



## **Yenepoya (Deemed to be University)**

Recognized under Sec 3(A) of the UGC Act 1956 Accredited by NAAC with 'A+' Grade

# **CURRICULUM GOVERNING BCA (Hons) / (Hons with Research) PROGRAMME**

## **Bachelor of Computer Applications (BCA)**

### **Specialization in**

1. Cloud Computing, Cybersecurity and Ethical Hacking
2. Cybersecurity, Ethical Hacking and Digital Forensics
3. AIML, Robotics and IoT
4. Cybersecurity, Digital Forensics and Data Science
5. Game Development and AR/VR
6. Artificial Intelligence, Cloud Computing and DevOps
7. Data Science and Big Data Analytics
8. Artificial Intelligence, Machine Learning and Robotics
9. Data Science and Artificial Intelligence
10. Business Intelligence, Data Science and Big Data Analytics

Offered by

**Department of Computer Science**

**The Yenepoya Institute of Arts, Science, Commerce and Management**

Under the

**FACULTY OF SCIENCE**

**Yenepoya (Deemed to be University)**

**2023-24**

## Programme Outcomes (POs)

PO1:	<b>Communication:</b> Communicate effectively on complex technological activities with the team. <b>(K, S, A)</b>
PO2:	<b>Technical Knowledge:</b> Apply the knowledge of mathematics, science and computer science to the solution of complex, societal and technical problems. <b>(K,S)</b>
PO3:	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. <b>(K, S, A)</b>
PO4:	<b>Problem analysis:</b> Identify, formulate and analyse computational and business problems. <b>(K, S)</b>
PO5:	<b>Development of solutions:</b> Develop solutions for complex problems and processes that meet the specified needs. <b>(K, S, A)</b>
PO6:	<b>Modern tool usage:</b> Identify and apply appropriate techniques, resources, and modern IT tools to computing activities with an understanding of the limitations. <b>(K, S)</b>
PO7:	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices. <b>(A)</b>
PO8:	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. <b>(A)</b>

## 1. Programme Specific Outcomes (PSOs):

BCA (Hons) programs aim to develop students' abilities in Designing and developing software solutions, applying computational concepts, utilizing information Technology Tools, adapting emerging technologies and Demonstrating ethical and professional practices.

### **Cybersecurity and Ethical Hacking**

1. Recognise various aspects of cybersecurity in the context of organisations as well as people.
2. Apply various Ethical Hacking Techniques to better understand threats and vulnerabilities.
3. Perform Vulnerability Assessments and Penetration Testing to develop security strategies.
4. Demonstrate various strategies related to Offensive and Defensive Security.

### **Cloud Computing and DevOps**

5. Define elements of Cloud Architecture for better understanding of implementation of Cloud.
6. Apply principles of cloud computing to implement scalable and fault-tolerant solutions on the Cloud.
7. Demonstrate knowledge of security and compliance in the cloud, and DevOps and Continuous Deployment.
8. Apply principles of Big Data Analytics in the Cloud to solve real world problems.

### **Game Development and AR/VR**

9. Define various aspects of development of games and applications in AR and VR pertaining to use cases in the industry.
10. Demonstrate 3D Modelling and Animation skills for development of games and applications in AR and VR.
11. Implement game features, mechanics, and systems using best coding practices.
12. Apply concepts of Game Testing and Debugging to develop various games.

### **Robotics, AIML and Internet of Things**

13. Differentiate different types of sensors for application in Internet of Things.
14. Explain Robot Kinematics and Dynamics in the context of developing robotics applications.
15. Develop solutions using machine learning concepts and deep learning techniques.
16. Apply concepts of Robotics and Internet of Things to develop prototype IoT devices using microcontrollers for real-world IoT applications.

### **Data Science and Data Analytics**

17. Apply advanced statistical and ML techniques to analyse large datasets to solve complex problems.
18. Demonstrate competence in processing and analysing large-scale datasets and use techniques of data visualization to present the analysis.
19. Apply data mining techniques on small and large datasets to solve complex problems.
20. Create informative and visually appealing data visualizations to effectively communicate insights to stakeholders.

### **Artificial Intelligence and Machine Learning**

21. Analyse the knowledge of human cognition, Artificial Intelligence, Machine Learning and data engineering in terms of real world problems to meet the challenges of the future.
22. Develop computational knowledge and project development skills using innovative tools

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23. Design techniques to solve problems in the areas related to Deep Learning, Machine learning, Artificial Intelligence.
  24. Apply the acquired knowledge to identify and solve real-world research problems.

