOMATED ANALYSIS OF PAP SMEARS AND CLINICAL DECISION SUPPORT IN MEDICINE**: Introduction, Background and Related Work, Processing and Data Analysis, Applying SVM, Applying DBNs (Deep Belief Network), Conclusion and Discussion, Introduction on Clinical Decision Support, Case Based Review of Selected Clinical Support Systems (2003 – 2012), Future Directions.	12
5	**NATURAL LANGUAGE PROCESSING AND INTELLIGENT PERSONAL HEALTH RECORD**: Introduction, NLP tasks in medicine, NLP methods, Clinical NLP resources and Tools, Current clinical NLP systems, Medical applications of NLP. Architecture of the intelligent personal health record system, guided search of disease information, recommending SCAs and HHPs and continuous user monitoring.	10

References:

1. Ranschaert, E. R., Morozov, S., & Algra, P. R. (Eds.). (2019). Artificial Intelligence in MedicalImaging: Opportunities, Applications and Risks. Springer.
2. Riaño, D., Collado, A., Peek, N., Morales, R. M., & Peleg, M. (2019). Artificial Intelligence inMedicine. Springer International Publishing.
3. Dua, S., Acharya, U. R., & Dua, P. (Eds.). (2014). Machine learning in healthcare informatics(Vol. 56).

Berlin: Springer.
4. Panesar, A. (2019). Machine Learning and AI for Healthcare. Apress.
5. Alloghani, M., Al-Jumeily, D., Aljaaf, A. J., Khalaf, M., Mustafina, J., & Tan, S. Y. (2019,September). The Application of Artificial Intelligence Technology in Healthcare: A Systematic Review. In International Conference on Applied Computing to Support Industry: Innovation andTechnology (pp. 248-261). Springer, Cham.

Course Title: Fundamentals of Machine Learning	Course Code: 25BCAAI5L2
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:
1. To Understand and outline problems for each type of machine learning.
2. Design a Decision tree and Random Forest for an application.
3. Implement Probabilistic, and Generative algorithms for an application and analyze the results.
4. Apply learning aspects and optimized solutions to solve problems.
5. Use a tool to implement typical Classification Algorithms for different types of applications.
6. Design recommendation systems.

Unit	Description	Hours
1	**PRELIMINARIES OF MATHEMATICS IN MACHINE LEARNING:** Multivariate Calculus: Gradient, Hessian, Jacobian, Chain Rule; Linear Algebra: Determinants, Eigen Values and Eigen Vectors, Singular Value Decomposition (SVD); Preliminaries in Probability Theory: Conditional Probability, Marginal Probability, Bayes Rule.	11
2	**The Art of Machine Learning**: Different Perspectives on Prediction Models, Choosing a Machine Learning Approach, Matching Machine Learning Approaches to Projects Matching Machine Learning Approaches to Data and Your Next Steps. Descriptive Statistics & Data Visualization for Machine Learning: Descriptive Statistics for Continuous Features, Central Tendency, Variation, Descriptive Statistics for Categorical Features, Populations & Samples.	10
3	**SUPERVISED LEARNING AND LINEAR MODELS Supervised Learning:** Learning a Class from Examples, Vapmik- Chervonikis Dimension, Model Selection and Generalization; Local/Proximity-based methods; K- Nearest Neighbor Algorithm, Condensed Nearest Neighbor. Decision Trees: Univariate Trees, Classification and Regression Trees, Pruning, Rule Extraction from Trees, Learning Rules from Data, Linear models: Support Vector Machines, Kernel Ridge Regression;	11
4	**NON-LINEAR MODELS Non-linear models:** Kernel Methods, Learning by probabilistic modeling Probabilistic Discriminative Models, Generalized Linear Models for Classification Perceptron and Winnow Algorithm, Logistic Regression, Generative methods Bayesian Networks and Naive Bayes Classifier	12
5	**CORE CONCEPTS IN MACHINE LEARNING Structured output prediction**: Multilabel Classification, Sequence Tagging, Ranking: Rank Boost, Ensemble Methods: Boosting-AdaBoost, eXtreme Gradient Boosting Model, Random Forests, Support Vector Classifier, Support Vector Regression	12

References:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
2. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press. 2010.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, 2009
4. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar. Foundations of Machine Learning, The MIT Press, 2012
5. Kevin Murphy, Machine Learning: A Probabilistic Perspective, The MIT Press, 2012.
6. M. Gopal, Applied Machine Learning, McGraw Hill Education, 2018.
7. Tom, M Mitchell: Machine Learning. Edition 2013, Burr Ridge, McGraw Hill Education (India) Edition 2017 Reprints.
8. Bing Liu Web data mining: Exploring hyperlinks, contents, and usage data. Vol. 1. Berlin: Springer, 2011.

