



Scheme of Instructions & Syllabi  
of

**Bachelor of Computer Applications  
(Artificial Intelligence)  
(2022-25)**

With the collaboration of  
**CSED**

**(Center for Skill and Entrepreneurship Development)**  
[As per CBCS guidelines given by UGC]

**Total Credit of the Program**

Semester	I	II	III	IV	V	VI	Total
Credits	23	24	26	22	21	24	<b>140</b>

**Faculty of Computer Applications  
INVERTIS UNIVERSITY  
Bareilly-243123 U.P.**

**STUDY AND EVALUATION SCHEME**  
**Bachelor of Computer Applications (Artificial Intelligence)**  
(2022-2025)

**SEMESTER I, YEAR I**

S.No	Course Code	Course Title	L+T+P	CA	EE	Total	Credit
1	BCAI101	English-I	2+1+0	25	50	75	3
2	BCAI102	Theory of Mathematics	2+1+0	25	50	75	3
3	BCAI104	Programming in C	2+1+0	25	50	75	3
4	BCAI105	Client Side Scripting	2+1+0	25	50	75	3
5	IOT1	Introduction to IIOT Foundation	3+1+0	30	70	100	4
<b>PRACTICAL / PROJECTS</b>							
6	BCAI106	Office Automation Lab	0+0+4	15	35	50	2
7	BCAI107	Programming in C Lab	0+0+2	10	15	25	1
8	BCAI108	Client Side Scripting Lab	0+0+4	15	35	50	2
9	BCAI109	Effective Communication Skills	0+0+4	15	35	50	2
<b>TOTAL</b>			<b>11+5+14</b>	<b>185</b>	<b>390</b>	<b>575</b>	<b>23</b>

**STUDY AND EVALUATION SCHEME**  
**Bachelor of Computer Applications (Artificial Intelligence)**  
**(2022-2025)**

**SEMESTER II, YEAR I**

S.No	Course Code	Course Title	L+T+P	CA	EE	Total	Credit
1	BCAI202	Linux Shell Scripting	2+1+0	25	50	75	3
2	BCAI204	Operating Systems	2+1+0	25	50	75	3
3	BCAI205	Data Structures using C	2+1+0	25	50	75	3
4	BCAI206	Environmental Studies	2+1+0	25	50	75	3
5	BCAI211	Python Programming	2+1+0	25	50	75	3
6	IHOT2	Communication and Standard Interfaces	3+1+0	30	70	100	4
<b>PRACTICAL / PROJECTS</b>							
7	BCAI207	Data Structures using C Lab	0+0+4	15	35	50	2
8	BCAI208	Linux Shell Scripting Lab	0+0+2	10	15	25	1
9	BCAI212	Python Programming Lab	0+0+4	15	35	50	2
<b>TOTAL</b>			<b>13+6+10</b>	<b>195</b>	<b>405</b>	<b>600</b>	<b>24</b>

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**SEMESTER III, YEAR II**

S.No	Course Code	Course Title	L+T+P	CA	EE	Total	Credit
1	BCAI301	DBMS	2+1+0	25	50	75	3
2	BCAI302	Computer Networks	2+1+0	25	50	75	3
3	BCAI305	Object Oriented Programming Using Java	2+1+0	25	50	75	3
4	BCAIAI301	Statistics and Probability	3+1+0	30	70	100	4
5		Elective-I	2+1+0	25	50	75	3
6	IOT3	Introduction to Data Analytics	3+1+0	30	70	100	4
<b>PRACTICAL / PROJECTS</b>							
7	BCAI303	DBMS Lab	0+0+4	15	35	50	2
8	BCAI306	Object Oriented Programming Using Java Lab	0+0+4	15	35	50	2
9	BCAI304	Business Communication and Presentation Skills	0+0+4	15	35	50	2
<b>TOTAL</b>			<b>14+6+12</b>	<b>205</b>	<b>445</b>	<b>650</b>	<b>26</b>

<b>Elective I</b>		
S.No	Course Code	Program Elective-I
1	BCAIAI302	Digital Electronics
2	BCAIAI303	Data Visualization
3	BCAIAI304	Business Intelligence

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**SEMESTER IV, YEAR II**

S.No	Course Code	Course Title	L+T+P	CA	EE	Total	Credit
1	BCAIAI401	Introduction to RPA Tools	2+1+0	25	50	75	3
2	BCAIAI402	Introduction to Artificial Intelligence	2+1+0	25	50	75	3
3	BCAIAI403	Sensor Technology	2+1+0	25	50	75	3
4		Elective-II	2+1+0	25	50	75	3
5	BCAI403	Logical Reasoning and Thinking	3+1+0	15	35	50	2
6	IIOT4	Machine Learning	3+1+0	30	70	100	4
<b>PRACTICAL / PROJECTS</b>							
7	BCAIAI407	Introduction to Artificial Intelligence Lab	0+0+4	15	35	50	2
8	BCAIAI408	Introduction to RPA Tools Lab	0+0+4	15	35	50	2
<b>TOTAL</b>			<b>14+6+8</b>	<b>175</b>	<b>375</b>	<b>550</b>	<b>22</b>

<b>Elective II</b>		
S.No	Course Code	Program Elective-II
1	BCAIAI404	Business Process Management
2	BCAIAI405	Introduction to Data Science
3	BCAIAI406	Pattern Recognition

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**SEMESTER V, YEAR III**

S.No	Course Code	Course Title	L+T+P	CA	EE	Total	Credit
1	BCAIAI501	Six Sigma and Lean Methods	2+1+0	25	50	75	3
2	BCAIAI502	Digital Image Processing	2+1+0	25	50	75	3
3		Elective –III	1+1+0	15	35	50	2
4		Elective – IV	2+1+0	25	50	75	3
5		Generic Elective-I	2+1+0	25	50	75	3
6	IOT5	Deep Learning	3+1+0	30	70	100	4
<b>PRACTICAL / PROJECTS</b>							
7	BCAIAI511	Digital Image Processing Lab	0+0+4	15	35	50	2
8		Elective – III Lab	0+0+2	10	15	25	1
<b>TOTAL</b>			<b>12+6+6</b>	<b>170</b>	<b>355</b>	<b>525</b>	<b>21</b>

Elective III		
S.No	Course Code	Program Elective-III
1	BCAIAI503	Test Automation using Selenium
2	BCAIAI504	Software Testing

Elective III Lab		
S.No	Course Code	Program Elective-III Lab
1	BCAIAI512	Test Automation using Selenium Lab
2	BCAIAI513	Software Testing Lab

Elective IV		
S.No	Course Code	Program Elective-IV
1	BCAIAI505	Introduction to web Services
2	BCAIAI506	Digital Signal Processing
3	BCAIAI507	Embedded Systems

Generic Elective-I		
S.No	Course Code	Generic Elective-I
1	BCAIAI508	Design Thinking
2	BCAIAI510	Cloud Computing

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**SEMESTER VI, YEAR III**

S.No	Course Code	Course Title	L+T+P	CA	EE	Total	Credit
<b>PRACTICAL / PROJECTS</b>							
1	BCAI601	Major Project / Internship	0+0+40	180	420	600	24
<b>TOTAL</b>			<b>0+0+40</b>	<b>180</b>	<b>420</b>	<b>600</b>	<b>24</b>

# Syllabus

# Semester: I

**BCAI-101: English-I**

**L=1, T=1, P=0, C=3**

**MM 75**

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*Syllabus as per CBCS (2022-25)*

*Page 8*



**Course Objective:**

1. To train students in how to be effective communicators by practicing various skills and also help them in becoming well-groomed individuals in terms of both verbal and non-verbal communication

**Unit I: Communication Process**

What is communication? The communication model, elements of communication, Importance of effective communication skills in the business world, Components of Communication Process, practicing effective communication, good communication Vs effective communication, styles of communication, intercultural communication skills- need for attitude change and benefits

**Unit II: Types of Communication & Barriers to communication**

Verbal Communication, Non Verbal Communication, Written Communication, Do's and don'ts of each type, barriers to effective communication and how to overcome them, interaction of verbal and non-verbal communication, talents of a corporate communicator, silence- merits and limitations of each type

**Unit III: Listening Skills & Reading Skills**

What is listening, various types of listening – Active, passive, selective, listening and note taking, listening and comprehending, listening to speak, principles of good listening Techniques to develop effective listening skills, Reading Skills- skimming, scanning and inferring- common reading techniques, practicing smart reading.

**Unit IV: Conversation Skills**

Importance of conversation skills, features of a good conversation, Tips to improve Conversation skills, importance of questioning skills, techniques to ask right questions- role play situations to practice the same, discussing issues (social, political and cultural), formal and informal conversation

**Unit V: Telephone Etiquette**

Basic rules of telephone etiquette- formal vs. informal; tone, pitch and vocabulary related to formal ways of speaking over the phone, leaving voice messages; practice sessions (role plays)

Persuasive communication: What is persuasive communication, different techniques of persuasive communication, How to negotiate using persuasive communication, the act of negotiation, negotiation style and their contexts, fundamentals of negotiation, common hurdles in negotiation and how to overcome them

**Text Books:**

1. “Active Listening 101: How to Turn Down Your Volume to Turn Up Your Communication Skills, by Emilia Hardman, 2012
2. The Power of Communication: Skills to Build Trust, Inspire Loyalty, and Lead Effectively, by Helio Fred Garcia, 2012

**Reference Books:**

1. Power Listening: Mastering the Most Critical Business Skill of All, by Bernard T. Ferrari, 2012
2. Fitly Spoken: Developing Effective Communication and Social Skills, by Greg S. Baker, 2011
3. The Secrets of Successful Communication: A Simple Guide to Effective Encounters in Business (Big Brain vs. Little Brain Communication), by Kevin T. McCartney, 2011.

**Course Outcomes:**

1. In the end of the course, students will be able to channelize areas of communication in which they need to improve and use communication more effectively to get their messages across to people more clearly.

**BCAI-102: Theory of Mathematics**

L=1, T=1, P=0, C=3

MM 75

**Course Objective:**

1. To develop the skills in the areas of Matrices, Sets, relations and functions, Differentiation and Integration.
2. Mathematics concepts serves as a pre-requisite for post graduate courses, specialized studies and research.

**Unit I: Sets, relations and functions**

Definition of Set, Type of Sets, Operations on Sets, Venn diagram, Cartesian Product, Relations, Functions, Types of function, Some elementary functions with their graphs (Exponential, logarithmic, modulus), Limit & continuity of a function (Simple Problems).

**Unit II: Matrices and Determinants**

Types of Matrices, Operations of addition, Scalar Multiplication and Multiplication of Matrices, Determinant of a Square Matrix, Minors and Cofactors, Transpose, adjoint and inverse of a matrix, solving system of linear equations, in two or three variables using inverse of a matrix.

**Unit III: Limits, Continuity and Differentiation**

Limit at a Point, Properties of Limit, Computation of Limits of Various Types of Functions, Continuity at a Point, Continuity Over an Interval, Intermediate Value Theorem, Type of Discontinuities. Derivative, Derivatives of Sum, Differences, Product & Quotients, Chain Rule, Derivatives of Composite Functions

**Unit IV: Coordinate Geometry**

2D Cartesian Co-ordinate system, Straight line: (Equation & Slope of a line), Circle: Equation of Circle, Equation to Tangent, Conic Sections: Focus, Eccentricity, Directrix, Axis of a conic section, Parabola & Ellipse: (Definitions, equations and shape of curve only)

**Unit V: Statistics and Probability**

Introduction, definition, terminologies in statistics and probability, measure of central tendency and dispersion, probability distribution – continuous and discrete, Bayes theorem, testing of hypothesis, basics of ANOVA, Correlation and Regression Analysis.

**Text Book:**

1. Mathematics for BCA by G. C. Sharma & Madhu Jain, Oscar Publication
2. Mathematics Vol-2 by R. D. Sharma, Dhalpat Raj & Sons

**Reference Books:**

The Elements of Co-ordinate Geometry Part-I by S. L. Loney, Book Palace, New Delhi.

**Course Outcome:**

After completion of the course the student will be able:

1. To know and define the use of basic concepts of Matrices.
2. To apply the concept of set relation and functions in functions.
3. To know the methods and rules of calculus.
4. To understand the basics 2D Cartesian Co-ordinate system, Straight line.
5. To know the basics of statistics and probability for computer science.

**BCAI-104: Programming in C**

L=1, T=1, P=2, C=3

MM 75

### **Course Objective:**

1. Even with the introduction of several high level languages and frameworks, the development of procedural codes is important in several commercial app developments.
2. The object oriented platforms and event driven systems use procedural languages for coding integral command content. C is an important procedural language and was developed initially to write the UNIX operating system.
3. UNIX operating system, C compiler and all UNIX application programs are written in C. C is popular because, it is easy to learn, produces efficient programs, can handle low-level activities, and can be compiled on a variety of platforms.
4. This course focuses on all the basic concepts, syntax and constructs of the C language. For students, who are new to programming, this unit can be considered as the starting point before taking up any other programming oriented units.
5. The students will be implementing the concepts explained here to create simple to complex programs.

### **Unit I: Introduction to Programming:**

Problem Solving Using Computers: Language Classification, Problem Analysis, Algorithm and Flowchart design. Algorithms: Steps in developing algorithms, advantages and disadvantages. Flowcharts: Symbols used in developing flowcharts, advantages and disadvantages. Coding, testing, debugging, Documentation and maintenance. Program development and modular design.

### **Unit II: Fundamentals of C programming and Control Structures:**

History, Structure of a C program, C Conventions, Character Set, Identifiers, Keywords, Simple Data types, Modifiers, Variables, Constants, Operators (Arithmetic operator, relational operator, logical operator, ternary operator, unary operator, shorthand operator, bit-wise operator and arithmetic operator) Operator precedence. Input and Output operation: Single character input and output, formatted input and output, Buffered input. Control Structures: Introduction, Conditional statement, if statement, if-else statement, nested if statement, else-if statement and switch statement. Goto statement. Looping statement, while statement, do-while statement, for statement, break and continue, nested for statement

### **Unit III: Arrays and Functions:**

Arrays: Introduction (One and multi-dimensional), Declaration of arrays, Initialization of arrays, processing with arrays. String manipulation, declaration of string arrays, string operations. Functions: Introduction, advantages of subprograms, Function definition, function call, Actual and formal arguments, local and global variables, function prototypes, types of functions, recursive functions, arrays and functions.

### **Unit IV: Storage Classes, Structures, Unions and Pointers:**

Storage Classes, Structures and Unions: Introduction, types of storage classes, Introduction to structures, Advantages of structures, accessing elements of a structure, nested structures, array of structures, functions and structures, Unions, bit-fields, enumerated data types.

Pointers: Introduction, pointer variable, pointer operator, pointer arithmetic, pointers and arrays, pointers and strings, array pointers, dynamic allocation

### **Unit V: Files, Preprocessor, standard library and header files:**

Files: Introduction, File data type, opening and closing a file, file functions (getc, putc, getw, putw, fscanf, fprintf, fread, fwrite, fgets, fputs, feof).

Preprocessor: #define, #include, #undef, Conditional compilation directives, C standard library and header files: Header files, string functions, mathematical functions, Date and Time functions

### **Text Book:**

1. Forouzon A Behrouz, Gilberg F Richard, A Structured Programming Approach using C - 3rd Illustrated Edition, 2009.
2. Kanetkar, Yashavant: "Let Us C", 6th Edition. BPB Publications.

3. Balagurusamy, E: “Programming in ANSI C” 3rd Edition. Tata McGraw-Hill

**Reference Books:**

1. The C programming Language by Richie and Kernighan, 2004, BPB Publication
2. Gottfried, Byron S: “Programming with C”, 1996. Tata McGraw-Hill
3. Deitel, H M and Deitel P J: “C How to Program”, 2nd Edition. Prentice-Hall

**Course Outcome:**

After completion of the course the student will be able:

1. To be able to use the basic concepts of Computer components.
2. To be able to design, implement, test, debug and document programs in C.
3. To be able to use functions, and functions with parameters passing option.
4. To be able to use pointers and arrays, perform pointer arithmetic.
5. To be able to understand the advance topics in C like file handling functions and the concept of Standard C library.
6. To be able to learn the concept of C preprocessor and its application in program development.

**BCAI-105: Client Side Scripting**

L=1, T=1, P=0, C=3

MM 75

## **Course Objective:**

1. To introduce students to web technologies such as HTML, CSS, XML, Java Script teach them to create static and simple dynamic web pages or applications using these technologies and to understand web application deployment and software architectures.
2. Students will learn basic web application design, development and testing skills.
3. On completion of this course the learner should be able to design and implement a variety of dynamic Website

## **Unit I: Introduction to the Internet and the World Wide Web**

Introduction, History of internet, Internet Design Principles, Internet Protocols - FTP, TCP/IP, SMTP, Telnet, etc., Client Server Communication, Web System architecture

Evolution of the Web, Web architectures, Web clients and servers, Static and Dynamic Web Applications, Front end and back end web development. HTML, CSS, JS, XML; HTTP, secure HTTP, etc.; URL, Web Services – SOAP, REST.