## Course Structure

### Semester 1 / Year 1

Semester 1										
SL No	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA101T	CC	Problem Solving and Programming in C (Theory)	2	0	0	50	50	100	2
2	BCA101P	CC	Problem Solving and Programming in C (Practical)	0	4	0	50	50	100	2
3	BCA102T	CC	Computer System Architecture (Theory)	3	0	0	50	50	100	3
4	BCA102P	CC	Computer System Architecture (Practical)	0	2	0	50	50	100	1
5	BCA103	CC	Basic Mathematics and Statistics	3	0	0	50	50	100	3
6	BCA104	ME	ME Group 1	3	0	0	25	25	50	3
7	BCA105	VAC	VAC Group 1	2	0	0	50	50	100	2
8	BCA106	AEC	Language Group 1	4	0	0	50	50	100	4
										<b>20</b>

### Semester 2 / Year 1

Semester 2										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA201T	CC	Object Oriented Programming with Java (Theory)	3	0	0	50	50	100	3
2	BCA201P	CC	Object Oriented Programming with Java (Practical)	0	2	0	50	50	100	1
3	BCA202T	CC	Database Designing (Theory)	3	0	0	50	50	100	3
4	BCA202P	CC	Database Designing (Practical)	0	2	0	50	50	100	1
5	BCA203T	CC	Operating System with Linux (Theory)	3	0	0	50	50	100	3
6	BCA203P	CC	Operating System with Linux (Practical)	0	2	0	50	50	100	1
7	BCA204	CC	Networking and Communication	2	0	3	50	50	100	3
8	BCA205	ME	ME Group 2	3	0	0	25	25	50	3
9	BCA206	VAC	VAC Group 2	2	0	0	50	50	100	2
10	BCA207	AEC	Language Group 2	4	0	0	50	50	100	4
										<b>24</b>

#### Exit:

1. UG Certificate in Computer Application

## Semester 3 / Year 2

Semester 3										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA301T	CC	Data Structures and Algorithms (Theory)	3	0	0	50	50	100	3
2	BCA301P	CC	Data Structures and Algorithms (Practical)	0	2	0	50	50	100	1
3	BCA302T	CC	Python Programming (Theory)	2	0	0	50	50	100	2
4	BCA302P	CC	Python Programming (Practical)	0	4	0	50	50	100	2
5	BCA303	CC	Fundamentals of Cybersecurity and Cryptography	2	0	3	50	50	100	3
6	BCA304	CC	Introduction to Artificial Intelligence	2	0	3	50	50	100	3
7	BCA305	ME	ME Group 3	3	0	0	25	25	50	3
8	BCA306	VAC	VAC Group 3	2	0	0	100	-	100	2
9	BCA307	SEC	SEC Group 1	3	0	0	100	-	100	3
										<b>22</b>

## Semester 4 / Year 2

Semester 4										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA401T	CC	Introduction to Machine Learning (Theory)	3	0	0	50	50	100	3
2	BCA401P	CC	Introduction to Machine Learning (Practical)	0	2	0	50	50	100	1
3	BCA402T	CC	Introduction to Internet of Things (Theory)	3	0	0	50	50	100	3
4	BCA402P	CC	Introduction to Internet of Things (Practical)	0	2	0	50	50	100	1
5	BCA403	CC	Foundation in Cloud Technology	3	0	3	50	50	100	4
6	BCA404	CC	Statistics for Machine Learning	2	0	3	50	50	100	3
7	BCA405	DSE	DSE Group 1	3	0	3	50	50	100	4
8	BCA406	SEC	SEC Group 2	3	0	0	100	-	100	3
										<b>22</b>

### Semester 4

#### Discipline Specific Elective (DSE) Group 1

Course Code	Specialization	Course Name
BCA405A	Cloud Computing, Cybersecurity and Ethical Hacking	Network Information Security
	Cybersecurity, Ethical Hacking and Digital Forensics	
	Cybersecurity, Digital Forensics and Data Science	
BCA405B	AIML, Robotics and IoT	Introduction to Robotics
	Artificial Intelligence, Machine Learning and Robotics	
BCA405C	Game Development and AR/VR	Introduction to Gaming
BCA405D	Artificial Intelligence, Cloud Computing and DevOps	Cloud Services and Models
BCA405E	Data Science and Big Data Analytics	Data Analytics using Cassandra
	Data Science and Artificial Intelligence	
	Business Intelligence, Data Science and Big Data Analytics	