Course Title: Big Data Analytics	Course Code: 25BCAAI5L3
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:
1. Understand Big Data and its analytics in the real world
2. Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics
3. Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm.
4. Implement Big Data Activities using Hive

Unit	Description	Hours
1	**Introduction to Big Data**: Types of Digital Data-Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, 3Vs of Big Data, Non-Definitional traits of Big Data, Business Intelligence vs. Big Data, Data warehouse and Hadoop environment, Coexistence	11
2	**Big Data Analytics**: Classification of analytics, Data Science, Terminologies in Big Data, CAP Theorem, BASE Conc	11
3	**NoSQL**: Types of Databases, Advantages, NewSQL, SQL vs. NOSQL vs NewSQL. **Introduction to Hadoop**: Features, Advantages, Versions, Overview of Hadoop Eco systems, Hadoop distributions, Hadoop vs. SQL, RDBMS vs. Hadoop, Hadoop Components, Architecture, HDFS.	12
4	**Map Reduce**: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression. Hadoop 2 (YARN): Architecture, Interacting with Hadoop Eco systems. No SQL databases: Mongo DB: Introduction, Features, Data types, Mongo DB Query language, CRUD operations, Arrays. Functions: Count, Sort, t – Limit, Skip, Aggregate, Map Reduce. Cursors: Indexes, Mongo Import, Mongo Export.	12
5	**Cassandra**: Introduction, Features, Data types, CQLSH, Key spaces, CRUD operations, Collections, Counter, TTL, alter commands, Import and Export, Querying System tables**.** **Hadoop Eco systems**: Hive, Architecture, data type, File format, HQL, SerDe, User defined functions.	10

References:

1.T. Erl , W.Khattak and P. Buhler., Big Data Fundamentals, Concepts, Drivers & Techniques (1e), The Prentice Hall Service Technology Series, 2016.
2. S. Acharya, Big Data and Analytics, Wiley India Pvt. Ltd., 2015
3. V. Prajapati, Big Data Analytics with R and Hadoop, Packt Publishing Ltd., 2013.
4. A. Holmes, Hadoop in Practice, (2e), Manning Publications, 2015
5. S. Ryza, Advanced Analytics with Spark: Patterns for Learning from Data at Scale, (2e), O'Reilly, 2017

Course Title: Cyber Security	Course Code: 25BCAAI5EA1
Total Contact Hours: 56	No. of Credits: 04
L:T:P=4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. This course comprises a unique mix of cybersecurity technical and real-world industry skills, brought to provide awareness on the impact of cybersecurity threats in key industries and geographies.
2. Analyze top targeted industries and trends.
3. Explore how cyber criminals are using operating system tools to get control.

Unit	Description	Hours
1	**Understand the current impact of cyber security threats**: Research global cyber security trends in different geographies, Familiarize with the taxonomy of cyberattacks, Explore the enterprise cyber security domains Explore the most frequently targeted industry sectors including: Government, Energy and Utilities, Retail and Telecom Explore the cyber resilience framework understand the cyber resilience lifecycle	**11**
2	**Understand the need for a cyber-threat hunting approach**: Explore cyber-attack adversary frameworks, Investigate enterprise threat protection methods, Explore industry case studies Understand network attack trends in the financial sector using crypto miners: Understand how cyber criminals use networks in the dark web to perform illicit crime activities, Learn network protection practices like DNS, VPN, Understand enterprise network security practices through the analysis of an advanced persistent threat	**12**
3	**Explore the mobile and IoT global phenomena**: Understand mobile and IoT attack surface, Explore recent most threatening IoT cyber-attack scenarios, Learn to protect your home and organization with endpoint protection practices Understand the wide adoption of industry applications: Learn web application fundamentals, Investigate application security practices, Examine the anatomy of the most dangerous applications threats	**12**
4	**Understand the reason of the global enterprise adoption of cloud computing**: Understand the cloud security challenges brought by an integrated data, network, access infrastructure, Review the key cloud security practices for the enterprise, Explore a Telco cloud data breach scenario	**11**
5	**Understand the Incident Response and Threat hunting practice**: Explore the benefits of establishing a SOC (security Operation Center), understand the roles and responsibilities of SOC Operations team	**10**

References:

1. Timothy Morey Andrew Burt, Thomas C. Redman, Christine Moorman "Customer Data and Privacy: The Insights You Need from Harvard Business"
2. Naavi "Personal Data Protection Act of India (PDPA 2020)".