## **Unit II: HTML, CSS & JavaScript**

Introduction to Html, Html Document structure, Html Editors, Html element/tag & attributes, designing simple page - Html tag, Head tag, Body tag; More Html tags - Anchor tag, Image tag, Table tag, List tag, Frame tag, div tag; Html forms - Input type, Text area, Select, Button, Images. Introduction to CSS, Syntax, Selectors, Embedding CSS to Html, Formatting fonts, Text & background color, Inline styles, External and Internal Style Sheets, Borders & boxing. Introduction to JavaScript: Data types, variables, operators, expressions, statements, functions, objects, arrays, date, math, error handling, flow control, loops

## **Unit III: XML and HTML5, CSS3**

Introduction to XML, Difference b/w Html & XML, XML editors, XML Elements & Attributes XML DTD, XML Schema, XML Parser, Document Object Model (DOM), XML DOM. Introduction to HTML5, CSS3, New features, Local storage, Web Sockets, Server events, Canvas, Audio & Video, Geolocation, Microdata, Drag and Drop. Browser life cycle and browser rendering stages. Service workers.

## **Unit IV: Practical website development**

Commonly used Web Servers and browsers, Setting up a server and domain name, website types and structures, web authoring tools, Web hosting, website maintenance, generating traffic to your website.

## **Unit V: PHP Server side scripting**

Introduction to PHP, Basic Syntax, Variables, constants and operators, Loops, Arrays and Strings, Environment & environment variables, responding to HTTP requests, Files, Cookies, Sessions, Examples.

## **Text Books:**

1. Practical Web Design for Absolute Beginners, Adrian W. West. Apress 2016
2. Introducing Web Development, Jorg Krause. Apress 2017.
3. HTML & CSS: The Complete Reference, Thomas Powell. McGraw Hill, Fifth Edition, 2010
4. Creating a Website: The Missing Manual, 3rd Edition, Mathew Macdonald. O'Reilly
5. Web Technologies - HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and Ajax Black, Kogen Learning Systems (Dreamtech Press), 5th Edition 2009.

## **Reference Books:**

1. HTML, XHTML & CSS Bible, Brian Pfaffenberger, Steven M.Schafer, Charles White, Bill Karow- Wiley Publishing Inc, 2010

2. HTML5 & CSS3 for the Real World, 2 Edition, Alexis Goldstein, Estelle Weyl, Louis Lazaris. Apress 2015.
3. HTML5 & CSS3 for Dummies, Andy Harris. Wiley 2014.
4. Learning PHP A Gentle Introduction to the Web's Most Popular Language, David Sklar. O'Reilly 2016.
5. Build Your Own Database Driven Web Site Using PHP & MySQL, Kevin Yank. Sitepoint , 4th Edition, 2009.

**Course Outcome:**

Students will gain the knowledge and skills required to develop Simple Web Applications. They should be able to:

1. Explain basic Client-Server web architecture
2. Understand working of web protocols like HTTP, TCP/IP, DNS as well as IP and web address resolution schemes such as URIs/URLs and DNS
3. Use and recognize commonly used HTTP request and response messages
4. Differentiate and create both static and dynamic web applications
5. Understand and use HTML/CSS and XML
6. Create static web pages using HTML & CSS
7. Understand and use PHP for server side scripting
8. Create simple dynamic web pages supporting user interaction using HTML, CSS &Java Script

Program Name- **INTRODUCTION TO IOT FOUNDATION**

Program Hours- **50**

Tentative Credit- **4**

### **OBJECTIVES**

- To learn the concepts of IOT.
- To identify the different technology.
- To learn different applications in IOT.
- To learn different protocols used in IOT.
- To learn the concepts of smart systems with development in IOT.
- To learn how to visualize the real time data in IOT.

### **OUTCOMES**

- Project oriented learning with real time applications.
- End - to - end learning & development with different technologies of IOT System.
- Apply IOT to different applications using Thingworx.
- Application and analysis of protocols used in IOT.
- Design and develop smart things in IIOT using Thingworx.
- Analysis and evaluation of the data received through sensors in IOT using different visualization techniques.

### **SCOPE**

- IIOT Designer
- IIOT Developer
- IIOT Analyst
- IIOT Tester
- Entrepreneurship

### **PROJECTS**

- Smart Home Automation
- Smart washroom
- Smart Kitchen
- Smart Dustbin
- Smart Smoke Detector
- Smart Irrigation
- Smart Street Light
- Thingworx app development

## INTRODUCTION TO IOT FOUNDATION

### Module 1:

**Programming of Microcontroller:** Problem Statement Understanding, Tinker CAD Introduction, Simulation with LEDs & Serial Monitor, Introduction Sensors, Development board and Different Actuators, Basic Electronics Components of IOT, Basic Arduino Programs with Sensors & Actuators, Interfacing LED, Interfacing LCD, Installing Board Packages, Serial Monitor and Debugging Tool, Installing Sensor Libraries.

### Module 2:

**Embedded coding and Debugging of Microcontroller:** Hardware Selection, Interfacing with Development Board, Coding & Testing, Architecture of Microcontroller, Analog & Digital Signals, Basic gates, Timers, Counters, flipflops, Registers, RAM, and ROM (PROMS, EPROMS, EEPROMS), Multiplexers, De-Multiplexers, Encoders, Decoders.

### Module 3:

**IOT Communication Protocols-** IOT Communication Protocols, Wired Protocols Introduction to (Ethernet: Twisted pair, Co-axial cables, Optical Fiber), Wireless Protocols Introduction to (Wi-Fi, Bluetooth, Zigbee, RFID, LoRa), Networking Protocols (OSI Model, TCP/IP, Ethernet), Network Architecture, protocols, and serial monitoring.

### Module 4:

**Interfacing of Sensors:** Interfacing Ultrasonic Sensors, Interfacing Temperature Sensor, Interfacing PIR Sensors, Interfacing MQ Sensors, Interfacing Servo Motor, Interfacing Soil Moisture Sensor, Interfacing Photo Sensor.

### Module 5:

**IoT Web Application Development in Thingworx:** Experiencing IoT Application, Thingworx Composer, Creating Thing, ThingTemplate, Creating Properties, Creating Alerts, Creating Subscription, Building Mashups, Mapping Thing Model to Mashup, Application Keys, Thingworx REST API, ESP32-GPIO and Environment, Wi-Fi (802.11) Interfacing.

### Reference Books & Materials:

- [The Internet of Things \(The MIT Press Essential Knowledge series\) by Samuel Greengard](#)
- [The Fourth Industrial Revolution Paperback – by Klaus Schwab](#)
- [Introduction to Arduino](#)
- [Programming with Arduino](#)
- [Getting to Know Thingworx Platform](#)



## BCAI-106: Office Automation Lab

L=0, T=0, P=4, C=2

MM 50

### List of Experiments:

1. Installing Operating Systems and Basic Software
2. **MS Word**
  1. Prepare a document about any tourist destination of your choice with appropriate pictures and editing features.
  2. Prepare a News Paper Layout. Insert appropriate pictures wherever necessary. Use the following Features:
    - Three Column and Four Column setting
    - Set One or Two Advertisements
    - Use Bullets and Numbering.
  3. Create a Document consisting of Bio-data. It includes
    - A table giving your qualification and/or experience of work. Table should be Bordered and Shaded.
    - A Multilevel list giving your areas of interest and further areas of interest. The sub areas should be numbered as
    - 'a', 'b', etc while the areas should be numbered as '1', '2', etc.
    - The information should be divided in “General” and “Academic” sections.
    - The header should contain “BIO-DATA” while the footer should have page numbers in the format Page 1 of 10.
    - Assign a password for the document to protect it from unauthorized access.
  4. Assume that you are coordinating a seminar in your organization. Write a letter to 10 different IT companies asking them to participate in the seminar using mail merge facility.
  5. Prepare a document which contains template of marks card of students. Assume that there are 10 students. The footer for the document should be ' University Name '.
  6. Prepare a document about any topic in mathematics which uses mathematical symbols. (At least 5 mathematical symbols should be used). Assign a password for the document to protect it from unauthorized access. Demonstrate the use of Hyperlink Option. Sets margins to your document, a font of size and double spaced document.
3. **MS – Excel**
  1. Open a new workbook, save it as JavaCoffeeBar.xls. In sheet1 write following sales data for Java Coffee bar to show their first 6 months’ sales.
    - Select cell B4:D4 and change the horizontal alignment to center and text to 90 degrees.
    - All titles should be in bold
    - Format all cells numbers to currency style and adjust width as necessary. •Add border to data.
    - Select the cell range A1:H1, merge and center these cells. Apply same format to A2:H2.
    - Give border, shading and pattern to data in sheet •Apply different font settings for all titles in sheet
    - Apply green color and bold setting to sales above 10000 (use conditional formatting)
    - Rename current worksheet as FirstHalfSales
  2. Prepare a worksheet to maintain student information. The work sheet should Contain Roll Number, Name and marks in 5 subjects. (Max Marks is 100). Validate the marks. Calculate the total marks. Assign the grade according to the following. Assign grade 'A' if the total marks is above 450. From 401 to 449 assign the grade as 'B'. From 351 to 400 assign the Grade as 'C'. From 300 to 350 the grade to be assigned is 'D'. For the total marks less than 300 No grade is assigned. A student is eligible to get a grade only when he gets 40 and above in all the subjects. In such cases the grade is “FAIL”. (Assume that there are 10 students).
  3. Prepare a pay-bill using a worksheet. The work sheet should contain Employee Id, Name, Designation, Experience and Basic Salary and Job ID. If Job Id is 1 then DA is 40% of the basic salary. HRA is Rs. 4500. If Job Id is 2 then DA is 35% of the basic salary. HRA is Rs. 3500. If Job Id is 3 then DA is 30% of the basic salary. HRA is Rs. 2500. If Job Id is 4 then

DA is 25% of the basic salary and HRA is RS.2500. For all the other Job ids DA is 20% of the basic salary and HRA is Rs. 1500. For all the above Job ids PF to be deducted is 4%. For the job ids between 1-4Rs. 100 to be deducted as Professional Tax. Find the net pay.

4. For the above employee worksheet perform the following operations
  - Use filter to display the details of employees whose salary is greater than 10,000.
  - Sort the employees on the basis of their net pay
  - Use advance filter to display the details of employees whose designation is "Programmer" and Net Pay is greater than 20,000 with experience greater than 2 yrs
5. Using Excel project the Product sales for any five products for five years.
  - Compute the total sales of each product in the five years.
  - Compute the total sales of all the products in five years.
  - Compute the total sales of all products for each year.
  - Represent annual sale of all the products using Pie-Chart.
  - Represent annual sales of all products using Bar Chart.
  - Represent sale of a product for five years using Pie-Chart.
  - Label and format the graphs
6. Create a statement of Telephone Bill Charge for a customer.
  - Telephone Calls
  - Up to 150 calls- free
  - 151 to 500 calls- 0.80 per call
  - 501 to 1000 calls- 1.00 per call
  - 1001 to 2000 - 1.25 per call
  - Above 2000- 1.40 per call
7. Perform Following:
  - Using Excel write sales data with columns product, month and sales. Write at least 5 records. Create Pivot Table chart and Report for the data.
  - Create a macro to change the name of worksheet as Macro Example, merge first three columns of first row and write heading as DATA in green color with yellow background
  - Link word document in excel worksheet to show the usage of linking and embedding.

#### 4. MS – PowerPoint

Assume that you are going to give a presentation about Information Technology. (Choose some latest technologies). The presentation should have minimum 10 slides. Insert appropriate images wherever necessary. Use proper formatting, Diagrams and tables. Show the usage of action buttons, hyperlinks, and animations.

## BCAI-107: Programming in C Lab

L=0, T=0, P=2, C=1

MM 25

### Part A

1. Printing the reverse of an integer.
2. Printing the odd and even series of N numbers.
3. Get a string and convert the lowercase to uppercase and vice-versa using `getchar()` and `putchar()`.
4. Input a string and find the number of each of the vowels appear in the string.
5. Accept N words and make it as a sentence by inserting blank spaces and a full stop at the end.
6. Printing the reverse of a string.

### Part B

1. Searching an element in an array using pointers.
2. Checking whether the given matrix is an identity matrix or not.
3. Finding the first N terms of Fibonacci series.
4. Declare 3 pointer variables to store a character, a character string and an integer respectively. Input values into these variables. Display the address and the contents of each variable.
5. Define a structure with three members and display the same.
6. Declare a union with three members of type integer, char, string and illustrate the use of union.
7. Recursive program to find the factorial of an integer.
8. Finding the maximum of 4 numbers by defining a macro for the maximum of two numbers.
9. Arranging N numbers in ascending and in descending order using bubble sort.
10. Addition and subtraction of two matrices.
11. Multiplication of two matrices.
12. Converting a hexadecimal number into its binary equivalent.
13. Check whether the given string is a palindrome or not.
14. Demonstration of bitwise operations.
15. Applying binary search to a set of N numbers by using a function.
16. Create a sequential file with three fields: empno, empname, empbasic. Print all the details in a neat format by adding 500 to their basic salary.

## BCAI-108: Client Side Scripting Lab

L=0, T=0, P=4, C=2

MM 50

### List of Experiments:

1. Design a simple web page with head, body and footer, with heading tags, image tag
2. Design a web site for book information, home page should contain books list, when particular book is clicked, information of the books should display in the next page.
3. Design a page to display the product information such as name, brand, price and etc with table tag
4. Design a web site for book information using frames, home page should contain two parts, left part should contain books list, and right part should contain book information.
5. Design a web page to capture the user information such as name, gender, mobile number, mail id, city, state, and country using form elements.
6. Design a web page with nice formatting like background image, text colors and border for text using external CSS.
7. Design a web page to perform mathematical calculations such as addition, subtraction, multiplication, and division using form elements and Java Script.
8. Design a web page to capture the user information such as name, gender, mobile number, mail id, city, state, and country using form elements and display them into other pages using Java Script.
9. Design a web page to display timer in the left side of the web page using Java Script.
10. Design a web page to capture the student details such as student number, name, age, marks using Java Script Object.
11. Design a web page to read data from an XML file and display the data in tabular format, take the data as employee information.
12. Design a web site for online purchase using CSS, JS and XML, web site should contain the following web pages.
  - Home page
  - Login page
  - Signup page
  - Product details pageDesign a web site for Student details using PHP, web site should contain the following web pages.
  - Home page
  - Login page
  - Signup page
  - Student details page

## BCAI-109: Effective Communication Skills

L=0, T=0, P=4, C=2

MM 50

### Course Objective:

1. To train students to be comfortable with everyday communication.
2. Training the students in English grammar.

### Unit I: Everyday Conversations

- Introducing self / others
- Weather
- Classroom
- Asking about facilities around
- Describing a person / thing

Points to cover: Vocabulary, grammar, Construction of sentences, listening.  
Methodology: Role plays, Videos, Classroom conversation, worksheets.

### Unit II: Asking for.

- Help/ Suggestion/ ideas
- Clarification/ Directions
- Time/ food
- Advice
- Uses

Points to cover: Vocabulary, grammar, Construction of sentences, listening.  
Methodology: Role plays, Videos, Classroom conversation, worksheets.

### Unit III: Reporting/ Describing

- Incidences
- Personalities
- Experiences
- Wants/Needs
- Intentions

Points to cover: Vocabulary, grammar, Construction of sentences, listening  
Methodology: Role plays, Videos, Classroom conversation, worksheets

### Unit IV: Meeting People

- Greetings
- Starting the Conversation
- Small talks
- Closing the conversation

Points to cover: Vocabulary, grammar, Construction of sentences, listening  
Methodology: Role plays, Videos, Classroom conversation, worksheets

### Unit V: Expressing

- Happiness/Displeasure
- Preferences
- Doubts
- Views
- Unawareness

Points to cover: Vocabulary, grammar, Construction of sentences, listening

Methodology: Role plays, Videos, Classroom conversation, worksheets

**Talking about....**

- Interests
- Different Cultures
- Clothes , cars, institutes, situations
- Schedules, prices

Points to cover: Vocabulary, grammar, Construction of sentences, listening

Methodology: Role plays, Videos, Classroom conversation, worksheets

**Text Books:**

3. Speak Now Level I & II, Oxford Press
4. Business Benchmark, Level – Upper Intermediate by Cambridge University Press.

**Reference Books:**

5. Practical English Usage by Michel Swan, Oxford University Press
6. Cambridge Grammar for English: A comprehensive Guide for spoken & written English (South Asian edition), Cambridge University Press.

**Course Outcome:**

7. The students will have a better understanding of English grammar.
8. The students will be able to use grammar more effectively in their verbal and written communication.

# Syllabus

## Semester: II

# BCAI- 202: Linux Shell Scripting

L=2, T=1, P=0, C=3

MM 75

## Course Objectives:

1. The course provides an overview of the Linux Operating System, geared toward new users as an exploration tour and getting started guide.
2. This unit provides examples to help the learners get a better understanding of the Linux system. The unit also provides the guidelines for the learners to take up vendor certifications.
3. The unit explores the basics of Linux, the underlying management of the Linux operating system and its network configuration. The complete system services of Linux is explained along with the troubleshooting.