#### Exit:

1. UG Diploma in Computer Application
2. Professional Certification in Cloud Computing, Cybersecurity and Ethical Hacking / Cybersecurity, Ethical Hacking and Digital Forensics / AIML, Robotics and IoT / Cybersecurity, Digital Forensics and Data Science / Game Development and AR/VR / Artificial Intelligence, Cloud Computing and DevOps / Data Science and Big Data Analytics

### Semester 5 / Year 3

#### Semester 5

SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA501T	CC	Progressive Web Apps [Theory]	2	0	0	50	50	100	2
2	BCA501P	CC	Progressive Web Apps [Practical]	0	4	0	50	50	100	2
3	BCA502T	CC	Software Engineering [Theory]	3	0	3	50	50	100	4
4	BCA503XT	DSC	DSC Group 2 [Theory]	2	0	0	50	50	100	2
5	BCA503XP	DSC	DSC Group 2 [Practical]	0	4	0	50	50	100	2
6	BCA504XT	DSC	DSC Group 3 [Theory]	4	0	0	50	50	100	4
7	BCA505XT	DSE	DSE Group 4	3	0	0	50	50	100	3
8	NSEC3	SEC	SEC Group 3	3	0	0	100	-	100	3
			<b>Total Hours / Credits</b>	<b>17</b>	<b>8</b>	<b>3</b>			<b>800</b>	<b>22</b>

Semester 5		
Discipline Specific Elective (DSE) Group 2		
Course Code	Specialization	Course Name
BCA505A	Cloud Computing, Cybersecurity and Ethical Hacking	Application and Web Security
	Cybersecurity, Ethical Hacking and Digital Forensics	
	Cybersecurity, Digital Forensics and Data Science	
BCA505B	Artificial Intelligence, Machine Learning and Robotics	Deep Learning
	Artificial Intelligence, Cloud Computing and DevOps	
	Data Science and Big Data Analytics	
	Business Intelligence, Data Science and Big Data Analytics	
	Data Science and Artificial Intelligence	
	AIML, Robotics and IoT	
BCA505C	Game Development and AR/VR	Game Development using Unity

Semester 5		
Discipline Specific Elective (DSE) Group 3		
Course Code	Specialization	Course Name
BCA504A	Cybersecurity, Ethical Hacking and Digital Forensics	Operating System Security
	Cybersecurity, Digital Forensics and Data Science	
BCA504B	Cloud Computing, Cybersecurity and Ethical Hacking	Principles of Virtualization
	Artificial Intelligence, Cloud Computing and DevOps	
BCA504C	AIML, Robotics and IoT	IoT Architecture
	Artificial Intelligence, Machine Learning and Robotics	
BCA504D	Data Science and Big Data Analytics	R Programming
	Data Science and Artificial Intelligence	
	Business Intelligence, Data Science and Big Data Analytics	
BCA504E	Game Development and AR/VR	2D and 3D Graphic Design



Semester 5		
Discipline Specific Elective (DSE) Group 4		
Course Code	Specialization	Course Name
BCA505A	AIML, Robotics and IoT	Automation Devices
BCA505B	Cybersecurity, Ethical Hacking and Digital Forensics	Threat Hunting
	Cloud Computing, Cybersecurity and Ethical Hacking	
BCA505C	Artificial Intelligence, Machine Learning and Robotics	Natural Language Processing
	Artificial Intelligence, Cloud Computing and DevOps	
	Data Science and Artificial Intelligence	
BCA505D	Cybersecurity, Digital Forensics and Data Science	Predictive Analytics
	Data Science and Big Data Analytics	
	Business Intelligence, Data Science and Big Data Analytics	
BCA505E	Game Development and AR/VR	UI and UX Design

## Semester 6 / Year 3

Semester 6										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA601T	CC	Mobile Application Development [Theory]	3	0	3	50	50	100	4
2	BCA602XT	DSE	DSE Group 5	3	0	3	50	50	100	4
3	BCA603XT	DSE	DSE Group 6	3	0	3	50	50	100	4
4	BCA604P	Internship	Internship / Capstone Project	0	0	24	200	200	400	8
Total Hours / Credits				9	0	30			700	20