Course Title: Information Retrieval System	Course Code: 25BCAAI5EB1
Total Contact Hours: 56	No. of Credits: 04
L:T:P=4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

1. Understand the basic information retrieval problem.
2. Understand the various basic retrieval strategies.
3. Understand theoretical aspects as well as implementation issues of classical and modern retrieval problems.
4. Design the model for information retrieval.
5. Understand the search systems to process XML and text data for better search result.

Unit	Description	Hours
1	**Introduction to Information Retrieval**: Mathematical Basics, Vector spaces and Similarity, Probabilities and Statistics, Text Analysis; Pre-processing: Document processing, Stemming, String Matching, Basic NLP tasks – POS Tagging Shallow Parsing.	12
2	**Retrieval Systems**: System Architecture, Boolean Models, Inverted Indexes, Document Ranking, IR Evaluation;	10
3	**Retrieval Models and Implementation**: Vector Space Models, TFIDF Weighting, Retrieval Axioms, Implementation Issues, Probabilistic Models;	10
4	**Filtering**: Adaptive Filtering, Collaborative Filtering, User Interfaces, Text Classification, Naïve Bayes, K-nearest neighbors, Feature selection, Semi supervised Learning;	12
5	**Text Clustering**: Vector-space Clustering; K-means, EM algorithm, Text shingling; Graph-Based Methods: Word Net, Document and Word Graphs, Network Analysis, Random Walks, Harmonic Functions.	12

References:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval", (2e), Cambridge University Press, 2015.
2. B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, (3e), MIT Press, 2016.
3. Chengxiang Zhai, Statistical Language Models for Information Retrieval (Synthesis Lecture Series on Human Language Technologies), (2e), Morgan &Claypool Publishers, 2017.

Course Title: Internet of Things	Course Code: 25BCAAI5EC1
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:
This course will enable students to
1. To illustrate how exactly IoT architecture is built and Smart objects are interconnected.
2. To demonstrate the working of IoT-related protocols
3. To design and build simple IoT Systems using Arduino and Raspberry Pi
4. To develop IoT infrastructure for popular applications

Unit	Description	Hours
1	**FUNDAMENTALS OF IOT & SMART OBJECTS**: Introduction to IoT: Evolution from Internet of Things, IoT impact, IoT challenges, IoT Network Architecture and Design: Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, Sensors, Actuator and Sensor networks, Connecting Smart Objects: Communications Criteria	**11**
2	RELATED PROTOCOLS: IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a , 802.11ah and LoRaWAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo - Routing over Low Power and Lossy Networks Application Transport Methods: Supervisory Control and Data 10 Hours Acquisition, Application Layer Protocols: CoAP and MQTT. IoT Communication Protocols: Wi-Fi, ZigBee, Bluetooth, Edge Computing: Basic Architecture	**12**
3	**DESIGN AND DEVELOPMENT OF IOT**: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino Board details, IDE programming, Raspberry Pi - Interfaces and Raspberry Pi with Python Programming	**11**
4	**)ATA ANALYTICS AND SUPPORTING SERVICES**: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning, No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django AWS for IoT, System Management with NETCONF-YANG.	**12**
5	**CASE STUDIES / INDUSTRIAL APPLICATIONS**: Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.	**10**

References:

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things – Principle and Paradigms", Elsevier, 2016.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key Applications and Protocols", Wiley, 2012.
3. Khaled Salah Mohamed, "The Era of Internet of Things Towards a Smart World", Springer, 2019.
4. Jan Holler et al., "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

Semester - VI

Course Title: Neural Network & Deep Learning.	Course Code: 25BCAAI6L1
Total Contact Hours: 56	No. of Credits: 04
L:T:P=4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. To understand different neural network architectures.
2. To train and test the neural networks.
3. To design a neural network system for a given problem.
4. To appreciate the need for deep learning