## Unit 1: Introduction to UNIX:

History of UNIX - Unix Components/Architecture - Features of Unix – UNIX Environment and UNIX Structure - Posix and Single Unix specification - The login prompt - UNIX commands – Basic commands - echo, printf, ls, who, date, passwd, cal - Combining commands

Internal and external commands – type, man, more and other commands - the user terminal, displaying its characteristics and setting characteristics - The root login - super user: su command - /etc/passwd and /etc/shadow files - Commands to add, modify and delete users.

## Unit II: UNIX file system:

UNIX File basics - File types and Categories – File Organization – Directories - home directory and the HOME variable - Reaching required files- the PATH variable - Relative and absolute pathnames. Directory commands – pwd, cd, mkdir, rmdir commands. The dot (.) and double dots (..) notations to represent parent directories - File related commands – cat, mv, rm, cp, wc

File inodes and the inode structure. File links – hard and soft links – Head and tail commands

Cut and paste commands - The sort command - Special files /dev/null and /dev/tty - File attributes and permissions - The umask and default file permissions - ls command - Changing file permissions: the relative and absolute permissions changing methods. Recursively changing file permissions. Directory permissions

## Unit III: UNIX Process Management:

The Structure of Processes: Process States and Transitions - Layout of system memory - Context of a process. Process Control: Process Creation – Signals – Process Termination – Invoking other programs – PID & PPID – Shell on a Shell.

## Unit IV: Vi Editor:

Introduction to Text Processing, Command & edit Mode, Invoking vi, deleting & inserting Line, Deleting & Replacing Character, Searching for Strings, Yanking, Running Shell Command Macros, Set Window, Set Auto Indent, Set No. Communicating with Other Users: who, mail, wall, send, msg.

## Unit V: Shell programming:

Introduction – Need for Scripts – Creating and Calling the Script – The Shebang – Different ways of running a script - Using variables in Script – Reading Input – Integer Variables – Arithmetic Expressions – Read-only variables – Exporting variables – Arrays - Control Statements: If, Then, Else, While and Until, Classic For, Break and Continue, Case – Handling Script Parameters: Shift, Getopts – Shell Functions – Handling Conditional expression patterns and Regular expressions in scripts.

## Text Books:

1. Sumitabha Das., UNIX Concepts and Applications. 4th Edition. Tata McGraw Hill, July 2017.
2. Behrouz A. Forouzan, Richard F. Gilberg : UNIX and Shell Programming- Cengage Learning – India Edition. 2009

## Reference Books:



1. M.G. Venkatesh Murthy: UNIX & Shell Programming, Pearson Education.
2. Richard Blum, Christine Bresnahan: Linux Command Line and Shell Scripting Bible, 2nd Edition , Wiley,2014.

### **Course Outcomes**

Students can,

1. To enable the students to have a hands on practical exposure to the Linux Red Hat Enterprise and make them prepared for the RHCE Certification.

# BCAI-204: Operating System

L=2, T=1, P=0, C=3

MM 75

## Course Objective:

1. The operating system is the most important program that runs on a computer. Every general-purpose computer must have an operating system to run other programs.
2. Operating systems perform basic tasks, such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers.
3. This course covers the concept of operating system and its applications

## Unit I: Introduction to Operating System

Introduction, Objectives and Functions of OS, Evolution of OS, OS Structures, OS Components, OS Services, System calls, System programs, Virtual Machines.

## Unit II: Process Management

**Processes:** Process concept, Process scheduling, Co-operating processes, Operations on processes, Inter process communication, Communication in client-server systems. **Threads:** Introduction to Threads, Single and Multi-threaded processes and its benefits, User and Kernel threads, Multithreading models, threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling Algorithms, Multiple Processor Scheduling, Real-time Scheduling, Algorithm Evaluation, Process Scheduling Models. **Process Synchronization:** Mutual Exclusion, Critical – section problem, Synchronization hardware, Semaphores, Classic problems of synchronization, Critical Regions, Monitors, OS Synchronization, Atomic Transactions **Deadlocks:** System Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

## Unit III: Storage Management

**Memory Management:** Logical and physical Address Space, Swapping, Contiguous Memory Allocation, Paging, Segmentation with Paging. **Virtual Management:** Demand paging, Process creation, Page Replacement Algorithms, Allocation of Frames, Thrashing, Operating System Examples, Page size and other considerations, Demand segmentation **File-System Interface:** File concept, Access Methods, Directory structure, File- system Mounting, File sharing, Protection and consistency semantics.

## Unit IV: File-System Implementation:

File-System structure, File-System Implementations, Directory Implementation, Allocation Methods, Free-space Management, Efficiency and Performance, Recovery Disk Management: Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, Disk Attachment, stable-storage Implementation

## Unit V: Protection and Security

**Protection:** Goals of Protection, Domain of Protection, Access Matrix, and Implementation of Access Matrix, Revocation of Access Rights, Capability- Based Systems, and Language – Based Protection. **Security:** Security Problem, User Authentication, One – Time Password, Program Threats, System Threats, Cryptography, Computer – Security Classifications.

## Text Books:

1. Milan Milonkovic, Operating System Concepts and design, II Edition, McGraw Hill 1992.
2. Tanenbaum, Operation System Concepts, 2nd Edition, Pearson Education.
3. Silberschatz / Galvin / Gagne, Operating System, 6<sup>th</sup> Edition, WSE (WILEY Publication)

**Reference Books:**

1. William Stallings, Operating System, 4th Edition, Pearson Education.
2. H.M.Deitel, Operating systems, 2nd Edition ,Pearson Education
3. Nutt: Operating Systems, 3/e Pearson Education 2004.

**Course Outcome:**

1. After learning the fundamental concepts in Operating system including how OS has evolved over the years and different components of OS, students will continue to more significant functions of OS like Process management, storage and memory management etc.
2. This will provide the necessary information for students to extract maximum benefits out of the OS while developing programs, working with applications and etc.

## Course Objective:

1. A data structure is a particular way of storing and organizing data in a computer so that it can be used efficiently.
2. Different kinds of data structures are suited to different kinds of applications and some are highly specialized to specific tasks.
3. This course covers the basic concepts of different data structures which are the basic building blocks of Programming and problem solving.

## Unit I: Introduction to Data structures

Definition, Classification of data structures: primitive and non-primitive, Elementary data organization, Time and space complexity of an algorithm (Examples), String processing. Dynamic memory allocation and pointers: Definition of dynamic memory allocation, Accessing the address of a variable, Declaring and initializing pointers, Accessing a variable through its pointer, Meaning of static and dynamic memory allocation, Memory allocation functions: malloc(), calloc(), free() and realloc(). Recursion: Definition, Recursion in C (advantages), Writing Recursive programs – Binomial coefficient, Fibonacci, GCD.

## Unit II: Searching and Sorting

Basic Search Techniques: Sequential search: Iterative and Recursive methods, Binary search: Iterative and Recursive methods, Comparison between sequential and binary search. Sort: General background and definition, Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort.

## Unit III: Stack and Queue

Stack – Definition, Array representation of stack, Operations on stack: Infix, prefix and postfix notations, Conversion of an arithmetic expression from Infix to postfix, Applications of stacks. Queue: Definition, Array representation of queue, Types of queue: Simple queue, Circular queue, Double ended queue (deque), Priority queue, Operations on all types of Queues.

## Unit IV: Linked List

Definition, Components of linked list, Representation of linked list, Advantages and Disadvantages of linked list. Types of linked list: Singly linked list, doubly linked list, Circular linked list, Operations on singly linked list: creation, insertion, deletion, search and display.

## Unit V: Tree Graphs and their Applications:

Definition: Tree, Binary tree, Complete binary tree, Binary search tree, Heap Tree  
Terminology: Root, Node, Degree of a node and tree, Terminal nodes, Non-terminal nodes, Siblings, Level, Edge, Path, depth, Parent node, ancestors of a node. Binary tree: Array representation of tree, Creation of binary tree. Traversal of Binary Tree: Preorder, Inorder and postorder. Graphs, Application of Graphs, Depth First search, Breadth First search.

## Text Book

1. Weiss, Data Structures and Algorithm Analysis in C, II Edition, Pearson Education, 2001
2. Lipschutz: Schaum's outline series Data structures Tata McGraw-Hill
3. Robert Kruse Data Structures and program designing using 'C'

**Reference Books:**

1. Trembley and Sorenson Data Structures
2. E. Balaguruswamy Programming in ANSI C.
3. Bandyopadhyay, Data Structures Using C Pearson Education, 1999
4. Tenenbaum, Data Structures Using C. Pearson Education, 200
5. Kamthane: Introduction to Data Structures in C. Pearson Education 2005.
6. Hanumanthappa M., Practical approach to Data Structures, Laxmi Publications, Fire Wall media 2006
7. Langsam, AusensteinMaoshe& M. Tanenbaum Aaron Data Structures using C and C++ Pearson Education

**Course Outcome:**

1. Students will benefit from the knowledge of Data Structures and different operating one can perform on these like searching, sorting, stacking and etc.
2. This forms a very strong foundation for programming in different languages that the students will take up in subsequent semesters or in any other course.

## BCAI-206: Environmental Studies

L=3, T=0, P=0, C=3

MM 50

### Unit I:

Introduction and natural resources: Multidisciplinary nature and public awareness, renewable and non-renewable resources and associated problems, forest, water, mineral, food, energy and land resources. Introduction to natural resources, conservation of natural resources and human role.

### Unit II:

Ecosystem: Ecological concepts, concept of ecosystems, types of ecosystems, ecosystem structure and functioning, energy flow, food chains and food webs, ecological pyramids.

### Unit III:

Biodiversity and Conservation: Definition, genetic species and ecosystem diversity biogeographically, classification of Indian value of biodiversity at national and local levels, India as a mega-diversity nation, treats to biodiversity and endangered and endemic species of India, need for conservation of biodiversity.

### Unit IV:

Environmental pollution: Definition, causes, effect and control of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, electromagnetic pollution, nuclear hazards, human role in prevention of pollution, solid waste management, disaster management, floods, earthquake, cyclone, and landslide

Firework Safety: Combustion of firework and pollution (noise, smoke, fireworks fallout and residue pollution), heavy metal toxicity due to fireworks and associated health effects.

### Unit V:

Social Issue and Environment: Unsuitable to suitable development, urban problem related to energy and water conservation, environment protection act, wild life protection act, forest conservation act, environmental issues, population explosion, and family welfare programme. Environmental and human health HIV, women and child welfare, role of information technology on environment and human health.

Corruption: definition and reasons, details of organizations/agencies working against corruption, role of individual against corruption and mode of action.

Ethics: Meaning, nature, determinants and objectives of ethics, ethics and its relation to values norms and morals, Indian ethos, Swami Vivekananda and ethics.

### Text/Reference Books

1. Fundamentals of Environmental Biology, K. C. Agrawal, Nidhi Publishers (Bikaner).
2. Fundamentals of Ecology, E.P. Odum, W.B. Saunders Co. (USA).
3. Fundamentals of Ecology, E. P. Odum, Natraj Publisher (Dehradun).
4. Ecology: Principles and Applications, J. L. Chapman & , M. J. Reiss, Cambridge University Press.
5. Atmospheric pollution, W. Buch, Tata McGraw Hill(TMH)
6. Professional Ethics and Human Values, M. Govindarajan, PHI Learning Private Limited (Delhi).
7. Corruption and Reform in India, Jennifer Bussell, Cambridge University Press.

## Course Objective:

1. To setup the environment to run the python programs
2. To understand concepts about Data Types and Looping techniques
3. To understand and implement the OOP concepts, Decorators, and Iterators
4. To understand and build the Web Applications
5. Debugging and Troubleshooting Python Programs

## Unit I: Introduction to Python

Introduction: Introduction to Python, setting up the environment, Installing Python, running python program, Python's execution model, Guidelines on how to write good, The Python culture, A note on the IDEs. **Built-in Data Types:** Numbers, Immutable sequences, Mutable sequences, set types, Mapping types – dictionaries, the collections module, Final considerations **Iterating and Making Decisions:** Conditional programming, Looping, Putting this all together.

## Unit II: Advanced Concepts

Functions, the Building Blocks of Code: Use of functions, Scopes and name resolution, input parameters, return values, Recursive functions, Anonymous functions, Function attributes, Built-in functions, importing objects. **Saving Time and Memory:** map, zip, and filter, Comprehensions, Generators, some performance considerations, Name localization, and Generation behavior in built-ins. **Advanced Concepts:** OOP, Decorators, and Iterators: Decorators, Class and object namespaces, Attribute shadowing, initializing an instance, Accessing a base class, Multiple inheritance, Static and class methods, Private methods and name mangling, The property decorator, Operator overloading, Polymorphism

## Unit III: Web Development

The Edges – GUIs and Scripts: Scripting-The imports, Parsing Arguments, The business logic, GUI application- The import, The layout logic, The business logic, The tkinter.tixmodule, The turtle module, wxPython, PyQt, and PyGTK, The principle of least astonishment, Threading considerations. **Web Development Done Right:** Django design philosophy, The Django URL dispatcher, setting up Django, Adding the Entry model, Customizing the admin panel, Creating the form, Writing the views, tying up URLs and views, Writing the templates, writing a Flask view, Building a JSON quote server in Falcon.

## Unit IV: Cloud Native Python

Building Microservices in Python, Modeling microservices, building microservices, Testing the RESTful API. Building a Web Application in Python: Getting started with applications, working with Observables and AJAX, Binding data for the adduser template, working on Observables with AJAX for the addtweet template, Data binding for the addtweet template, CORS - Cross-Origin Resource Sharing, Session management, Cookies. **Interacting Data Services:** MongoDB terminology, Initializing the MongoDB database, integrating microservices with MongoDB, working with user resources, Working with the tweets resources.

## Unit V: Exception Handling

Testing, Profiling, and Dealing with Exceptions: The anatomy of a test, testing guidelines, Unit testing, Test-driven development, Exceptions, Profiling Python. Debugging and Troubleshooting: Debugging with print, Debugging with a custom function, Inspecting the traceback, Using the Python debugger, Inspecting log files, Other techniques, Troubleshooting guidelines.

**Text Books:**

1. Learn Python Programming, 2nd Edition by Fabrizio Romano
2. Python Cookbook, 3rd Edition by David Beazley (Author), Brian K. Jones (Author)

**Reference Books:**

1. Python Programming: A Step-by-Step Guide For Absolute Beginners by Brian Jenkins and ATS Coding Academy
2. Python and AWS Cookbook: Managing Your Cloud with Python and Boto by Mitch Garnaat
3. Advanced Python Programming: Build high performance, concurrent, and multi-threaded apps with Python using proven design patterns by Dr. Gabriele Lanaro
4. Programming Google App Engine with Python: Build and Run Scalable Python Apps on Google's Infrastructure by Dan Sanderson

**Course Outcome:**

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

1. Install and Run Python Program
2. Write functions and Loops in the python program
3. Implementing OOPs concepts while writing Python Program
4. Developing web applications using Django
5. Build micro services in Python
6. Test, Debug and Troubleshoot Python Programs



Program Name- **INDUSTRIAL COMMUNICATION PROTOCOLS & CONNECTIVITY**

Program Hours- **50**

Tentative Credit - **4**

### **OBJECTIVES**

- Address the real-world problems and find the required solution.
- Study the various communication protocols and networking.
- Study the basic concepts of programming/ hardware/ emulator for ESP Controllers.
- Understanding the real time requirement for Smart System Development.
- Study the various server-based communication models.
- Build and test Smart Genset project successfully.
- Improve the team building, communication, and management skills of the students.

### **OUTCOMES**

- Identify the requirements for the real-world problems.
- Building Mashup and Widgets using Thingworx.
- Study and enhance software/ hardware skills.
- Demonstrate and build the project successfully by hardware, requirements, coding, emulating, and testing.
- To report and present the findings of the study conducted in the preferred task.
- Demonstrate an ability to work in teams and manage the conduct of the research study.

### **SCOPE**

- IIOT Designer
- IIOT Developer
- IIOT Analyst
- IIOT Tester
- Entrepreneurship

### **PROJECTS**

- Smart Genset Monitoring System
- Thingworx App Development

## INDUSTRIAL COMMUNICATION PROTOCOLS & CONNECTIVITY

### Module 1:

**Project Presentation** – Smart GENSET.

**Programming for Smart genset:** Problem Statement Understanding, Hardware Selection, GPIO-ESP32, External Library Importing for Target Board, Interfacing with Development Board, Coding & Testing.

### Module 2:

**Peripherals Interfacing with Communication Protocol for Smart genset:** On board Communication Protocol-SPI, I2C, UART, Display Sensor Data on Serial Monitor, Display Sensor Data on LCD.

### Module 3:

**Introduce ARM Cortex-A72 for Smart genset:** OS installation on ARM, Package installation and purging, GPIO –ARM Cortex-A72 and Interfacing, File handling using Scripting.