Semester 6		
Discipline Specific Elective (DSE) Group 5		
Course Code	Specialization	Course Name
BCA602A	Cybersecurity, Ethical Hacking and Digital Forensics	Mobile Device Forensics
	Cloud Computing, Cybersecurity and Ethical Hacking	
	Cybersecurity, Digital Forensics and Data Science	
BCA602B	Artificial Intelligence, Cloud Computing and DevOps	Blockchain Technologies
BCA602C	Business Intelligence, Data Science and Big Data Analytics	Healthcare Data Analytics
	Data Science and Artificial Intelligence	
	Data Science and Big Data Analytics	
BCA602D	Artificial Intelligence, Machine Learning and Robotics	IoT System Design
	AIML, Robotics and IoT	
BCA602E	Game Development and AR/VR	2D and 3D Game Design

Semester 6		
Discipline Specific Elective (DSE) Group 6		
Course Code	Specialization	Course Name
BCA603A	Cybersecurity, Ethical Hacking and Digital Forensics	Cloud Security
	Cloud Computing, Cybersecurity and Ethical Hacking	
BCA603B	AIML, Robotics and IoT	Semantic Web & Social Networks
	Artificial Intelligence, Machine Learning and Robotics	
	Artificial Intelligence, Cloud Computing and DevOps	
BCA603C	Data Science and Artificial Intelligence	Social Network Analysis
	Cybersecurity, Digital Forensics and Data Science	
	Business Intelligence, Data Science and Big Data Analytics	
	Data Science and Big Data Analytics	
BCA603D	Game Development and AR/VR	Augmented and Virtual Reality Development

## BCA HONOURS (Coursework)

### Semester 7 / Year 4

Semester 7										
Mode A: Coursework										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA701	DSE	SWAYAM	4	0	0	50	50	100	4
2	BCA702	TDE	SWAYAM	4	0	0	50	50	100	4
3	BCA703	DSE	Discipline Specific Elective 1	4	0	0	50	50	100	4
4	BCA704	DSE	Discipline Specific Elective 2	4	0	0	50	50	100	4
5	NME4	ME	Discrete Mathematical Structures	3	2	0	50	50	100	4
<b>Total</b>									<b>500</b>	<b>20</b>

**\*T- Theory, P- Practical, E- Experiential Learning**

### Semester 8 / Year 4

Semester 8										
Mode A: Coursework										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA801	DSE	Discipline Specific Elective 3	2	0	6	50	50	100	4
2	BCA802	DSE	Discipline Specific Elective 4	2	0	6	50	50	100	4
3	BCA803	DSE	Discipline Specific Elective 5	4	0	0	50	50	100	4
4	BCA804	SEC	Minor Research Project	0	0	24	100	100	200	8
<b>Total</b>									<b>500</b>	<b>20</b>

**\*T- Theory, P- Practical, E- Experiential Learning**

## BCA HONOURS (Coursework + Research)

### Semester 7 / Year 4

Semester 7										
Mode B : Coursework + Research										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA701	DSE	SWAYAM	4	0	0	50	50	100	4
2	BCA702	TDE	SWAYAM	4	0	0	50	50	100	4
3	BCA703	DSE	Discipline Specific Elective 1	4	0	0	50	50	100	4
4	BCA704	DSE	Discipline Specific Elective 2	4	0	0	50	50	100	4
5	NME4	ME	Discrete Mathematical Structures	3	2	0	50	50	100	4
<b>Total</b>									<b>500</b>	<b>20</b>

\*T- Theory, P- Practical, E- Experiential Learning

### Semester 8 / Year 4

Semester 8										
Mode B: Coursework+ Research										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA801	DSE	Discipline Specific Elective 3	2	0	6	50	50	100	4
2	BCA802	DSE	Discipline Specific Elective 4	2	0	6	50	50	100	4
3	BCA803	SEC	Research	0	0	36	100	100	200	12
<b>Total</b>									<b>400</b>	<b>20</b>

\*T- Theory, P- Practical, E- Experiential Learning

## BCA HONOURS (Coursework + Internship)

### Semester 7 / Year 4

Semester 7										
Mode C : Coursework + Internship										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA701	DSE	SWAYAM	4	0	0	50	50	100	4
2	BCA702	TDE	SWAYAM	4	0	0	50	50	100	4
3	BCA703	DSE	Discipline Specific Elective 1	4	0	0	50	50	100	4
4	BCA704	DSE	Discipline Specific Elective 2	4	0	0	50	50	100	4
5	NME4	ME	Discrete Mathematical Structures	3	2	0	50	50	100	4
<b>Total</b>									<b>500</b>	<b>20</b>