Unit	Description	Hours
1	**INTRODUCTION TO NEURAL NETWORKS**: What is a Neural Network? The Human Brain, Models of a Neuron, Network Architectures, Learning Processes and Learning Tasks. Rosenblatt's Perceptron, Perceptron Convergence Theorem, Wiener Filter, Least Mean Square Algorithm, Markov Model Portraying the deviation.	11
2	**INTRODUCTION TO MULTILAYER PERCEPTRON**, Some Preliminaries, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Multilayer Perceptron Applications.	11
3	**FEEDFORWARD NEURAL NETWORKS**: Introduction, Pattern classification using perceptron, Multilayer feedforward neural networks (MLFFNNs), Backpropagation learning, Empirical risk minimization, Regularization, Autoencoders.	12
4	**DEEP NEURAL NETWORKS AND CONVOLUTION NEURAL NETWORKS**: Introduction, Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods for training, Regularization methods (dropout, drop connect, batch normalization).	12
5	**Convolution neural networks (CNNs):** Introduction to CNNs – convolution, pooling, Deep CNNs, Different deep CNN architectures – LeNet, AlexNet, VGG, PlacesNet, Training a CNNs: weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs	10

References:

1 Daniel Graupe, Principles of Artificial Neural Networks, 3rd ed, World Scientific Publishing, 2013 2 Eugene Charniak, Introduction to Deep Learning, MIT Press, 2018

*****

Course Title: Data Warehousing and Mining	Course Code: 25BCAAI6L2
Total Contact Hours: 56	No. of Credits: 04
L:T:P=4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. Understand the concepts of data pre-processing
2. Understand the methodologies related to design, construction and usage of data warehouse
3. Characterize the kinds of patterns that can be analysed by association rule mining.
4. Understand various kinds of classification and clustering models through real life examples

Unit	Description	Hours
1	INTRODUCTION: Introduction to data mining, Kinds of data, Data Warehouse, Kinds of Patterns, Technologies Used, Applications, Major Issues	10
2	Data Warehouse Building Blocks, Dimensional Modeling - Star Schema, Updates to the Dimension Tables, Miscellaneous Dimensions, Snowflake Schema, Aggregate Fact Tables, Families of Stars, ETL - Overview, Data Extraction, Data Transformation, Data Loading, Data Quality - Challenges, Tools, Initiative, OLAP – Major Features and Functions, OLAP Models, Implementation Considerations, Case Study	11
3	DATA PRE-PROCESSING: Descriptive Data Summarization, Data cleaning and Transformation, Data Integration, Data reduction, Case Study	12
4	MINING FREQUENT PATTERNS, ASSOCIATIONS AND CORRELATIONS: Basic concepts and a road map, Apriori Algorithm for finding frequent item sets with candidate generation, Improving Efficiency of Apriori, FP – Growth without generating candidate generation, Frequent Itemsets from Vertical Data Format, Pattern Evaluation Methods, Case Study.	12
5	CLASSIFICATION: Basic Concepts, Classification by Decision Tree Induction, Pruning Technique, Bayesian classification, Rule-Based classification, Classification by Back Propagation, Support Vector Machines, Lazy Learners, Model Evaluation and Selection, Techniques to improve Classification Accuracy, Case Study	11

References:

1. Jiawei Han and Micheline Kamber, Data Mining- Concepts and Techniques,(3e), Morgan Kaufmann Publishers, 2011
2. Paulraj Ponniah, Data Warehousing, (2e), Wiley India Pvt. Ltd., 2010
3. Galit Shmueli, Nitin R. Patel, Peter C. Bruce, Data Mining for Business Intelligenc, (2e), Wiley, 2010
4. Ian H Witten, Eibe Grank, Mark A Hall, Data Mining, Practical Machine Learning Tools and Techniques, (3e), Morgan Kaufmann Publishers, 2011

Course Title: Cloud Computing	Course Code: 25BCAAI6L3
Total Contact Hours: 56	No. of Credits: 04
L:T:P: 4:0:2	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

After studying this course, students will have the:

1. Ability to distinguish between conventional computing systems and cloud computing systems.
2. Ability to learn role of virtualization in Infrastructure as a service
3. Ability to understand issues related to service-oriented architecture
4. Ability to learn cloud management and develop applications using cloud programming model.
5. Ability to identify security threats for a given cloud application.