### Module 4:

**Applied Python for Smart genset:** Data Type, Keyword, Identifier, Conditional Statement, Iterative statement, Functions, Library Importing using PIP.

### Module 5:

**Interfacing Industrial Sensor:** Interfacing Fuel Level Sensor, Interfacing Temperature Sensor, Interfacing Energy Meter Sensor, Interfacing Vibration Sensor, Interfacing Rotation Counter, Interfacing Smoke Sensor, Data Transmission.

### Module 6:

**Host Communication:** Client and Server, ESP-Now, ESP-MESH, WebSocket's, Kephware.

### Module 7:

**Thingworx Composer with apps Design:** Industrial Mashup Composing, Services and Alerts, Events and Subscriptions, Thingworx apps Design, Fuel Level Sensor Data on Thingworx, Temperature Sensor Data on Thingworx, Energy Meter Sensor Data on Thingworx, Vibration Sensor Data on Thingworx, Tachometer Sensor Data on Thingworx, Smoke Sensor Data on Thingworx, Self-Start Event and Alerts, Data Visualization.

#### Reference Books & Materials:

- [Introduction and History of GENSET's](#)
- [Fundamentals of IoT Communication Technologies by Herrero Rolando](#)
- [Thingworx Design & Development](#)
- [Introduction to HTTP Protocol](#)

## BCAI-207: Data Structures using C Lab

L=0, T=0, P=4, C=2

MM 50

### List of Experiments:

#### Part A

1. Use a recursive function to find GCD of two numbers.
2. Use a recursive function to find the Fibonacci series.
3. Use pointers to find the length of a string and to concatenate two strings.
4. Use pointers to copy a string and to extract a substring from a given a string.
5. Use a recursive function for the towers of Hanoi with three discs.
6. Insert an integer into a given position in an array.
7. Deleting an integer from an array.
8. Write a program to create a linked list and to display it.
9. Write a program to sort N numbers using insertion sort.
10. Write a program to sort N numbers using selection sort.

#### Part B

1. Inserting a node into a singly linked list.
2. Deleting a node from a singly linked list.
3. Pointer implementation of stacks.
4. Pointer implementation of queues.
5. Creating a binary search tree and traversing it using in order, preorder and post order.
6. Sort N numbers using merge sort.

## BCAI-208: Linux Shell Scripting Lab

L=0, T=0, P=2, C=1

MM 50

1. Use of Basic UNIX Shell Commands: ls, mkdir, rmdir, cd, cat, touch, file, wc, sort, cut, grep, dd, dfspace, du, ulimit.
2. Commands related to inode, I/O redirection and piping, process control commands, mails.
3. Shell Programming: Shell script exercises based on following:
  - (i) Interactive shell scripts
  - (ii) Positional parameters
  - (iii) Arithmetic
  - (iv) if-then-fi, if-then- else-fi, nested if-else
  - (v) Logical operators
  - (vi) else + if equals elif, case structure
  - (vii) while, until, for loops, use of break.
4. Write a shell script to create a file. Follow the instructions
  - (i) Input a page profile to yourself, copy it into other existing file;
  - (ii) Start printing file at certain line
  - (iii) Print all the difference between two file, copy the two files.
  - (iv) Print lines matching certain word pattern.
5. Write shell script for-
  - (i) Showing the count of users logged in,
  - (ii) Printing Column list of files in your home directory
  - (iii) Listing your job with below normal priority
  - (iv) Continue running your job after logging out.
6. Write a shell script to change data format. Show the time taken in execution of this script.
7. Write a shell script to print files names in a directory showing date of creation & serial number of the file.
8. Write a shell script to count lines, words and characters in its input.
9. Write a shell script to print end of a Glossary file in reverse order using Array.
10. Write a shell script to check whether Ram logged in, continue checking further after every 30 seconds till success.
11. Write a shell script to compute GCD & LCM & of two numbers. Use the basic function to find GCD & LCM of N numbers.
12. Write a shell script to find whether a given number is prime. Take a large number such as 15 digits or higher and use a proper algorithm.
13. Write a shell script to reverse a given integer.
14. Write a shell script to list the files arranged in descending order of their size.
15. Write a shell script to check whether the given string is palindrome or not.

## **BCAI-212: Python Programming Lab**

**L=0, T=0, P=2, C=1**

**MM 50**

1. Write a python code to find given number is prime or not
2. Write a python code to find LCM and GCM of a given list
3. Write a python code to find mean and standard deviation of a given list of numbers
4. Write a python code to add and delete element from a dictionary using functions
5. Write a python code to print 10 student details using class and lists
6. Write a python code to find student from a given list using class
7. Write a python code to inherit employee class to student class
8. Write a python code to build simple GUI calculator
9. Write a python code to build web page with student registration form
10. Write a python code to build web pages with sign-in and sing-up forms
11. Write a python code to build Rest API for product
12. Write a python code to build Ajax enabled web application for product

# Syllabus

## Semester: III

**Course Objective:**

1. A database management system (DBMS) is collection of software meant to manage a Database. Many popular databases currently in use are based on the relational database model.
2. RDBMSs have become a predominant choice for the storage of information in new databases used for financial records, manufacturing and logistical information, personnel data and much more.
3. The course covers the basic concepts of databases in general with an emphasis on relational databases, modeling techniques and writing queries. Normalization techniques, Transaction processing, Concurrency Control techniques and Recovery of databases against crashes are also covered.

**Unit I: Introduction**

Purpose of Database System -- Views of data – Data Models – Database Languages — Database System Architecture – Database users and Administrator – Entity– Relationship model (E-R model ) – E-R Diagrams -- Introduction to relational databases

**Unit II: Relational Model**

The relational Model – The catalog- Types– Keys - Relational Algebra – Domain Relational Calculus – Tuple Relational Calculus - Fundamental operations – Additional Operations- SQL fundamentals, Oracle data types, Data Constraints, Column level & table Level Constraints, working with Tables, Defining different constraints on the table, Defining Integrity Constraints in the ALTER TABLE Command, Select Command, Logical Operator, Range Searching, Pattern Matching, Oracle Function, Grouping data from Tables in SQL, Manipulation Data in SQL.

**Unit III: SQL**

Joining Multiple Tables (Equi Joins), Joining a Table to itself (self Joins), Sub queries Union, intersect & Minus Clause, creating view, Renaming the Column of a view, Granting Permissions, - Updating, Selection, destroying view Creating Indexes, Creating and managing User, Integrity – Triggers - Security – Advanced SQL features –Embedded SQL– Dynamic SQL- Missing Information– Views – Introduction to Distributed Databases and Client/Server Databases

**Unit IV: Database Design**

Functional Dependencies – Non-loss Decomposition – Functional Dependencies – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form-Multi-Valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

**Unit V: Transactions**

Transaction Concepts - Transaction Recovery – ACID Properties – System Recovery – Media Recovery – Two Phase Commit - Save Points – SQL Facilities for recovery –Concurrency – Need for Concurrency – Locking Protocols – Two Phase Locking – Intent Locking – Deadlock-Serializability – Recovery Isolation Levels – SQL Facilities for Concurrency.

**Text Book:**

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Fifth Edition, Tata McGraw Hill, 2006.
2. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Fourth Edition, Pearson/Addision Wesley, 2007.

**Reference Books:**

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Fifth Edition, Tata McGraw Hill, 2006
2. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Pearson/Addision Wesley, 2007.
3. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003.

**Course Outcome**

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

1. Understand the Purpose of Database System
2. Understand the relational model
3. Describe Integrity Constraints
4. Describe SQL fundamentals
5. Understand Functional Dependencies
6. Describe the concepts of transaction
7. Understand ACID properties



## BCAI-302: Computer Networks

L=3, T=0, P=0, C=3

MM 75

### Course Objective:

1. To understand the basics of networking and its underlying principles. This course enables learners to understand computer networking concepts, how they work, operate, communicate with ports and Protocols. Standards and models associated with networking technology and their troubleshooting mechanisms.

### Unit I: Networking Fundamentals

Basics of Network & Networking, Advantages of Networking, Types of Networks, Types of Network Architecture, Workgroup vs. Domain. Network Topologies, Types of Topologies, Logical and physical topologies, selecting the Right Topology, Types of Transmission Media, Communication Modes, Wiring Standards and Cabling, media connectors, Introduction of OSI model, Functions of the seven layers, Introduction of TCP/IP Model, Comparison between OSI model & TCP/IP model.

### Unit II: Basics of Network Devices

Network Devices- NIC- functions of NIC, installing NIC, Hub, Switch, Bridge, Router, Gateways, And Other Networking Devices, Repeater, CSU/DSU, Modem, Ethernet standards, Ethernet Components, Point-to-Point Protocol, Address Resolution Protocol, Message format, transactions, Benefits of Wireless Technology, Types of Wireless Networks, Wireless network Components, wireless LAN standards, wireless security Protocols.

### Unit III: Basics of Network, Transport and Application Layers

Network Layer: Internet Protocol (IP), IP standards, versions, functions, The IPv4 and IPv6 Datagram Format, IPv4 addressing, IPv4 Subnetting, CIDR and VLSM, IPv6 Addressing, , Internet Control Message Protocol , Internet Group Management Protocol ,Introduction to Routing and Switching concepts, Transport Layer: Transmission Control Protocol(TCP), User Datagram Protocol (UDP), Overview of Ports & Sockets, Application Layer Protocols

### Unit IV: WAN Technology

Introduction to WAN, WAN Switching techniques, connecting to the Internet, Satellite-Based Services, Cellular Technologies, Technologies used for Connecting LANs, Remote Access Connections and technologies, Authentication and Authorization, Tunnelling and Encryption Protocols, Security Appliances and Security Threats.

### Unit V: Troubleshooting Network

Trouble Shooting Networks: Command-Line Interface Tools, Network and Internet Troubleshooting, Troubleshooting Model, identify the affected area, probable cause, implement a solution, test the result, recognize the potential effects of the solution, document the solution, Using Network Utilities: ping, traceroute, tracert, ipconfig, arp, nslookup, netstat, nbtstat, Hardware trouble shooting tools, system monitoring tools.

### Text Book:

1. CCNA Cisco Certified Network Associate: Study Guide (With CD) 7th Edition (Paperback), Wiley India, 2011
2. CCENT/CCNA ICND1 640-822 Official Cert Guide 3 Edition (Paperback), Pearson, 2013

**Reference Books:**

1. Routing Protocols and Concepts CCNA Exploration Companion Guide (With CD) (Paperback), Pearson, 2008
2. CCNA Exploration Course Booklet: Routing Protocols and Concepts, Version 4.0 (Paperback), Pearson, 2010

**Course Outcome:**

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

1. Explain the types of Network and its architecture
2. Identify the function of each layer in OSI and TCP/IP Models
3. Describe the Ethernet and wireless standards
4. Discuss the functionality of Networking devices
5. Demonstrate the IPv4 and IPv6 addressing types
6. List the WAN Technologies
7. Practice Network troubleshooting.

# BCAI-305: Object Oriented Programming Using Java

L=2, T=0, P=0, C=2

MM 75

## Course Objective:

1. Object oriented programming is the most proven technique for developing reliable programs. It helps in increased productivity, reusability of code, decrease in the development time, and reduces cost of production to an extent.
2. The cost of maintaining such systems have also considerably decreased. There are many languages which used the object oriented concepts and techniques. Some of them are C++, Java, Smalltalk, Objective-C, etc.
3. Java is a purely object oriented language. Systems/applications created using java programming language reduces the need for developing and maintain complex and space consuming applications. Java has a lot of advantages of being simple, robust, platform independent, etc. Nowadays java is also found in the mobile phones.

## Unit I: Introduction

History and Overview of Java, Object Oriented Programming, Control statements- if and for loop. Using Blocks of codes, Lexical issues - White space, identifiers, Literals, comments, separators, Java Key words, Data types - Integers, Floating point, characters, Boolean, a closer look at Literals, Variables, Type conversion and casting. Automatic type promotion in Expressions Arrays. Operators - Arithmetic operators, Bit wise operators, Relational Operators, Boolean Logical operators, Assignment Operator, Operator Precedence. Control Statements – Selection Statements - if, Switch, Iteration Statements - While, Do-while, for Nested loops, Jump statements.

## Unit II: Classes

Class Fundamentals, Declaring objects, Assigning object reference variables. Methods - constructors, “this” keyword, finalize ( ) method A stack class, Over loading methods. Using objects as parameters, Argument passing, Returning objects. Recursion, Access control, Introducing final, understanding static. Introducing Nested and Inner classes. Using command line arguments. Inheritance – Basics, Using super, method overriding, and Dynamic method Dispatch, Using abstract classes and final with Inheritance.

## Unit III: Packages

Definition. Access protection importing packages. Interfaces: Definition and implementation. Exception Handling – Fundamentals, types, Using try and catch and Multiple catch clauses, Nested try Statements, throw, throws, finally. Java’s built-in exception, using Exceptions.

## Unit IV: Multithreaded Programming:

Java thread model – main thread, creating single and multiple thread. Is alive ( ) and join ( ). Thread – Priorities, Synchronization, Inter thread communication, suspending, resuming and stopping threads, using multi-threading. I / O basics – Reading control input, writing control output, Reading and Writing files. Applet Fundamentals – AWT package, AWT Event handling concepts, the transient and volatile modifiers. Using instance of using assert.

## Unit V: JAVA Database Connectivity (JDBC)

Database connectivity – JDBC architecture and Drivers. JDBC API - loading a driver, connecting to a database, creating and executing JDBC statements, handling SQL exceptions. Accessing result sets: types and methods. An example - JDBC application to query a database. .

## Text Books:

1. The complete reference Java –2: V Edition by Herbert Schildt Pub. TMH.
2. SAMS teach yourself Java – 2: 3rd Edition by Rogers Cedenhead and Leura Lemay Pub. Pearson Education.

**Course Outcome:**

1. Read and understand Java-based software code of medium-to-high complexity.
2. Use standard and third party Java's API's when writing applications.
3. Understand the basic principles of creating Java applications with graphical user interface (GUI).
4. Understand the fundamental concepts of computer science: structure of the computational process, algorithms and complexity of computation.
5. Understand the basic approaches to the design of software applications.
6. Apply the above to design, implement, appropriately document and test a Java application of medium complexity, consisting of multiple classes

## BCAIAI-301: Statistics and Probability

L=3, T=1, P=0, C=4

MM 100

### Course Objectives:

1. To understand the basic concepts of statistics and probability.
2. To understand the description of data using statistical techniques
3. To understand the summary of data using statistical measures
4. To understand the statistical methods involved in hypothesis testing
5. To understand the ANOVA and its importance in business performance.

### Unit I: Descriptive Statistics

Data and Data Sources, Types of Data, Measures of Central Tendency – Mean, median mode for raw and grouped data, measures of dispersion – Range, standard deviation, variance, coefficient of variation, mean deviation, mean absolute deviation, measures of symmetry: Skewness and Kurtosis.

### Unit II: Elements of Probability and Sampling Distributions

Experiments and events, Basic Relations of Probability, Conditional Probability, Joint Probability, conditional probability on discrete case and continuous case, computing expectations by conditioning, introduction to Bayes theorem, problems related to Bayes Theorem, Discrete Probability Distribution (Binomial and Poisson), Continuous Probability Distribution (Normal). Various types of Probability and Non-Probability Sampling, Sampling distribution of important statistic.

### Unit III: Hypothesis Testing

Introduction, Statistical assumptions for parametric test, Level of significance, confidence level, Type I Error, Type II error, Critical value, power of the test, sampling distribution, small sample test – t test, F test, Large Sample test – Z test for equality of single mean with population mean, equality of two sample mean, equality of single proportion with population proportion and equality of two sample proportions.

### Unit IV: Correlation and Regression Analysis

Correlation analysis, properties, significance of single and multiple correlation coefficients, multiple and partial correlation, linear model, factor, effect, residuals, dependency, independency, assumptions of linear model, estimation of parameters of regression coefficients, properties, significance, diagnostic testing: auto correlation, multi collinearity, heteroscedasticity, normality, significance of estimated parameters in multiple linear regression.

### Unit V: Linear Model

Introduction, assumptions, factors and levels in ANOVA, layout of one-way ANOVA, multiple comparison of sample means, one-way analysis of variance with unequal sample sizes, two factor analysis of variance – introduction and parameter estimation, two-way analysis of variance with interaction, Post ANOVA: testing of hypothesis for significance of mean using Fishers Least Significance Difference test (lsd), Tukeys test, Dunnet test, Duncan Multiple Range test.

### Text Book:

1. Fundamentals of mathematical statistics – SC Gupta and VK Kapoor, Sultan Chand & Sons Publication, New Delhi

### Reference Books:

1. Introduction to probability Models, Ninth Edition – Sheldon M. Ross, Elsevier Publication, Academic Press, UK
2. Introduction to Probability and Statistics for Engineers and Scientists, Third Edition - Sheldon M. Ross, Elsevier Publication, Academic Press, UK

**Course Outcomes:**

On successful completion of the module students will be able to:

1. Able to know the importance of statistics in different research areas.
2. Able to know the basic concepts of Statistics and its evolution.
3. Able to apply suitable statistical measures to describe and summarize the data
4. Able to apply t and f test for testing the statistical measures to know the significance.
5. Able to apply ANOVA for testing significance of arithmetic mean and regression coefficients

# BCAIAI-302 (Elective-I): Digital Electronics

L=3, T=0, P=0, C=3

MM 75

## Course Objective:

1. Understand concepts of combinational and sequential circuits.
2. Analyze the synchronous and asynchronous logic circuits.
3. Understand concepts of memory, programmable logic and digital integrated circuits.
4. Design Combinational and sequential systems.