\*T- Theory, P- Practical, E- Experiential Learning

### Semester 8 / Year 4

Semester 8										
Mode B: Coursework+ Internship										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA801	DSE	Discipline Specific Elective 3	2	0	6	50	50	100	4
2	BCA802	DSE	Discipline Specific Elective 4	2	0	6	50	50	100	4
3	BCA803	SEC	Internship	0	0	36	100	100	200	12
<b>Total</b>									<b>400</b>	<b>20</b>

\*T- Theory, P- Practical, E- Experiential Learning

## BCA HONOURS (Research)

### Semester 7 / Year 4

Semester 7										
Mode D: Research										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	BCA701	DSE	SWAYAM	4	0	0	50	50	100	4
2	BCA702	TDE	SWAYAM	4	0	0	50	50	100	4
3	BCA703	DSC	Advanced Data Analysis Tools	3	2	0	50	50	100	4
4	BCA704	DSC	Advanced Research Methodology	3	2	0	50	50	100	4
5	NME4	ME	Discrete Mathematical Structures	3	2	0	50	50	100	4
<b>Total</b>									<b>500</b>	<b>20</b>

\*T- Theory, P- Practical, E- Experiential Learning

### Semester 8 / Year 4

Semester 8										
Mode D: Research										
SL. No.	Course Code	Course Type	Course Title	Hours per Week			CIA	SEE	Total	Credits
				T	P	E				
1	25BCA801	SEC	Research Project	0	0	60	200	200	400	20
<b>Total</b>									<b>400</b>	<b>20</b>

\*T- Theory, P- Practical, E- Experiential Learning

<b>Discipline 1: Cybersecurity OR Ethical Hacking OR Digital Forensics</b>		
<b>Course Code</b>	<b>Type</b>	<b>DSE Course</b>
DSEA1	DSE	Cryptography and Network Security
DSEA2	DSE	Application and Web Security
DSEA3	DSE	Operating System Security
DSEA4	DSE	File System Forensics
DSEA5	DSE	Threat Hunting
DSEA6	DSE	Mobile Device Forensics

<b>Discipline 2: Artificial Intelligence OR Machine Learning OR Data Science</b>		
<b>Course Code</b>	<b>Type</b>	<b>DSE Course</b>
DSEB1	DSE	Natural Language Processing
DSEB2	DSE	Pattern Recognition
DSEB3	DSE	Computer Vision
DSEB4	DSE	Deep Learning
DSEB5	DSE	Healthcare Data Analytics
DSEB6	DSE	Semantic Web & Social Networks

<b>Discipline 3: Cloud Computing OR IoT OR DevOps</b>		
<b>Course Code</b>	<b>Type</b>	<b>DSE Course</b>
DSEC1	DSE	Principles of Virtualization
DSEC2	DSE	DevOps
DSEC3	DSE	Cloud Security
DSEC4	DSE	Advances in IoT
DSEC5	DSE	Managing Big Data
DSEC6	DSE	Blockchain Technologies

<b>Discipline 4: Data Science OR Big Data Analytics</b>		
<b>Course Code</b>	<b>Type</b>	<b>DSE Course</b>
DSED1	DSE	Healthcare Data Analytics
DSED2	DSE	Semantic Web & Social Networks
DSED3	DSE	Social Network Analysis
DSED4	DSE	Predictive Analytics
DSED5	DSE	Advances in IoT
DSED6	DSE	Managing Big Data



<b>Discipline 5: Cyber Security OR Data Science OR IoT OR Artificial Intelligence</b>		
<b>Course Code</b>	<b>Type</b>	<b>DSE Course</b>
DSEE1	DSE	Principals of Cyber Security
DSEE2	DSE	Fundamental of Computer Networking
DSEE3	DSE	Generative Deep Learning
DSEE4	DSE	Human Computer Interaction
DSEE5	DSE	Data Science for Internet of Things
DSEE6	DSE	AI for Cybersecurity
DSEE7	DSE	Sentiment Analysis
DSEE8	DSE	Cognitive Computing
DSEE9	DSE	IoT for Smart Cities
DSEE10	DSE	Deep Reinforcement Learning
DSEE11	DSE	Micro services and Devops
DSEE12	DSE	Social Network Analysis
DSEE13	DSE	Data Visualization Techniques
DSEE14	DSE	Cyber Crime and Computer Ethics
DSEE15	DSE	Secure Cloud Computing
DSEE16	DSE	Interfacing with Virtualization
DSEE17	DSE	Industry IoT 4.0

- Groups of Discipline Specific Electives are given based on the learning domains/ specialization/ disciplines
- Student shall choose the electives from the same discipline across the third and fourth semesters
- All the DSE courses are at the same learning levels i.e. NCRF Level 6.5.
- Discipline/ Groups are indicative. Discipline Specific Groups with additional industrial relevant courses may be added time to time. More industry relevant courses may be added to the discipline time to time.