Unit	Description	Hours
1	**INTRODUCTION TO CLOUD COMPUTING**: Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks, public clouds, private clouds, and hybrid clouds.	10
2	**VIRTUALIZATION & INFRASTRUCTURE AS A SERVICE**: Understanding Virtualization: Describing virtualization, Importance of Virtualization, Understanding Virtualization software operation. Introduction to Hyper converged Infrastructure: Definition, resources to consolidate. Architecting the Hyper converged Data Center: server support, software defined storage, The Role of Custom Hardware in a Commodity Infrastructure Hyper convergence and the Public Cloud: Public cloud, private cloud.	11
3	**SERVICE ORIENTED ARCHITECTURES**: Services and Service Oriented Architectures, Message-Oriented Middleware, Portals and Science Gateways, Discovery, Registries, Metadata, and Databases, Workflow in Service-Oriented Architectures	12
4	**CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENTS**: Features of Cloud and Grid Platforms, Parallel and Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure	12
5	**CLOUD SECURITY**: Cloud Security Fundamentals, Vulnerability Assessment, Security and Privacy, Cloud Computing Security Architecture, Access Management, Trust Management, Delivery Model Specific Security Techniques.	11

References:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Mastering Cloud Computing, McGraw Hill Education (India) Private Limited New Delhi, 2013.
2. Gautam Shroff, Enterprise Cloud Computing, Cambridge University Press, 2012.
3. John Rhoton, Cloud Computing Explained, (2e), Recursive Press, 2010. Barrie Sosinsky, Cloud Computing: Bible, Wiley India, 2011.

Course Title: BIO-INFORMATICS	Course Code: 25BCAAI6EA1
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. Understand the essential of Bioinformatics and Biological databases
2. Understand the Sequence alignment (s), Structural Bioinformatics and its Applications.
3. Use & develop tools to curate (compare &analyze) biological data

Unit	Description	Hours
1	**INTRODUCTION AND BIOLOGICAL DATABASES** Introduction: What Is Bioinformatics, Goal, Scope, Applications, Limitations, New Themes. Introduction to Biological Databases: What Is a Database? Types of Databases, Biological Databases, Pitfalls of Biological Databases, Information RetrievalfromBiological Databases. Molecular Sequences and Structures: Retrieval of Sequence(s) from the NCBI Nucleotide Database, Retrieval of Protein Sequence from UniProtKB, Downloading Protein Structure, Visualizing Protein Structure, Sequence Format Conversion, Nucleotide Sequence Analysis Using Sequence Manipulation Suite (SMS), Detection of Restriction Enzyme Sites,	12
2	**SEQUENCE ALIGNMENT** Different scoring models, Substitution matrices (PAM and BLOSUM), Pairwise Alignment: Concept of Global and Local Alignment, Dot matrix method, Dynamic programming (Needleman-Wunsch algorithm, Smith-Waterman algorithm, Choosing of best scoring matrix, gap penalties, Significance of score, EVD, FASTA and BLAST algorithms (BLASTn, BLASTp, BLASTx), Comparison of FASTA and BLAST, Information theory and Shanon Entropy	11
3	**MULTIPLE SEQUENCE ALIGNMENT** Scoring Function, Exhaustive Algorithms, Heuristic Algorithms, Practical Issues. Multiple Sequence Alignment, methods (MSA), Scoring of a MSA, Progressive (CLUSTALW and PILEUP), Iterative (Genetic) and Hidden Markov Model (HMM), methods of MSA, Local MSA (Profile and BLOCK analysis, and Pattern searching, and Expectation Maximization (EM) Algorithm (MEME) and Gibbs Sampler. Protein Motifs and Domain Prediction: Identification of Motifs and Domains in Multiple Sequence Alignment, Motif and Domain Databases Using Regular Expressions.	12
4	***MOLECULAR PHYLOGENETICS*** Phylogenetic tree and terminology, different methods of Phylogenetic tree prediction: maximum parsimony, distance (UPGMA, NJ), maximum likelihood methods, bootstrapping, Jacknifing and Phylogenetic analysis by using Bayesian Network.	10
5	**STRUCTURAL BIOINFORMATICS** Introduction, Protein stability and folding, Protein folding, Applications of hydrophobicity, Superposition of structures, and structural alignments, DALI and MUSTANG, Evolution of protein structures, Classifications of protein structures, Protein structure prediction and modelling, A priori and empirical methods, Critical Assessment of Structure Prediction, Secondary structure prediction, Homology modelling.	11

References:

1. Jin Xiong. Essential Bioinformatics, Cambridge University Press, 2006
2. Chandra Sekhar Mukhopadhyay, Ratan Kumar Choudhary, Mir Asif Iquebal. Basic Applied Bioinformatics, John Wiley & Sons, Inc. 2018.