## Unit I: Basic Concepts, Boolean algebra, Theorems and Functions

Number Systems: Decimal number system, binary number system, octal number system, hexadecimal number system, BCD number system, Excess-3 code, Gray code, Alpha numeric code, error detecting and error correcting codes. Arithmetic: Arithmetic number representation, Binary arithmetic, Hexadecimal arithmetic, BCD arithmetic. Boolean algebra and Theorems: Logic gates and logic operations, Boolean theorems and postulates, SOP's & POS's, Minterms and Maxterms. Minimization of Boolean Functions: Algebraic simplification, Karnaugh map simplification, Quine-Mc Cluskey or Tabulation method.

## Unit II: Logic Gates

Logic Families: Metal Oxide Semiconductor logic families- switching properties of NMOS and PMOS transistors, static NMOS, dynamic NMOS, Static CMOS and dynamic CMOS logic families, CMOS Transmission gate circuits, Bipolar logic families- switching properties of NPN and PNP transistors, TTL, Schottkey TTL, Comparison of MOS logic circuits(CMOS) with that of a TTL digital circuit, Tristate gates. Electrical characteristics: Meanings of speed, propagation delay, operating frequency, and power dissipated per gate, supply voltage levels, operational voltage levels of various logic families.

## Unit III: Combinational Systems

Binary arithmetic units (Adder, Subtractor, n-bit parallel adder & Subtractor, look ahead carry generator), decoder, encoder, multiplexer, Demultiplexer, code converters, Magnitude comparators, parity generators. Implementation of combinational logic by standard IC's.

## Unit IV: Sequential Systems

Flip-flop and Latch: SR latch, JK flip-flop, T flip-flop, D flip-flop and latch, Master-slave RS flip-flop, Master-slave JK flip-flop, asynchronous inputs. Registers & Counters: Shift registers (SISO, SIPO, PISO, PIPO), universal shift register. Counters Asynchronous/Ripple counters, Synchronous counters, Modulus-n Counter, Ring counter, Johnson counter, Up-Down counter, asynchronous clear, preset and load in a counter, synchronous clear, preset and load in a counter, typical IC's for counters. Synchronous (Clocked) sequential circuits: Moore and Mealey state machine circuits, Analysis & design of synchronous sequential circuits – State machine design with SM charts

## Unit V: Memory and Programmable Logic

RAM, memory decoding, ROM, PROMs, PAL & PLA, Sequential Programmable Devices (discuss three major devices without going into their detailed construction).

## Text Book:

1. Morris Mano M, Michael D. Ciletti, "Digital Design", Pearson Education, 4th Edition, 2007.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.
3. Floyd and Jain, "Digital Fundamentals", Pearson Education, 8th Edition, 2007.

**Reference Book:**

1. Ronald J. Tocci, “Digital Systems: Principles and Applications”, Pearson Education, 10th Edition, 2009.
2. Donald P Leach, Albert Paul Malvino, Goutam Saha, “Digital Principles and Applications”, Tata McGraw Hill, 6th Edition, 2008

**Course Outcome:**

At the end of this course students able to

1. Understand different number systems and its inter-conversions.
2. Understand the concept of Boolean algebra and its different theorems, properties etc.
3. Understand simplification of Boolean functions.
4. Understand the construction and working of different combinational circuits etc.
5. Understand different flip-flops and its applications.
6. Understand different sequential logic circuits and basic design of sequential circuits and counters.
7. Understand different types of memories and its applications.



## BCAIAI-303 (Elective-I): Data Visualization

L=3, T=0, P=0, C=3

MM 75

### Course Objective:

1. To understand the importance of data visualization in the business and engineering
2. To understand the application and role of visualization tools in creating the advanced techniques.
3. To understand the importance of vector visualization in multivariate data analysis
4. To understand the impact of visualization techniques in ease the analytics decision making process.

### Unit I: Introduction to Data Visualization

Brief history of data visualization, scientific design choices in data visualization- choice of graphical form, grammar of graphical techniques of large amount of data, crucial need of visualization techniques, challenges in visualization techniques, classification of visualization techniques for qualitative and quantitative data, power of visualization techniques, introduction to different visualization techniques.

### Unit II: Static Graphical Techniques

Introduction to bar graph, basic understanding of making basic bar graph, grouping bars together, bar graphs on counts, customization of bar graphs by changing color, size, title, axis units, changing width and spacing of the bar chart, adding labels to bar graph, application of bar graph in business.

### Unit III: Multivariate Graphical Techniques

Introduction to correlation matrix, application of correlation matrix in the multivariate analysis, network graph, basics of heat map, difference between heat map and tree map, introduction to higher dimensional scatter plot, axis adjustment in the higher dimensional scatter plot, addition of prediction surface of higher dimensional scatter plot.

### Unit IV: Graphical Validation

Basics of multivariate statistical visual representations and its results, dendrogram, importance of dendrogram in grouping (cluster analysis), Scree Plot, importance of Scree Plot, application of Scree Plot in determining number of clusters and factors, QQ plot, importance of QQ plot in distribution of data for the further quantitative analysis, PP plot, applications and usage of PP Plot for distribution detection.

### Unit V: Customization

Introduction to annotations – adding : text, mathematical expression , lines, arrows, shaded shapes, highlighting the texts and items, adding error bars, introduction to axis, swapping x and y axis, changing the scaling ration in the axis, positioning of axis and arranging tick marks and labels, changing the appearance of axis labels, circular graphs, using themes, changing the appearance of theme elements, creating the own themes, legends : removing the legends, position of legends, legend title, labels in legends.

### Text Books

1. Data Visualization Principles And Practice, Second Edition - Alexandru Telea, Crc Press.
2. Hand book of Data Visualization – Chun-houh Chen, Wolfgang Härdle, Antony Unwin, Springer Publication.

**Reference Books**

1. R Graphics Cook Book, Winston Chang, First Edition, O'Reilly Publication.
2. ggplot2 Elegant Graphics for Data Analysis – Hadley Wickham, Springer Publication

**Course Outcome:**

At the end of this course students able to

1. Understand the application of different visualization tool for the business report representation.
2. Understand the different visualization techniques to find out the distribution of data set.
3. Understand the importance of visualization in multivariate environment.
4. Understand the importance of customization of graphical representation of data in business communication

## BCAIAI-304 (Elective-I): Business Intelligence

L=3, T=0, P=0, C=3

MM 75

### Course Objective:

1. To understand the basic concepts of Business Intelligence and its architecture.
2. To understand the procedure for Business Performance management and business intelligence.
3. To understand the importance of OLAP and Business Intelligence Data stages.
4. To understand the different types of business intelligence, reporting and dash board design.
5. To understand how the Business Intelligence system is implemented.

### Unit I: Introduction to Business Intelligence

Introduction to Business Intelligence, A Framework for Business Intelligence (BI), Definitions of BI, A Brief History of BI The Architecture of BI, Styles of BI, The Benefits of BI, Event-Driven Alerts, Intelligence Creation and Use and BI Governance, A Cyclical Process of Intelligence Creation and Use, Intelligence and Espionage, Transaction Processing versus Analytic Processing, Successful BI Implementation, The Typical BI user Community, Appropriate Planning and Alignment with the Business Strategy, Real-Time, On-Demand BI Is Attainable, Developing or Acquiring BI Systems, Justification and Cost-Benefit Analysis, Security and Protection of Privacy, Integration of Systems and Applications , Major Tools and Techniques of Business Intelligence.

### Unit II: Business Performance Management

Business Performance Management (BPM) Overview, BPM Defined, Comparison of BPM and BI, Operational Planning, Financial Planning and Budgeting, Pitfalls of Variance Analysis, Act and Adjust: What Do We Need to Do Differently?, Performance Measurement, Key Performance Indicators (KPI) and Operational Metrics, Problems with Existing Performance Measurement Systems, Effective Performance Measurement, BPM Methodologies, Balanced Scorecard (BSC) , Six Sigma, BPM Technologies and Applications, BPM Architecture, Commercial BPM Suites, BPM Market versus the BI Platform Market, Performance Dashboards and Scorecards, Dashboards versus Scorecards, Dashboard Design, important properties of design of dash board.

### Unit III: Business Intelligence: Stages

Introduction, Extract, Transform, and Load (ETL), Data Warehouse, Data Warehouse Architecture, Design of Data Warehouses, Dimensions and Measures, Data Warehouse Implementation Methods: Top-Down Approach, The Bottom-Up Approach, The Federated Approach, The Need for Staged Data, Integrating Data from Multiple Operating Systems, OLAP, Types of OLAP, Multidimensional OLAP (MOLAP), Relational OLAP (ROLAP), Hybrid OLAP (HOLAP), Data Mining, Data Mining and Statistical Analysis, Data-Mining Operations, Data Mining—Data Sources, Data Dredging, Data Management, Data Usage, Enterprise Portal (EP).

### Unit IV: Types of Business Intelligence

Multiplicity of BI Tools, The Problem with Multiple BI Tools, Types of BI, Enterprise Reporting, Cube Analysis, Ad Hoc Query and Analysis, Statistical Analysis and Data Mining, Alerting and Report Delivery, Modern BI, Enterprise Reporting, Support for Different Forms and Types, Support for Personalization and Customization, Support for Wide Reach, High Throughput and Access across All Touch Points, The Enterprise BI, Single Unified User Interface, Single Unified Backplane, Vision of a Critical BI System, Centralized Business Logic, Flexible Data Structures, Advanced Analytics, Reporting, Rich Report Design, Flexible Information Delivery, Self-Service Reporting, Critical BI for the Enterprise.

### Unit V: Business Intelligence Implementation

The Introduction, Implementation of BI System: An Overview, BI Implementations Factors, Managerial Issues Related to BI Implementation , BI and Integration Implementation, Types of Integration, Levels of BI Integration, Embedded Intelligent Systems, Connecting BI Systems to Databases and Other Enterprise Systems, Connecting to Databases, Integrating BI Applications and Back-End Systems,

Middleware, On-Demand BI, The Limitations of Traditional BI, The On-demand Alternative, Key Characteristics and Benefits, Issues of Legality, Privacy, and Ethics, Legal Issues, Privacy, Ethics in Decision Making and Support.

**Text Books:**

1. Business Intelligence: A Managerial Approach, 2nd Edition - Turban, Sharda Efraim; Ramesh, Dursun Delen and King, David. (2011), Prentice Hall.
2. Business Intelligence for Telecommunications – Deepak Pareek, Auerbach Publications.

**Reference Book:**

1. Applied Data Mining Statistical Methods for Business and Industry - PAOLO GIUDICI, John Wiley & Sons Ltd.
2. Data Mining: Concepts and Techniques, Second Edition - Han, Jiawei and Kamber, Micheline. (2009). San Francisco: Morgan Kaufmann Publishers.
3. Business Analysis for Business Intelligence - Bert Brijs, CRC Press.

**Course Outcome:**

At the end of this course students able to

1. Understand the important terminologies and architecture of Business Intelligence system.
2. Understand the important difference between business performance management and business intelligence.
3. Understand the different OLAP systems used in Business Intelligence Report creations and analytics.
4. Learn the different business intelligence types, and importance of report creation and dashboard design.
5. Understand implementation procedure for business intelligence systems.

Program Name- **INTRODUCTION TO DATA ANALYTICS**

Program Hours- **50**

Tentative Credit - **4**

### **OBJECTIVES**

- This course will serve as a comprehensive introduction to various topics in Data Analytics.
- Conceptualization and summarization of data pre-processing and data wrangling.
- Representation of data and visualization of data with different techniques.
- Descriptive analytics for industrial data.
- Study the various Python libraries.

### **OUTCOMES**

- At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems, and be able to evaluate and interpret the results of the algorithms.
- Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.
- Ability to select and implement Data analytics techniques and computing environment that are suitable for the applications under consideration.
- Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.

### **SCOPE**

- Business Analyst
- Product Analyst
- Machine Learning Engineer
- Data Scientist

### **PROJECTS**

- Smart Transportation
- Motor Anomaly Detection-Temp, Vibration, RPM, Load
- Quality of Road Analytics
- Battery Management system analytics (BMS)
- Lidar based Driving Skill Analytics

## INTRODUCTION TO DATA ANALYTICS

### Module 1:

**Project Presentation** – Smart Electric Vehicle

**Language** - Keyword, Data Types, Data Type Operations, Statistics –Conditional Statements, Loops, exception handling, Function, Scope, File Handling, OOPS, Statistical Analysis, NumPy, Pandas, data set creation, libraries, and framework, Identifying invalid values.

### Module 2:

**Data Preprocessing:** Data cleansing, series & data frame, functions on data frame, feature scaling, dimensionality reduction.

### Module 3:

**Custom Filtering and Selection:** Sorting, group by split-apply-combine, handling missing data (missing imputation), indexing & selecting data, selection by level, selection by position, merging of data frame (concat and merge), reshaping: stack, unstack, pivot.

### Module 4:

**Exploratory Data Analysis:** Finding the best attributes, principal component analysis, data normalization, time/date components, parsing & manipulating data, period & period index.

### Module 5:

**Data Visualization:** Scatter Plots, Line Graphs, Bar Plots, Matplotlib, Seaborn, X And Y Ticks and Rotations, Histograms, Box Plot.

### Module 6:

**Data Scarping:** Introduction to Web Scraping, Libraries - RE, REQUESTS, OS, BeautifulSoup, Data Collection & Filtering.

#### Reference Books & Materials:

- [Introduction and History of Electric Vehicles](#)
- Data Analytics : [Data Analytics Tutorial for Beginners: A \[Step-By-Step\] Guide \(simplilearn.com\)](#)
- Pandas - [User Guide – pandas 1.4.4 documentation \(pydata.org\)](#)
- NumPy - [NumPy user guide – NumPy v1.23 Manual](#)
- Matplotlib - [Tutorials – Matplotlib 3.5.3 documentation](#)
- Seaborn - [User guide and tutorial – seaborn 0.11.2 documentation \(pydata.org\)](#)

**List of Experiments:**

1. Perform following actions using SQL statements
  - a. Create a new user with name “shiva” and password “kumar@1”
  - b. Assign the following privileges
    - i. Create and drop tables
    - ii. Create and drop users
    - iii. Allow to assign above privileges to new users
    - iv. List all tables in the database
    - v. List all users in the database
    - vi. Logout from current user and log in as “shiva”
2. Create following tables and insert minimum 10 rows in to each table
  - a. Department table with following columns with appropriate data types
    - i. DeptId
    - ii. DeptName
    - iii. DeptLoc
  - b. Employee table with following columns with appropriate data types
    - i. EmpId
    - ii. EmpName
    - iii. DOB
    - iv. DOJ
    - v. Job
    - vi. Salary
  - c. Product table with following columns with appropriate data types
    - i. ProdId
    - ii. ProdName
    - iii. Price
  - d. Sales table with following columns with appropriate data types
    - i. SalesId
    - ii. Date
    - iii. Quantity
3. Update above tables with following features using SQL statements
  - a. Make DeptId in Department table as Primary Key
  - b. Make EmpId in Employee table as Primary Key
  - c. Add DeptId column to the Employee table and make it foreign key from Department table and update the values
  - d. Add EmpId and ProdId to the Sales table and make them foreign key from Employee and Product table and update the values
  - e. Update all columns in all tables with appropriate constraint such as not null, check and so on
4. Perform the following SQL statements
  - a. Create a view “EmpDeptView” from Employee and Department table which contains following columns
    - i. EmpName
    - ii. DOB
    - iii. Salary
    - iv. DeptId
    - v. DeptName
    - vi. Loc
  - b. Retrieve all employees whose salary between 25,000 to 30,000
  - c. Retrieve all employees who is working in Accounts department (If it is not there add this

- row to Department table)
- d. Retrieve all employees who is working other than Accounts department
  - e. Retrieve all employee who is working in Sales department and Bangalore location
  - f. Retrieve all employees who completed minimum 5 years
  - g. Retrieve all employees who completed minimum 5 years and salary less than 30,000
5. Perform the following SQL statements
    - a. Retrieve all employees whose salary more than 30,000
    - b. Retrieve employee details who is getting maximum salary
    - c. Retrieve employee details who is getting minimum salary
    - d. Retrieve employee details who is getting 3rd maximum salary
    - e. Retrieve employee details who is getting 5th minimum salary
    - f. Retrieve total number of employees in each department in Bangalore location
    - g. Retrieve total number of employees in each location
    - h. Retrieve total number of employees in each location in Accounts department
    - i. Retrieve total number of employees who complete more than 10 years in each department
  6. Write a PL/SQL Procedure to find prime number from 1 to n, n is a user input or parameter
  7. Write a PL/SQL Functions to return number of days an employee working using EmpId
  8. Write a PL/SQL Procedure to find sum of salaries of all employee working in a particular location
  9. Write a PL/SQL Function to return sum of sales by ProdId
  10. Write a PL/SQL Function to return sum of sales by EmpId
  11. Write a PL/SQL Procedure to generate Employee Report department wise as follows:
 

DeptName	EmpName	Job	Location	Salary	Cumulative_Salary
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  12. Write a PL/SQL Trigger to insert row into OldEmployee table when a employee deleted from Employee table (Create OldEmployee table)
  13. Write a PL/SQL Trigger not to delete more than 2 employees at a time
  14. Write a PL/SQL Trigger not to update employee salary if it cross 67000
  15. Write a PL/SQL Package with following procedures and functions
    - a. Procedures
      - i. Print Total Quantity Sales Summary Report (SalesId, Date, Quantity and Total Quantity)
      - ii. Print Total Quantity Sales Summary Report by Date wise
    - b. Functions
      - i. Return employee name who made maximum sales till date
      - ii. Return product name soled maximum quantity till date



## **BCAI-306: Object Oriented Programming Using Java Lab**

**L=0, T=0, P=4, C=2**

**MM 50**

### **List of Experiments:**

#### **Part A**

1. Write a program to check whether two strings are equal or not.
2. Write a program to display reverse string.
3. Write a program to find the sum of digits of a given number.
4. Write a program to display a multiplication table.
5. Write a program to display all prime numbers between 1 to 1000.
6. Write a program to insert element in existing array.
7. Write a program to sort existing array.
8. Write a program to create object for Tree Set and Stack and use all methods.
9. Write a program to check all math class functions.
10. Write a program to execute any Windows 95 application (Like notepad, calculator etc)
11. Write a program to find out total memory, free memory and free memory after executing garbage Collector (gc).