## SYLLABUS



## Semester 5 / Year 3

<b>Semester: 5</b>	<b>BCA501T</b>	<b>Progressive Web Apps</b>
<b>2 Credits</b>	<b>TPE:2:2:0</b>	<b>Core Course - CC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA501T.1	Define the concepts of web application
BCA501T.2	Design the attractive front-end pages using HTML and CSS
BCA501T.3	Develop a front and back-end connection using PHP and JavaScript

### **Progressive Web Apps**

#### **Course Content:**

#### **Unit 1: Introduction to HTML**

**(12 Hours)**

Overview of Web and Cloud Development, Introduction to Front and Back-end Development, Application Development Tools, Tools and Technologies. Introduction to HTML, setting development environment, Features of HTML, Evolution of HTML, HTML structure, HTML Scripting, HTML elements and attributes, Text formatting with HTML, List and tables, HTML Comments, Forms and user input elements, Hyperlinks, Multimedia elements

#### **Unit 2: CSS**

**(12 Hours)**

CSS Box Model: Margin, Border, Padding, Syntax – Selectors, Properties & values, Styling and values, Positioning (relative, absolute, fixed, static), Display Methods, Styling, Selectors, Background Images and Opacity, Positioning, Pseudo Classes and Elements, Styling Images with Pseudo-classes, Transitions, Transforms, Navigation, CSS Framework

#### **Unit 3: Bootstrap**

**(12 Hours)**

Use of Bootstrap Framework and Implementation, Bootstrap grid system (Grid layout, Responsive design), Navigation Bars, Forms and buttons, Navbar Creation, Cards, Creating Carousels, Animate.css integration, Bootstrap components, Best practice for using Bootstrap effectively, Web Templates

#### **Unit 4: Frontend Frameworks**

**(12 Hours)**

React : Virtual DOM and JSX, State management (e.g., Redux, Context API), Routing and navigation, Angular :Components and templates,Dependency Injection (DI),RxJS and reactive

programming, Vue.js, Vue instance and lifecycle hooks, Vue components and props, State management with Vuex

### **Unit 5: Backend Frameworks**

**(12 Hours)**

Node.js with Express: Middleware concept, Routing and handling requests, Template engines (e.g., EJS, Handlebars), Django (Python) : MVC architecture in Django, ORM and database integration, Django templates and forms, Ruby on Rails : Convention over configuration, ActiveRecord and database interactions, Views and layouts in Rails

#### **Suggested Readings:**

- Full Stack Web Development for Beginners: Learn E commerce Web Development Using HTML5, CSS3 and Bootstrap, Riaz Ahmed
- HTML and CSS: The Complete Reference, Thomas A. Powell and Michael Morrison

<b>Semester: 5</b>	<b>BCA502T</b>	<b>Software Engineering</b>
<b>4 Credits</b>	<b>TPE:3:0:3</b>	<b>Core Course - CC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA502T.1	Translate end-user requirements into system and software requirements in a Software Requirements Document
BCA502T.2	Identify appropriate software architectures and patterns to carry out high level design of a system.
BCA502T.3	Develop a simple testing report.

## Software Engineering

### Course Content:

#### **Unit 1: Introduction to Software Engineering (10 Hours)**

Introduction: The evolving role of software, changing nature of software, software myths.

A Generic view of process: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models

Process models: The waterfall model, incremental process models, evolutionary process models, the unified process

#### **Unit 2: Software Requirements (15 Hours)**

Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document

Requirements engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management

System models: Context models, behavioral models, data models, object models, structured methods

#### **Unit 3: Design Engineering (15 Hours)**

Introduction: Design process and design quality, design concepts, the design model.

Creating an architectural design: software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams

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#### **Unit 4: Testing Strategies**

**(10 Hours)**

A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging. Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance

#### **Unit 5: Metrics for Process and Products, Risk and Quality Management (10 Hours)**

Metrics for Process and Products: Software measurement, metrics for software quality, Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan, Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.