Course Title: Robotics and Automation.	Course Code: 25BCAAI6EB1
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. Understand basic components of robotics, classification of robots and their applications.
2. Know on types of robot grippers, their usage and design considerations.
3. Understand about various types of sensory devices their working and applications.
4. Apply basic transformations related to the movement of manipulator.
5. Design a robot mechanism to meet kinematics requirements and to write simple programs

Unit	Description	Hours
1	**Basics of Robot** : Introduction to Robotics, major component of a robot, robotic like devices, classification of robots - Classification by coordinate system and by control method, Specifications of robots, fixed versus flexible automation. Applications of robot : Economic analysis, Robot applications in Material Handling, Processing and assembly	11
2	**Robot End Effectors** : Introduction, end effectors, interfacing, types of end effectors, grippers and tools. Selection : Selection and Design Considerations of End effectors, Remote Centre Compliance device	11
3	**Robotic Sensory Device**s : Position Sensors : Objective, Non-optical position sensors - potentiometers, synchros, inductocyn, optical position sensors - opto interrupters, optical encoders (absolute & incremental). Proximity Sensors : Contact type, non-contact type - inductive, capacitive proximity sensors, optical proximity sensor, and scanning laser proximity sensor.	11
4	**Touch and Slip Sensors** : Proximity rod & photo detector tactile sensor, slip sensors - Forced oscillation slip sensor, interrupted type slip sensors. Transformations : Objectives, homogenous coordinates, basic transformation operations, fixed angle representation, Euler angle representation.	12
5	**Forward Kinematics** : Forward solution - Denavit Hartenberg procedure. Simple problems involving 2 and 3 DOF manipulators, SCARA manipulator. Robot Programming : Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effecter commands, and Simple programs.	11

References:

1. Introduction to Robotics: Mechanics And Control, John J.Craig 3rd Edition, Pearson, 2008.
2. Robotics: Control, Sensing, Vision, and Intelligence, K. S. Fu, R. C. Gonzales, and C. S. G. Lee, Tata McGraw-Hill, NY, 2008.
3. Introduction to Robotics: Analysis, Systems, Applications, Saeed B. Niku, Prentice Hall, NJ, 2010.

Course Title: Soft Computing	Course Code: 25BCAAI6EC1
Total Contact Hours: 56	No. of Credits: 04
L:T:P= 4:0:0	
Internal Assessment Marks: 20	Duration of SEE: 03 Hours
Semester End Exam Marks: 80	

Course Outcomes (COs):

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

1. To learn the basic concepts of Soft Computing.
2. To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
3. To apply soft computing techniques to solve problems.

Unit	Description	Hours
1	**0**	11
2	**Artificial Neural Networks**: Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.	11
3	**Fuzzy Systems:** Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions - Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.	11
4	**Genetic Algorithms**: Basic Concepts- Working Principles -Encoding- FitnessFunction - Reproduction - Inheritance Operators - Cross Over - Inversion andDeletion - Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm	11
5	**Hybrid Systems:** Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller	12

References:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing‖, Prentice-Hall of India, 2002.
2. Kwang H.Lee, First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications‖, Prentice Hall, 1996.
4. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques‖, Addison Wesley, 2003.

*****

BCA/B.Sc Degree Examination,SEP – QP - Pattern

Time: 3 Hours **Max. Marks: 80**

Section – A

Note: Answer all sub questions
Each question carries TWO mark. **(10 x 2 = 20)**

1.

a)
b)
c)
d)
e)
f)
g)
h)
i)
j)

Section – B

Note: Answer any Four questions
Each question carries FIVE marks. **4 x 5 =20)**

2.
3.
4.
5.
6.
7.

Section – C

Note: Answer any Four questions
Each question carries TEN marks. **(4 x 10 =40)**

8.
9.
10.
11.
12.
13.

Note: 1. For Section –A, Two questions from each Unit.
2. For Section – B, One question from each Unit, and Q-7 must be from Unit 2 to 5.
3. For Section – C, One question from each Unit, and Q-13 must be from Unit 2 to 5.

BCA/B.Sc Degree Examination, SEP – Scheme for Practical Examination

1. Writing Two Programs : 14 Marks (for each 7 marks)
2. Execution of Two programs : 16 Marks (for each 8 marks)
3. Practical record : 05 Marks
4. Viva Voce : 05 Marks Total : 40 Marks

QUESTION PAPER PATTERNS FOR ALL SKILL PAPERS IS 40 MULTIPLE CHOICE QUESTIONS.