#### **Part B**

1. Write a program to copy a file to another file using Java to package classes. Get the file names at run time and if the target file is existed then ask confirmation to overwrite and take necessary actions.
2. Write a program to get file name at runtime and display number of lines and words in that file.
3. Write a program to list files in the current working directory depending upon a given pattern.
4. Create a textfield that allows only numeric value and in specified length.
5. Create a Frame with 2 labels, at runtime display x and y coordinate of mouse pointer in the labels.

## **BCAI-304: Business Communication & Presentation Skills**

L=0, T=0, P=4, C=2

MM 50

### **Course Objective:**

1. To train students in how to be effective communicators by practicing various skills and also help those in becoming well-groomed individuals in terms of both verbal and non-verbal communication.

### **Unit I: Principles of Effective written communication**

7 C's of Business communication: Clarity, Completeness, Conciseness, Consideration, Courtesy, Correctness, and Concreteness. Practice sessions for business writing.

### **Unit II: Letter writing**

Structure & Planning, Types of Letter: Leave letter, Cover Letter, Application Letter.

Persuasive Writing: AIDA; practice sessions on letter writing.

### **Unit III: Email & Memo writing**

Importance of Email & Memo writing in the business world, Format of Email & Memo, Structure of Email & Memo, practice sessions on email and memo writing

### **Unit IV: Precise Writing & Report Writing**

Techniques of Precise writing, qualities of a good precise. Different types of Report – sales report, Annual report, Technical report, Components of a good report focusing on how to write short reports, practice sessions on report writing

### **Unit V: Resume writing**

Components of a good resume, different formats of resume, resume writing practice

Different Types of meetings: Conducting Effective Meetings, Business meetings, Review meetings, Preparation for the meeting– Writing Agenda, MOM.

Presentation Skills: Planning & developing effective Presentation, Do's & don'ts of a good presentation, use of Effective visual aids in a presentation

### **Text Book:**

1. Matthukutty M Monippally, Business Communication Strategies, Tata McGraw-Hill.
2. Chaturvedi P.D. et al, Business Communication; Concepts, Cases, & Applications, Pearson Education.

### **Reference Books:**

1. Shirley Taylor, Communication for Business, Pearson Education.
2. Lesiicar and Flatley, Basic Business Communication, Tata McGraw-Hill.
3. Courtan L. Bovee et al., Business Communication Today, Pearson Education.
4. Meenakshi Raman & Prakash Singh, Business communication, Oxford University Press

### **Course Outcome:**

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

1. Students will be able to overcome nervousness and stage fear at the end of the course.

# Syllabus

## Semester: IV

## BCAIAI-401: Introduction to RPA Tools

L=3, T=0, P=0, C=3

MM 75

### Course Objective:

1. To understand the basics of RPA tools used in the industry.
2. To understand what RPA process.
3. To understand UI and tool windows.
4. To understand the packages installed for automatic specific targets.
5. To have practical knowledge on designing RPA solutions.

### Unit I: Robotic Process Automation concepts:

Introduction to RPA: Scopes and techniques of RPA, About UAIt, The future of automation. Record and Play: Record and Play, UAIt stack, Installing and Learning UAIt studio, Task recorder

### Unit II: Sequence and Data Manipulation

Sequence: Sequence, Flowchart and Control Flow, sequencing the workflow, control flow, various types of loops and decision making, step by step example using sequence, Flowchart and Control Flow.

Data Manipulation: Variables and scope, Collections, Arguments, Collections, Clipboard management, File operation, CSV/Excel to data table and vice versa

### Unit III: Overview of RPA Tools

User Interface Components: Ribbon, Toolbars Access, Library panel, project panel, Outline panel, locals panel, Debugging, Recording, Workflow execution, context menu, properties panel, Designer panel, Universal search bar. Workflow Design and UAIt Studio: Layout diagrams, Type of Decisions, switch activity, Flow Decision, Flow switch, Naming conventions, managing variables in studio, types of variables, managing arguments, Argument panel, Types of recording, Automatic recording, Basic, web and desktop automatic recording, Manual recording, Data scraping, Screen scraping and its methods.

### Unit IV: Control Flow Activities and Selectors:

Assign activity, Delay activity, while activity, do while activity, If activity, Switch activity, for each activity and Break activity. Selectors and input/output methods: Simple selectors, Generation of Dynamic selectors, passing the variables in selectors, Input methods, Output methods, Full text, Native, OCR.

### Unit V: Automation Excel and PDF Automation:

Reading and working with rows of excel, looping with excel, working with PDF and excel files, retrieving data from web. Email Automation: Outlook Email activity, Get IMAP mail activity, Get POP3 mail message, get exchange mail activity, sending and receiving mail messages. Orchestrator: Dashboard, Robots, Processes, Jobs, Queues, Schedules, Transaction

### Text Books:

1. Learning Robotic Process Automation with UAIt – Alok Mani TrAIti, Packt.
2. Intelligent Control: A stochastic optimization approach by Kaushik Das Sharma, Amitava Chatterjee, Anjan Rakshit. –Springer edition

### Reference Books:

1. Robotic Process Automation- Guide to building robots by Richard Murdoch.
2. Robotic Process Automation and Risk Mitigation: The Definitive Guide by Mary C. Lacity and Dr. Leslie P. Willcocks
3. Introduction to robotic process automation by Frank Casale.

**Course Outcome:**

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

1. Analyze technical goals and tradeoffs.
2. Know the importance of RPA tools.
3. Envision a basic RPA implementation plan.
4. Understand the challenges and risks when implementing RPA.
5. Appreciate knowledge on automation and optimization of business process.

# BCAIAI-402: Introduction to Artificial Intelligence

L=3, T=0, P=0, C=3

MM 75

## Course Objective:

- To understand the basics of Artificial Intelligence used in the industry.
- To understand what is process automation.
- To understand UI and tool windows.
- To understand the packages installed for automatic specific targets.
- To have practical knowledge on designing automated solutions.

## Unit I: Cognitive Process Automation concepts:

Introduction to CPA: Scopes and techniques of CPA, CPA features, CPA platform overview, The future of intelligent automation. Exploration of the tool: UAith architecture, Installing and Learning UAith studio, UAith operating model, Database installation.

## Unit II: Automation in UAith

UAith: Working with different stages, Calculation, Decision, Choice, Collection, Loop, Anchor, Understanding Business objects, Understanding UAith processes, Pages, Multi Page and page linking, Input, Output and Startup Parameters. End to End Automation: Creating and Managing Business objects in object studio, Creating and Managing UAith processes in process studio, CSV/Excel to data table transfer and vice versa.

## Unit III: UAith Life Cycle and their artifacts

User Interface Components: Ribbon, Toolbars Access, Library panel, project panel, Outline panel, locals panel, Debugging, Recording, Workflow execution, context menu, properties panel, Designer panel, Universal search bar. UI Automation and System Activities: UI automation, System, Properties, Variables, Output and Arguments.

## Unit IV: Natural Language Processing:

Text Analysis, Text Cleaning, Stemming, TDM and DTM, Sentiment Analysis, NLP API consumption, Build your own social media monitoring tool and Analysis of Email. Chatbot: Handling user events and assistant Bots, Monitoring system event triggers, Hotkey triggers, Mouse triggers, System triggers, Launching an assistant bot on a keyboard event.

## Unit V: Image and Text Automation:

Image Automation: Mouse and keyboard activities, Guides/text activities, OCR- activities, Types of OCR, Image Activities, Computer Vision, Image classification, Unstructured data to structure conversion, Invoice data extraction. Text Automation: Exception Handling, Logging, Debugging, Tracing, Connecting with Database, Executing Query with Database, Project Organization, PDF-data extraction and automation, Email automation.

## Text Books:

1. Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation by Mr Srikanth Merianda.
2. Intelligent Control: A stochastic optimization approach by Kaushik Das Sharma, Amitava Chatterjee, Anjan Rakshit. –Springer edition.
3. Learning Robotic Process Automation by Alok Mani TrAIthi.

**Reference Books:**

1. Robotic Process Automation- Guide to building robots by Richard Murdoch.
2. Robotic Process Automation and Risk Mitigation: The Definitive Guide by Mary C. Lacity and Dr. Leslie P. Willcocks
3. Introduction to robotic process automation by Frank Casale

**Course Outcome:**

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

1. Analyze technical goals and tradeoffs.
2. Know the importance of automation tools.
3. Envision a basic implementation plan.
4. Understand the challenges and risks when implementing automation techniques.
5. Appreciate knowledge on automation and optimization of business process through AI.

## Course Objective:

1. To discuss units, standards, error analysis and characteristics of measurement systems.
2. To understand the static and dynamic characteristics of transducers.
3. To describe the principle of operation, construction, and characteristics of resistance, inductance and capacitance & other transducers
4. To demonstrate the various types of basic transducers.
5. To understand applications of Sensors in Real time applications.

## Unit I: Science of Measurement and Instrumentation

Functional Elements of Measurement Systems. Definition, principles of sensing and transduction, Classification of transducers, Units and standards, Classification of errors Odds and uncertainty - Introduction to Calibration methods.

## Unit II: Resistive Transducers

The principle of operation, construction details, characteristics and application of resistance potentiometer, strain gauge and its signal conditioning circuits, RTD, LDR, thermistor, hot-wire anemometer and humidity sensor. Demonstration of RTD, Strain gauge, LDR

## Unit III: Inductive and Capacitive Transducers

Induction potentiometer - Variable reluctance transducers, LVDT - Variable Reluctance Tachometer, Proximity transducers - Capacitive transducer and types - Capacitor microphone

## Unit IV: Other Transducers

A piezoelectric transducer, magnetostrictive transducer - Digital transducers - Fiber optic transducer - Hall Effect transducer - Photo electric transducer- I/P & P/I transducer. Introduction to Smart sensors and MEMS. Points to be considered for selecting a transducer.

## Unit V: Sensor Applications

Typical applications of sensors, Sensors in Real time industry, Selection criterial of the sensor as per the application, Application Cases: Weather monitoring system, Water monitoring system, Sensor on the Conveyor system.

## Text Book:

1. E.A. Doebelin, "Measurement Systems – Applications and Design", Tata Mc Graw Hill, New York, 2012
2. John P. Bentley, "Principles of Measurement Systems", 4th Edition, Pearson Education, 2005
3. S. Ranganathan, "Transducer Engineering", Allied Publishers Pvt. Ltd.,2003

## Reference Book:

1. D.Patranabis, "Sensors and Transducers", Prentice Hall of India, 2004.

## Course Outcome:

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

1. What are the sensors and how they work in different applications?
2. Classification of sensors
3. How to select the sensor for specific application?
4. Real time integration of sensors with signal conditioning systems.



## **BCAIAI-404 (Elective-II): Business Process Management**

L=3, T=0, P=0, C=3

MM 75

### **Course Objective:**

1. Understand the business process methodology and its phases for the implementation
2. Understand the basics of Business process management life cycle.
3. Understand the business process management workflow and its methods.
4. Understand the architecture and important properties of business process management.

### **Unit I: Introduction to Business Process Management**

Introduction, definition, business process life cycle, classification of business process, goals, structures and organization, evolution of enterprise systems architecture, business process modelling foundation: Conceptual Model and Terminology, Activity Models and Activity Instances, Process Models and Process Instances, Process Interactions, Modelling Process Data, modelling organization and operations, business process flexibility.

### **Unit II: Process Orchestrations and Choreographies**

Introduction, Control Flow Patterns, Petri Nets, Event-driven Process Chains, Workflow Nets, Yet Another and Graph Based Workflow Language, Business Process Modeling Notation, Development Phases, Process Choreography Design and implementation, service interaction patterns.

### **Unit III: Properties and Architecture of Business Process Management**

Introduction, Data Dependencies, Structural Soundness, Soundness, Relaxed Soundness, Weak Soundness, Lazy Soundness, Workflow Management Architectures, Flexible Workflow Management, Web Services and their Composition, Advanced Service Composition.

### **Unit IV: Business Process Methodology – I**

Introduction, Methodology Overview, Strategy and Organization, Survey, Design Phase, Platform Selection, Implementation and Testing, Operation and Controlling Phase.

### **Unit V : Business Process Methodology - II**

Business Process Reengineering, Business Process Management (BPM) Implementation Methodology, Phases for Implementation: Commit, Research, Analyze, Design and Implement and Support.

### **Text Books:**

1. Business Process Management - Concepts, Languages, Architectures by Mathias Weske, Springer, 2007.
2. BUSINESS PROCESS MANAGEMENT SYSTEMS by James F. Chang, Auerbach Publications, 2006.

### **Reference Books:**

1. Business Process Management Practical Guidelines to Successful Implementations by John Jeston and Johan Nelis, Butterworth-Heinemann is an imprint of Elsevier, 2008
2. BUSINESS PROCESS MANAGEMENT APPLIED by Charles Poirier Ian Walker, J.Ross Publishing Inc, 2005

**Course Outcome:**

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

1. Explain about the life cycle of business process management and its components.
2. Draw a workflow for the business process management with different methods.
3. Create and explain about the architecture of business process management.
4. Create and implement the architecture of business process management.

## **BCAIAI-405 (Elective-II): Introduction to Data Science**

L=3, T=0, P=0, C=3

MM 75

### **Course objectives:**

1. To understand the overview and definition of Data Science with its crucial role in current business world.
2. To understand the importance of mathematics & Statistics in Data Science.
3. To understand the role of machine learning techniques in Data Science and its different types.
4. To know the integrated role of computers and its components in Data Science
5. To understand the flow and process model of data science project management.

### **Unit I: Data Science - An Overview**

Introduction to Data Science, Definition and description, history and development, terminologies, basic framework and architecture, difference between Data Science and business analytics, importance of Data Science, primary components of Data Science, users of Data Science and its hierarchy, overview of Data Science techniques, challenges and opportunities in Data Science, industrial application of Data Science techniques.

### **Unit II: Mathematics and Statistics in Data Science**

Role of mathematics, importance of probability and statistics, important types of statistical measures: Descriptive, Predictive and prescriptive statistics, introduction to statistical inference, application of statistical techniques, linear algebra: matrix and vector theory, role of linear algebra in Data Science, exploratory data analysis and visualization techniques, difference between exploratory and descriptive statistics.

### **Unit III: Machine Learning in Data Science**

Role of machine learning, different types of machine learning techniques and its broad scope: Supervised, unsupervised, reinforcement and deep learning, difference between different machine learning techniques, machine learning algorithms, importance of machine learning in today's business, difference between classification and prediction.

### **Unit IV: Computers in Data Science**

Role of computer science in Data Science, various components of computer science being used for Data Science, role of relation data base systems: SQL, NoSQL, data warehousing, importance of operating concepts and memory management, freely available software tools: R, Python, important proprietary software tools, business intelligence tools.

### **Unit V: Data Science Project Management**

Data Science project framework, execution flow of a Data Science project, various components of Data Science projects, stakeholders of Data Science project, industry use cases of Data Science implementation, challenges and scope of Data Science project management, process evaluation model, comparison of Data Science project methods, improvement in success of Data Science project models.

### **Text Books:**

1. Data Science from Scratch: First Principles with Python 1st Edition by Joel Grus
2. Principles of Data Science by Sinan Ozdemir, (2016) PACKT.