#### **Suggested Readings:**

- Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, Mc Graw Hill International Edition.
- Software Engineering- Sommerville, 7th edition, Pearson Education.
- The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.

<b>Semester: 5</b>	<b>BCA503AT</b>	<b>Application and Web Security</b>
<b>2 Credits</b>	<b>TPE:2:4:0</b>	<b>Discipline Specific Core - DSC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to:

CO#	Course Outcomes
BCA503AT.1	Identify common web application vulnerabilities and security concerns, including the evolution of web applications, common functions, and benefits.
BCA503AT.2	Describe key web application technologies and protocols, including HTTP methods, headers, authentication mechanisms, and encoding schemes, and their implications for security.
BCA503AT.3	Analyse web application security by mapping the application, identifying attack surfaces, and understanding common vulnerabilities related to authentication, access controls, and data stores.
BCA503AT.4	Evaluate and select appropriate web application security assessment tools and techniques, and interpret the results of security assessments.

### **Application and Web Security**

#### **Course Content:**

#### **Unit 1: Web Application (In) security (5 Hours)**

The Evolution of Web Applications, Common Web Application Functions, Benefits of Web Applications, and Web Application Security.

#### **Unit 2: Web Application Technologies (6 Hours)**

The HTTP Protocol, HTTP Requests, HTTP Responses, HTTP Methods, URLs, REST, HTTP Headers, Cookies, Status Codes, HTTPS, HTTP Proxies, HTTP Authentication, Web Functionality, Server-Side Functionality, Client-Side Functionality, State and Sessions, Encoding Schemes, URL Encoding, Unicode Encoding, HTML Encoding, Base64 Encoding, Hex Encoding, Remoting and Serialization Frameworks.

#### **Unit 3: Mapping the Application (7 Hours)**

Enumerating Content and Functionality, Web Spidering, User - Directed Spidering, Discovering Hidden Content, Application Pages Versus Functional Paths, Discovering Hidden Parameters, Analyzing the Application, Identifying Entry Points for User Input, Identifying Server-Side Technologies, Identifying Server-Side Functionality, Mapping the Attack Surface.

#### **Unit 4: Attacking Authentication (6 Hours)**

Authentication Technologies, Design Flaws in Authentication Mechanisms, Bad Passwords, Brute-Forcible Login, Verbose Failure Messages, Vulnerable Transmission of Credentials, Password Change, Functionality, Forgotten Password Functionality, "Remember Me" Functionality, User



Impersonation, Functionality Incomplete, Validation of Credentials, Non-unique Usernames, Predictable Usernames, Predictable Initial Passwords, Insecure Distribution of Credentials.

Attacking Access Controls: Common Vulnerabilities, Completely Unprotected, Functionality Identifier-Based Functions, Multistage Functions, Static Files, Platform Misconfiguration, And Insecure Access Control Methods.

### **Unit 5: Attacking Data Stores**

**(6 Hours)**

Injecting into Interpreted Contexts, By-passing a Login, Injecting into SQL, Exploiting a Basic Vulnerability Injecting into Different Statement Types, Finding SQL Injection Bugs, Fingerprinting the Database, The UNION Operator, Extracting Useful Data, Extracting Data with UNION, Bypassing Filters, Second-Order SQL Injection, Advanced Exploitation Beyond SQL Injection: Escalating the Database Attack, Using SQL Exploitation Tools, SQL Syntax and Error Reference, Preventing SQL Injection.

#### **Suggested Reading:**

- The Web Application Hacker's Handbook: Finding And Exploiting Security Defects Stuttard, Marcus Pinto Wiley Publishing, Second Edition.
- Professional Pen Testing for Web application, Andres Andreu, Wrox Press
- Carlos Serrao, Vicente Aguilera, Fabio Cerullo, Web Application Security Springer; 1st Edition
- Web Application Security, A Beginner's Guide By Bryan Sullivan, Vincent Liu , Tata McGraw Hill Publications

<b>Semester: 5</b>	<b>BCA503BT</b>	<b>Deep Learning</b>
<b>Credits: 2</b>	<b>TPE:2:2:0</b>	<b>Discipline Specific Core - DSC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA501AT.1	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
BCA501AT.2	Implement deep learning algorithms and solve real-world problems
BCA501AT.3	Execute performance metrics of Deep Learning Techniques.

## Deep Learning

### Course Content:

#### Unit 1: Machine Learning Basics (12 Hours)

Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

#### Unit 2: Deep Feedforward Networks (12 Hours)

Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back Propagation. Regularization: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.