**Reference Book:**

1. Data Science For Dummies by Lillian Pierson (2015)
2. Data Science for Business: What You Need to Know about Data Mining and Data- Analytic Thinking by Foster Provost, Tom Fawcett
3. Data Smart: Using Data Science to Transform Information into Insight 1st Edition by John W. Foreman. (2015) Wiley Publication.

**Course Outcome:**

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

1. After completing this course, students will be able to appreciate the need of Data Science in day to day life.
2. They will be able to understand the process and components of Data Science project.
3. Student will the Learn importance of probability and statistics in Data Science
4. Student will be able to understand the machine learning in today's business world.
5. Understands the various components of computer science being used for Data Science
6. Student will bale to understand the execution flow of a Data Science project

## BCAIAI-406 (Elective-II): Pattern Recognition

L=3, T=0, P=0, C=3

MM 75

### Course Objective:

1. To provide a strong foundation to students to learn the fundamentals of Pattern Recognition techniques.
2. To understand Parameter Estimation and Supervised Learning methods.
3. To understand kernel methods used in pattern classification models.
4. To understand Discriminant Functions and Syntactic Approach to Pattern Recognition. To understand the concept of basic tree models and applications in pattern recognition

### Unit I: Introduction to Pattern Recognition Systems

The Design Cycle-Learning And Adaptation-Supervised Learning- Unsupervised Learning-Reinforcement Learning-Linear Model For Classification-Discriminant Function(Two Class And Multiclass)-Least Square For Classification- Fisher's Linear Discriminant Analysis For Two And Multiple Class- Probabilistic Generative Models – Maximum Likelihood Solution.

### Unit II: Parameter Estimation and Supervised Learning

Maximum Likelihood Estimation - The Bayes Classifier - Learning The Mean Of A Normal Density - General Bayesian Learning - Nonparametric Technic – Density Estimation - Parzen Windows - K-Nearest Neighbor Estimation - Estimation Of Posterior Probabilities - Nearest- Neighbor Rule - K-Nearest Neighbor Rule.

### Unit III: Kernel Methods

Constructing Kernels – Kernel Density Estimators - Nearest Neighbor Methods – Gaussian Processes And Classification – Sparse Kernel Machines - Support Vector Machines – Maximum Margin Classifiers - Multi-Class Support Vector Machine. Graphical Models: Bayesian Networks - Generative Models - Linear Gaussian Models - Conditional Independence.

### Unit IV: Gaussian Mixture Models and Expectation Maximization

K-Means Clustering - Mixtures Of Gaussian -Expectation Maximum For Gaussian Mixtures. Continuous Latent Variables: PrincAll Component Analysis -Applications Of PrincAll Component Analysis -PCA For Higher Dimensional Data - Factor Analysis. Sequential Data: Markov Models – Hidden Markov Models - Maximum Likelihood For HMM–Forward- Backward Algorithm. Combining Models.

### Unit V: Tree Based Models

Tree based model- Pros and Cons, decision tree algorithms, classification tree, characteristics of classification tree, induction algorithms, probability estimation in decision tree – Laplace correction and no match method, stopping criteria for tree development, pruning techniques and pruned tree. Classification Methods: Information Gain: ID3-C4.5-C5-J 48. Gini Index: SPRINT-SLIQ. Decision Tree Advantages and Disadvantages-Application of decision tree- Classification and Regression Trees (CART).

### Text Books:

1. “Pattern Recognition And Machine Learning”,. Christopher M. Bishop , Springer, 2006
2. “Pattern Classification”, Second Edition, Richard O. Duda, Peter E. Hart And David G. Stork John Wiley & Sons, 2003

**Reference Books:**

1. Syntactic Pattern Recognition And Applications, Fu K.S., Prentice Hall, Eaglewood Cliffs
2. Pattern Recognition: Techniques And Applications by RajjanShinghal : Oxford University Press, 2008,
3. Pattern Classification And Scene Analysis, John Wiley, Duda& Hart P.E.
4. Syntactic Pattern Recognition - An Introduction by Addison Wesley Gonzalez R.C. & Thomson M.G.

**Course Outcome:**

1. Understand the basic concept of ML and also the applications of ML.
2. To understand Parameter Estimation and Supervised Learning methods.
3. Understand the concept of kernel methods and how it works in Support vector machines.
4. To understand Discriminant Functions and Syntactic Approach to Pattern Recognition.
5. Understand concept of basic tree models along with its application.

## **BCAI-403: Logical Reasoning and Thinking**

L=0, T=0, P=4, C=2

MM 50

### **Course Objective:**

1. To help students learn the techniques of enhancing and sharpening their aptitude skills related to verbal ability, quantitative aptitude, logical reasoning and data presentation.

### **Unit I: Verbal ability**

Synonyms, Antonyms and One word substitutes

### **Unit II: Basic quantitative aptitude**

Speed, Time and Distance, Time and Work, Linear Equations, Progressions (Sequences & Series), Permutation and Combination, Probability, Functions, Set Theory, Number Systems, LCM and HCF, Percentages, Collection and Scrutiny of data: Primary data, questionnaire and schedule; secondary data, their major sources including some government publications.

### **Unit III: Logical Reasoning - I**

Number and Letter Series, Calendars, Clocks, Cubes, Venn Diagrams, Binary Logic, Seating Arrangement, Logical Sequence, Logical Matching, Logical Connectives, Syllogism, Blood Relations; concept of a statistical population and sample from a population; qualitative and quantitative data

### **Unit IV: Measures of Central Tendency**

Objective of averaging, characteristics of good average, types of average, arithmetic mean of grouped and ungrouped data, correcting incorrect values, weighted arithmetic mean Median - median of grouped and ungrouped data merit and limitation of median, computation of quartile, decile and percentile Mode - calculation of mode of grouped and ungrouped data, merits and limitation of mode, relationship between mean, median and mode. Geometric mean and Harmonic mean.

### **Unit V: Presentation of Data**

Construction of tables with one or more factors of classification; Diagrammatic and Graphical representation of non-frequency data; Frequency distribution, cumulative frequency distribution and their graphical representation - histogram, Column Graphs, Bar Graphs, Line Charts, Pie Chart, Data Interpretation – Introduction and approaches

### **Text Books:**

1. Richard I Levin, David S. Rubin: Statistics for Management, Pearson Prentice Hall Education Inc. Ltd, NewDelhi, 5th Ed. 2007
2. Bajpai, N. Business Statistics, Pearson, 2010.

### **Reference Books:**

1. Sharma J.K., Business Statistics, Pearson Education India, 2010.
2. Anderson; David R, Dennis J. Sweeney and Thomas A. Williams, Quantitative Methods for Business, Prentice-Hall, West Publishing Company, 1996.
3. CAT Complete course, UPKAR publications.

### **Course Outcome:**

1. By the end of this course, students will be able to use their logical reasoning and thinking skills more effectively; hence making them ready to clear written aptitude tests in industries and get placed easily.

Program Name- **MACHINE LEARNING**

Program Hours- **50**

Tentative Credit - **4**

### **OBJECTIVES**

- To provide big data computing environment: To analyze and Configure a Predictive Maintenance that can be implemented into a production environment to apply the predictive data model to streaming data.
- To provide Machine learning techniques: Three phases of machine learning. types of learning support vector machine. decision trees and random forests.
- To provide Scaling up machine learning: Dimensionality reduction techniques like principal component analysis and feature hashing.

### **OUTCOMES**

- Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
- Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
- Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies.

### **SCOPE**

- Business Analyst
- Product Analyst
- Machine Learning Engineer
- Data Scientist

### **PROJECTS**

- Heart Attack Prediction
- Rain prediction
- Sensex prediction
- Engine health prediction Vibration
- Movie Recommendation System
- Auto Correct Keyboard -NLP
- Match prediction Sports Data
- Gold price Prediction



## **MACHINE LEARNING**

### **Module 1:**

**Introduction to Machine Learning:** Introduction to Multi-Dimensional Data- tensor, Different Algorithms and applications, Regression, Classification, Clustering and Association Rule Learning.

### **Module 2:**

**Supervised learning:** Regression, Simple & Multiple Linear Regression, Interaction Terms, Nonlinear Transformations, Dummy variable regression, K-fold Cross Validation, Subset selection methods.

### **Module 3:**

**Supervised learning:** Support Vector Machines, Optimization Objective, The Maximal Margin Classifier, Kernel Method, and Nonlinear Decision Boundaries, one versus One Classification, one versus All Classification, Character recognition using SVM Using Support Vector for Regression.

### **Module 4:**

**Supervised learning:** Random Forests & Decision Trees, Application of Random Forest, Ensembles of Estimators: Random Forests, Bagging and boosting, Feature training and testing, classification.

### **Module 5:**

**Supervised learning:** Introduction to Logistic Regression, Logistic Model cost function, Estimating the Coefficients, Making Predictions, Odds-Ratio, Performance Evaluation Matrices, Sensitivity/Specificity/PPV/NPV, Precision, ROC curve etc., Regularized Logistic Regression.

### **Module 6:**

**Supervised learning:** KNN (K-Nearest Neighbor), Background of KNN, Application of KNN, create a document retrieval system using k-nearest neighbors, identify various similarity metrics for text data, reduce computations in k-nearest neighbor search by using KD trees.

#### **Reference Books & Materials:**

- Machine learning basics – [Machine Learning – GeeksforGeeks](#)
- sklearn – [1. Supervised learning – scikit-learn 1.1.2 documentation](#)
- [Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems By Aurélien Géron](#)
- [Machine Learning Engineering Paperback – by Andriy Burkov](#)

## **BCAIAI-407: Introduction to Artificial Intelligence Lab**

**L=0, T=0, P=4, C=2**

**MM 50**

### **List of Experiments:**

1. Write a script for a bot to analyze the text from a given source.
2. Convert all the unstructured images to structured images used for classification.
3. Connect a bot to an API to analyze the sentiment of the different text messages.
4. Connect a bot to an API to summarize the input text.
5. Build a process to classify images based on their nominal data.
6. Build a process to fill the different invoice data.
7. Write a python code to build Ajax enabled web application for product.

## **BCAIAI-408: Introduction to RPA Tools Lab**

**L=0, T=0, P=4, C=2**

**MM 50**

### **List of Experiments:**

#### **Part A:**

1. Read and write the data and append it to excel
2. Prepare a process of sending and receiving mail with/without attachment
3. Fill the data to collection or to extract form SQL database.

#### **Part B:**

1. Write the script to an agent in order to login for the setup created.
2. Write a script to extract the information form Email and to analyze the same.
3. Setup a workflow scheduler to manage work queues management

# Syllabus

## Semester: V

## BCAIAI501: Six Sigma and Lean Methods

L=3, T=0, P=0, C=3

MM 75

### Course Objectives:

1. Develop a broad understanding of Six Sigma principles and practices
2. Build capability to implement Six Sigma tools, especially in manufacturing operations

### Unit 1:

Introduction, the DMAIC methodology, deliverables of a lean Six Sigma project, basic Six Sigma metrics, developing project metrics. Lean and Six Sigma, the seven elements of waste, 5S. Cause and effect diagrams, Pareto analysis, process mapping, SIPOC, value stream, scatter diagram, failure modes and effect analysis (FMEA).

### Unit 2:

Basic statistics, probability distributions, normal distribution, central limit theorem, measurement system analysis – precision, accuracy, bias, linearity, gage repeatability & reproducibility. Process capability analysis.

### Unit 3:

Multivariate analysis, sampling techniques, Hypothesis testing, testing with normal data, One Way ANOVA, nonparametric tests for non-normal data. Chi-square tests.

### Unit 4:

Regression and correlation, linear, non-linear, and multiple linear, confidence intervals, residual analysis. Lean controls – 5S, Kanban, Poka-Yoke (Mistake Proofing),

### Unit 5:

Statistical Process Control – control charts – I-MR, xbar-R, xbar-S, U, p, CuSum, EWMA charts, Six Sigma control plans.

### Text Books:

1. Michael L.George, David Rowlands, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000

### Reference Books:

1. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
2. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma: A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000
3. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 2003

### Course Outcomes:

1. After going through this course, the students will be able to:
2. Apply basic quality tools in manufacturing operations.
3. Calculate process capability and gage capability in a manufacturing process.
4. Perform statistical analysis to test hypotheses.
5. Perform regression and correlation analysis.
6. Build and analyze control charts for monitoring processes.

# BCAIAI502: Digital Image Processing

L=3, T=0, P=0, C=3

MM 75

## Course Objectives:

1. To describe and explain basic principles of digital image processing.
2. To study basic image operations.
3. To understand the algorithms that perform basic image processing (e.g. noise removal and image enhancement).
4. To design and implement algorithms for advanced image analysis (e.g. image morphing, image segmentation).
5. To expose students to current applications in the field of DIP.

## UNIT I

Introduction to digital image processing, applications, steps of digital image processing, Components of Image Processing system, Image sampling and Quantization.

## UNIT II

**Image Enhancement in Spatial Domain:** Meaning of spatial domain, image negatives, log transformation, power law transformation, Introduction to histogram Processing, histogram equalization, histogram specification, Enhancement using logical AND and logical OR operator, Image subtraction, Image Averaging.

## UNIT III

**Image Enhancement in Frequency Domain:** meaning of frequency domain, one dimensional Fourier frequency domain and its inverse, two dimensional Fourier frequency domain and its inverse, filtering in frequency domain, Smoothing Frequency-Domain Filters- Ideal Low Pass Filters, Butterworth Low Pass Filters, Gaussian Low Pass Filters, Sharpening Frequency Domain Filters- Ideal High pass Filters, Butterworth High pass Filters, Gaussian High pass Filters.

## UNIT IV

**Image Restoration:** Introduction to image restoration. Model of the Image Degradation/Restoration Process, Restoration in the Presence of Noise- arithmetic mean filter, geometric mean filter, harmonic mean filter, contra harmonic mean filter, Minimum Mean Square Error (Wiener) Filter, Geometric Mean Filter.

## UNIT V

**Morphological Image Processing:** Basic Concepts from Set Theory, Logic Operations Involving Binary Images, Dilation and Erosion, Opening and Closing, Hit or Miss Transformation, Extensions to Gray-Scale Images- Dilation, Erosion, Opening and Closing.

**Image Segmentation:** Detection of Discontinuities- Point Detection, Line Detection, Edge Detection, Global Processing via Graph-Theoretic Techniques

## Text and Reference Books

1. Fundamentals of Digital Image Processing, Anil K. Jain, Pearson, IIIrd, 2004.
2. Digital Image Processing, Rafel C. Gonzalez & Richard E. Woods, PHI, 10th, 2005.
3. Digital Image Processing using MATLAB, Rafel, Richard & Steven, Pearson, IInd, 2007.
4. Digital Image Processing, Jayaraman S, Veerakumar T, Esakkirajan S, TMH, Ist, 2009.

**Course Outcomes:**

After completing the course, students will be able to:

1. Understand general terminology of digital image processing.
2. Examine various types of images, intensity transformations and spatial filtering.
3. Develop Fourier transform for image processing in frequency domain.
4. Evaluate the methodologies for image segmentation, restoration etc.
5. Implement image process and analysis algorithms.
6. Apply image processing algorithms in practical applications.

## BCAIAI503 (Elective-III): Test Automation Using Selenium

L=3, T=0, P=0, C=3

MM 50

### Course Objectives:

1. Get an overview of Selenium
2. Identify what to automate in a project and configure the environment
3. Control browser behavior and manipulate web page elements
4. Understand the nuances of writing test and creating test suites
5. Create UI tests with Selenium WebDriver and analyze test results
6. Troubleshoot errors in automation and build meaningful reporting

### Unit 1:

**Introduction:** What is Selenium, Need of Selenium, Selenium with java vs. python, basic program structure

**Python programming:** Object Oriented Programming, Python data structures and operations, Functions and parameters, file operations, modules

### Unit 2:

**Selenium Execution Steps:** Environment setup (python, pycharm, selenium etc.), introduction with python and pycharm, first script on selenium,

### Unit 3:

**Selenium Web Driver:** Introduction to web driver and remote vs. local, installing web driver, first script on web driver, accessing forms in web driver, accessing table contents and links on web drivers, remote web driver

### Unit 4:

**Automation Framework:** Advanced web elements access methods- Contains, Sibling, Ancestor etc, framework designing methods, framework adaptation, feature testing automation, report generation out of automation, real time automation and challenges

### Unit 5:

**PyAutoGUI:** Controlling Mouse and Keyboard: Introduction to pyautogui, accessing flash content through pyautogui, controlling mouse and keyboard events on web driver

### Text and Reference Books:

1. Hands-On Web Scraping with Python: Perform advanced scraping operations using various Python libraries and tools such as Selenium, Regex, and others, Anish Chapagain, Packt, Birmingham Mumbai
2. Selenium with Python Simplified for Beginners - Simple, Concise & Easy guide to Automation Testing using Python and Selenium WebDriver, S Basu
3. Learn Selenium: Build data-driven test frameworks for mobile and web applications with Selenium Web Driver 3, Unmesh Gundecha, Carl Cocchiaro, Packt, Birmingham Mumbai
4. Selenium with Python - A Beginner's Guide: Get started with Selenium using Python as a programming language, Pallavi R Sharma



**Course Outcomes:**

After completing the course, students will be able to:

1. Understanding of the principles and importance of test automation in software development and quality assurance processes.
2. Learn the fundamentals of Selenium, including setting up the environment, interacting with web elements, and writing basic test scripts.
3. Explore different test automation frame works how to design and implement scalable and maintainable automation frameworks using Selenium.

## BCAIAI504 (Elective-III): Software Testing

L=3, T=0, P=0, C=3

MM 50

### Course Objectives:

1. To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
2. To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.
3. To understand software automation problems and solutions.

### Unit I: Review of Software Engineering:

Overview of Software Evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference Between Verification and Validation, Test Cases, Testing Suite, Test, Oracles, Impracticality of Testing All Data; Impracticality of Testing All Paths.

### Unit II: Functional Testing:

Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. Structural Testing: Control Flow Testing, Path Testing, Independent Paths, Generation of Graph from Program, Identification of Independent Paths, Cyclamate Complexity, Data Flow Testing, Mutation Testing.

### Unit III: Regression Testing:

What is Regression Testing? Regression Test cases selection, Reducing the number of test cases, Code coverage prioritization technique. Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis

### Unit IV: Software Testing Activities:

Levels of Testing, Debugging, testing techniques and their applicability, Exploratory Testing Automated Test Data Generation: Test Data, Approaches to test data generation, test data generation using genetic algorithm, Test Data Generation Tools, Software Testing Tools, and Software Test Plan.

### Unit V: Object Oriented Testing:

Definition, Issues, Class Testing, Object Oriented Integration and System Testing. Testing Web Applications: Web Testing, User Interface Testing, Usability Testing, Security Testing, Performance Testing, Database testing, Post Deployment Testing

### Textbooks:

1. Yogesh Singh, "Software Testing", Cambridge University Press, New York, 2012
2. K..K. Aggarwal & Yogesh Singh, "Software Engineering", New Age International Publishers, New Delhi, 2003.
3. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Fifth Edition, McGraw-Hill International Edition, New Delhi, 2001.

### References:

1. Marc Roper, "Software Testing", McGraw-Hill Book Co., London, 1994
2. M.C. Trivedi, Software Testing & Audit, Khanna Publishing House 6. Boris Beizer, "Software System Testing and Quality Assurance", Van Nostrand Reinhold, New York, 1984

**Course Outcomes:**

At the end of course, the student will be able to understand:

1. CO1: Have an ability to apply software testing knowledge and engineering methods.
2. CO2: Have an ability to design and conduct a software test process for a software testing project.
3. CO3: Have an ability to identify the needs of software test automation, define, and develop a test tool to support test automation.
4. CO4: Have an ability understand and identify various software testing problem.
5. CO5: Have basic understanding and knowledge of contemporary issues in software testing.

## **BCAIAI505 (Elective-IV): Introduction to Web Services**

**L=3, T=0, P=0, C=3**

**MM 75**

### **Course Objectives:**

1. Understand the fundamentals of web services and their role in modern software development.
2. Familiarize students with the principles and concepts of Service-Oriented Architecture (SOA).

### **UNIT I:**

Evolution and Emergence of Web Services: Evolution of distributed computing, Core distributed computing technologies, client/server, CORBA, JAVA RMI, Micro Soft DCOM, MOM, Challenges in Distributed Computing, role of J2EE and XML in distributed computing, emergence of Web Services and Service Oriented Architecture (SOA). Introduction to Web Services: The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services. Web Services Architecture: Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services.

### **UNIT II:**

Fundamentals of SOAP: SOAP Message Structure, SOAP Encoding, Encoding of different data types, SOAP message exchange models, SOAP communication and messaging, Java and Axis, Limitations SOAP.

### **UNIT III:**

Describing Web Services: WSDL, WSDL in the world of Web Services, Web Services life cycle, anatomy of WSDL definition document, WSDL bindings, WSDL Tools, limitations of WSDL.

### **UNIT IV:**

Discovering Web Services: Service discovery, role of service discovery in a SOA, service discovery mechanisms, UDDI: UDDI Registries, uses of UDDI Registry, Programming with UDDI, UDDI data structures, Publishing API, Publishing information to a UDDI Registry, searching information in a UDDI Registry, limitations of UDDI.

### **UNIT V:**

Web Services Interoperability: Means of ensuring Interoperability, Overview of .NET, Creating a .NET Client for an Axis Web Services, Creating Java Client for a web service, Challenges in Web Services Interoperability. Services Security: XML security frame work, Goals of cryptography, Digital Signature, Digital Certificate, XML encryption.

### **Text Books:**

1. Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley India, rp 2008.
2. Developing Enterprise Web Services, S. Chatterjee, J. Webber, Pearson Education, 2008.
3. XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education.

### **Reference Books:**

1. Building Web Services with Java, Second Edition, S. Graham and others, Pearson Edn., 2008.
2. Java web services, D.A. Chappell and T.Jewell, O'Reilly,SPD.
3. Java Web Services Architecture, McGovern, Sameer Tyagi etal., Elsevier.
4. Web Services, G. Alonso, F. Casati and others, Springer, 2005.

**Course Outcomes:**

1. Explain the concepts and principles of web services and their relevance in modern software development.
2. Design and develop basic web services using appropriate protocols and standards.
3. Understand the integration techniques and challenges associated with web services.
4. Evaluate and select appropriate tools and frameworks for web service development.

## BCAIAI506 (Elective-IV): Digital Signal Processing

L=3, T=0, P=0, C=3

MM 75

### Objectives:

1. To describe signals mathematically and understand how to perform mathematical operations on signals.
2. It will provide knowledge of Digital filter.
3. To discuss word length issues ,multi rate signal processing and application.

### UNIT- I: Basic elements of digital signal Processing:

Concept of frequency in continuous time and discrete time signals –Sampling theorem – Discrete time signals. Discrete time systems –Analysis of Linear time invariant systems –Z transform –Convolution and correlation.

### UNIT- II: Introduction to DFT:

Efficient computation of DFT Properties of DFT – FFT algorithms – Radix-2 and Radix-4 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms – Use of FFT algorithms in Linear Filtering and correlation.

### UNIT- III Structure of IIR:

System Design of Discrete time IIR filter from continuous time filter – IIR filter design by Impulse Invariance. Bilinear transformation – Approximation derivatives – Design of IIR filter in the Frequency domain.

### UNIT - IV: Symmetric & Anti-symmetric FIR filters:

Linear phase filter – Windowing techniques – rectangular, triangular, Blackman and Kaiser windows – Frequency sampling techniques – Structure for FIR systems.

### UNIT-V: Finite word length effects in FIR and IIR digital filters:

Quantization, round off errors and overflow errors. Multi rate digital signal processing: Concepts, design of practical sampling rate converters, Decimators, interpolators. Poly phase decompositions. Application of DSP – Model of Speech Wave Form – Vocoder.

### Text Books:

1. Oppenheim A V and Sehafer R W, “Discrete Time Signal Processing”, Prentice Hall (1989).
2. Proakis J G and Manolakis D G, “Digital Signal Processing”, Pearson Education India.

### References books:

1. Oppenheim A V, Willsky A S and Young I T, “Signal & Systems”, Prentice Hall, (1983).
2. Ifeachor and Jervis, “Digital Signal Processing”, Pearson Education India.
3. DeFatta D J, Lucas J G and Hodgkiss W S, “Digital Signal Processing”, J Wiley and Sons, Singapore, 1988
4. Sanjit K Mitra “Digital Signal Processing” TMH

### Course Outcomes:

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

1. Illustrate digital signals, systems and their significance.
2. Analyze the digital signals using various digital transforms DFT, FFT etc.
3. Design and develop the basic digital system.
4. Interpret the finite word length effects on functioning of digital filters.

## BCAIAI507 (Elective-IV): Embedded Systems

L=3, T=0, P=0, C=3

MM 75

### Course Objective

1. Understand an embedded system.
2. Implement programs using embedded C.
3. To know about software used to create embedded systems.

### Unit 1:

**Introduction to Embedded System:** History & need of Embedded System, Basic components of Embedded System, Programming Language Classification of Embedded System, Advantage & Disadvantage **Microprocessor & Microcontroller Classification:** Difference between Microprocessor & Microcontroller, Classification based on architecture, Memory Classification

### Unit 2:

**Introduction of Embedded C:** Introduction to Embedded C, Difference between C & Embedded C, Programming style, Basic structure of C Program **Constants, Variables & Data Types:** Keywords & Identifiers, Data type & its memory representation, Arrays and strings **Operators:** Types of Operators, Bitwise Operators explained

### Unit 3:

**Control Structures & Loops:** Decision making with if statement, If... else statement, Switch statement, and GOTO statement, The While and Do – While statements, for statement **Functions:** Why Functions, Types of Functions, A Multi-functional program, Return values & their types

### Unit 4:

**Introduction to Software:** Kiel Compiler, Proteus. **Interfacing of Led:** Introduction of LED's, Interfacing Circuit Description of LED's, Programming of LED's Interfacing. **Interfacing of Seven Segment Display:** Introduction to 7 Segment Display, Types of 7 Segment Display, Interfacing Circuit Description of 7 Segment Display, Programming of 7 Segment Display Interfacing

### Unit 5:

**Sensor Interfacing:** Introduction to sensing devices, Interfacing of IR Sensors, Interfacing of Temperature Sensor. **Embedded Networking:** I2C Bus Standard, Bluetooth, Zigbee, USB

### Text Books:

1. "Embedded Systems: Architecture, Programming and Design" by Raj Kamal
2. "Programming Embedded Systems: With C and GNU Development Tools" by Michael Barr and Anthony Massa

### Reference Books:

1. "The 8051 Microcontroller and Embedded Systems: Using Assembly and C" by Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay
2. "Embedded Systems: Design, Analysis and Verification" by M.A. Pai

### Course outcomes:

1. Elaborate the basics of embedded systems.
2. Implement programs using embedded C.
3. Developed knowledge about the software used in this field.

## BCAIAI508 (Generic Elective-I): Design Thinking

L=3, T=0, P=0, C=3

MM 75

### Course Objectives:

1. Inculcate the fundamental concepts of design thinking
2. Develop the students as a good designer by imparting creativity and problem solving ability
3. Conceive, conceptualize, design and demonstrate innovative ideas using prototypes

### Unit I: Introduction to Design Thinking:

Definition and history of design thinking, Basic principles of design thinking, the design thinking process, the benefits of using design thinking for problem-solving.

### Unit II: Empathizing with Users:

Techniques for understanding user needs and behaviors, how to conduct user research, how to create user personas and empathy maps. Defining the Problem: How to frame problems in a way that inspires innovative solutions, how to use a problem statement, Point of view (POV) statements and reframing the problem

### Unit III: Ideation and Brainstorming:

Techniques for generating and selecting innovative ideas, how to use brainstorming and mind mapping, SCAMPER: A technique for generating new ideas. Prototyping: How to create low-fidelity prototypes, the importance of iteration and testing, Techniques for prototyping: sketching, role-playing, storyboarding, and more.

### Unit IV: Testing and Feedback:

How to test prototypes with users, in incorporating feedback into the design process, Techniques for user testing and feedback loops. **Implementation and Scaling:** Strategies for taking a design from concept to implementation, Considerations for scalability and sustainability, Identifying potential challenges and opportunities.

### Unit V:

Ideation, Experimentation and Evolution Generating and Developing Ideas, Creativity as Teaching and Learning, Prototyping, and testing Learning Through Things & Interactions, Express, Test, Cycle **Ethics and Social Responsibility:** How to design with empathy and ethical considerations, addressing social and environmental issues in design solutions. **The importance of responsible design:** Design Documentation Representing Design Knowledge, Diffusion of Innovation, Design as research.

### Textbooks:

1. Design Thinking: Integrating Innovation, Customer Experience, and Brand Value, by Thomas Lockwood, Allworth Press, 2010.
2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd.
3. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons Inc 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization Book by Vijay Kumar.



**Reference Books:**

1. Design Thinking: Understand – Improve – Apply edited by Hasso Plattner, Christoph Meinel, Larry Leifer, Springer Science & Business Media, 2010
2. Brenda Laurel Design Research methods and perspectives MIT press 2003
3. Terwiesch, C. & Ulrich, K.T., 2009. Innovation Tournaments: creating and identifying Exceptional Opportunities, Harvard business press.
4. Ulrich & Eppinger, Product Design and Development, 3rd Edition, McGraw Hill, 2004
5. Stuart Pugh, Total Design: Integrated Methods for Successful Product Engineering, Bjarki Hallgrímsson, Prototyping and model making for product design, 2012, Laurence King Publishing Ltd
6. Kevin Henry, Drawing for Product designers, 2012, Laurence King Publishing Ltd

**Course Outcomes:**

Understand how teaching and learning occurs in the design process.

1. CO1: Demonstrate the critical theories of design, systems thinking, and design methodologies.
2. CO2: Produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact.
3. CO3: Understand the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices.
4. CO4: Conceive, organize, lead and implement projects in interdisciplinary domain and address social concerns with innovative approaches.

# BCAIAI510 (Generic Elective-I): Cloud Computing

L=3, T=0, P=0, C=3

MM 75

## Course Objectives:

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
3. To enable students exploring some important cloud computing driven commercial systems and applications.
4. To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

## Unit I: Introduction to Cloud Computing:

Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

## Unit II: Cloud Enabling Technologies Service Oriented Architecture:

REST and Systems of Systems – Web Services – Publish, Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery.

## Unit III: Cloud Architecture, Services and Storage:

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – LAAS – PAAS – SAAS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

## Unit IV: Resource Management and Security in Cloud:

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

## Unit V: Cloud Technologies and Advancements Hadoop:

MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

## Text Books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

## Reference Books:

1. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
2. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O’Reilly, 2009.

**Course Outcomes:**

At the end of course, the student will be able to understand:

1. CO1: Describe architecture and underlying principles of cloud computing.
2. CO2: Explain need, types and tools of Virtualization for cloud.
3. CO3: Describe Services Oriented Architecture and various types of cloud services.
4. CO4: Explain Inter cloud resources management cloud storage services and their providers  
Assess security services and standards for cloud computing.
5. CO5: Analyze advanced cloud technologies.

Program Name- **DEEP LEARNING**

Program Hours- **50**

Tentative Credit - **4**

### **OBJECTIVES**

- To create appreciation and understanding of both the achievements of AI and the theory underlying those achievements.
- To introduce the concepts of Computer Vision & Natural Language Processing that can be designed to solve problems.
- To impart basic proficiency in representing difficult real-life problems in a state space representation to solve them using AI techniques.
- To create an understanding of the basic issues of knowledge representation, as well as an understanding of topics such as parallel processing, accelerated computing & GPU etc. that play an important role in AI programs.

### **OUTCOMES**

- Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different searches.
- Develop intelligent algorithms for constraint satisfaction problems and design intelligent systems for Industrial Manufacturing Processes.
- Attain the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.

### **SCOPE**

- AI Developer and AI Analyst
- Data Scientist

### **PROJECTS**

- Parallel Processing
- AI Networks Design
- Smart Systems

## DEEP LEARNING

### Module 1:

**Introduction to AI, CV, NLP:** Applications of CV, Applications of NLP, Need for CV, and NLP Engineers Introduction to course. Learning mechanisms – 1: Introduction to types of learning mechanisms, Supervised – regression, classification, SVMs. Introduction to parallel processing: Parallel processing, Accelerated computing & GPUs.

### Module 2:

**Neural networks:** Biological neurons and Perceptrons, Multi-layer Perceptrons, Activation functions, Feed forward networks & Backpropagation, Base optimizers and loss functions, Training multi-layer perceptron.

### Module 3:

**Introduction to image processing:** Image processing libraries, Simple image processing functionalities, Feature extraction. **Building blocks of deep learning Layers:** Activation functions, Network creation and visualization.

### Module 4:

**Computer Vision Level 1 work** – CV Data collection, Data annotation, Classification data – EDA, Data augmentation, Data preprocessing.

**Computer Vision Level 2 work:** Optimizers and Loss functions, Training and Hyper-parameters, Evaluation and Inferencing, Process Monitoring.

**Computer Vision Level 3 work:** Blocks and CNNs, Transfer learning, Multi label image classification.

### Module 5:

**Approach using different libraries:** TensorFlow (+keras), Mxnet, Chainer, Paddle. Computer Vision Level 4 work: Post training optimization, Computer Vision Level 5 work: Peripheral tech integration, Processes, microservices and APIs, Model deployment and hosting.

**Learning mechanisms – 3:** Semi-supervised learning, Unsupervised learning.

#### Reference Books & Materials:

- [Learn AI with Python](#)
- [Starting with Pytorch](#)
- [OpenCV – Tutorial](#)
- [AI Tutorials](#)
- [Natural Language Processing with Python by Steven Bird, Ewan Klein, Edward Loper](#)