#### Unit 3: Optimization for Training Deep Models (12 Hours)

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

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**Unit 4: Sequence Modeling****(12 Hours)**

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory

**Unit 5: Practical Methodology****( 12 Hours)**

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. Applications: Vision, NLP, Speech.

**Suggested Readings:**

- Deep Learning, Ian Good fellow and Yoshua Bengio MIT Press, <https://www.deeplearningbook.org/>, 2016.
- Neural Networks: A systematic Introduction, Raúl Rojas 1996.
- Pattern Recognition and Machine Learning, Christopher Bishop 2007

<b>Semester: 5</b>	<b>BCA503CT</b>	<b>Game Development using Unity</b>
<b>Credits: 2</b>	<b>TPE:2:2:0</b>	<b>Discipline Specific Core - DSC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA501CT.1	Explain the fundamental principles of game design, including mechanics, dynamics, and aesthetics.
BCA501CT.2	Discuss various game genres and their characteristics.
BCA501CT.3	Demonstrate proficiency in navigating the Unity Editor and understanding its interface.
BCA501CT.3	Utilize Unity's components, GameObjects, and assets effectively in game development

### Game Development using Unity

#### Course Content:

#### Unit 1: Introduction to Unity Game Engine

**15 Hours**

Intro to Tools & navigation, Terrain system in Unity, Camera control, in Unity, Scene Navigation, Project setting / Player setting, Game, publishing using Unity

#### Unit 2: Introduction to C# programming in Unity

**15 Hours**

Constants and variables, Integers, Floats and Strings, Arrays and Lists, Arithmetical operators, Using if statements, Writing while, statements, Writing for statements, & all Other Basic C# Concept in, Unity

#### Unit 3: Unity Game Engine for Developing 2D Games

**15 Hours**

Intro to 2D Game system in unity, Sprite Editor in Unity, Sprite. Animation in Unity, 2D Physics in Unity, 2D Components, UI system in Unity, 2D Game Project

#### Unit 4: Introduction to Character Modeling

**15 Hours**

Rigging and Animation in Unity, Implementing Character Controllers, Creating Non-Player Characters (NPCs), Character Physics and Interactions

#### Suggested Reading:

- Goldstone W. Unity game development essentials. Packt Publishing Ltd; 2009 Oct 1.
- Blackman S. Beginning 3D Game Development with Unity 4: All-in-one, multi-platform game development. Apress; 2013 Sep 20.
- Hocking J. Unity in action: multiplatform game development in C. Simon and Schuster; 2022 Feb 8.

<b>Semester: 5</b>	<b>BCA504AT</b>	<b>Operating System Security</b>
<b>4 Credits</b>	<b>TPE:4:0:0</b>	<b>Discipline Specific Core - DSC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA504AT.1	Define key terms related to operating systems
BCA504AT.2	Develop ability to protect operating systems.
BCA504AT.3	Outline the security of operating systems from malicious software.
BCA504AT.4	Interpret OS issues related to the Internet, intranets, pervasive computing, embedded systems, mobile systems and wireless networks.
BCA504AT.5	Design a secure operating system

### Operating System Security

#### Course Content:

#### Unit 1: Fundamentals of OS

**(15 Hours)**

Fundamentals- OS Processes, Synchronization, Memory Management, File Systems, Trusted Operating Systems, Assurance in Trusted Operating Systems, Virtualization Techniques.

#### Unit 2: Secure OS and Access Control Fundamentals

**(15 Hours)**

Secure operating systems: Security goals, Trust model, Threat model. Access Control Fundamentals – Protection system – Lampson's Access Matrix, Mandatory protection systems, Reference monitor.

#### Unit 3: Multics System

**(15 Hours)**

Multics – Multics system, Multics security, Multics vulnerability analysis, Security in Ordinary OS – Unix, Windows, Verifiable security goals – Information flow, Denning's Lattice model, Bell-Lapadula model, Biba integrity model, Covert channels.

#### Unit 4: Security Kernels

**(15 Hours)**

Security Kernels – Secure Communications processor, Securing Commercial OS. Secure Capability Systems – Fundamentals, Security, Challenges. Secure Virtual Machine Systems, Case study - Linux kernel, Android, DVL, Solaris Trusted Extensions.

#### Suggested Readings:

- Andrew S. Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall, 2007.
- Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts with Java, Eighth Edition, Wiley, 2008.

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- Trent Jaeger, Operating System Security, Synthesis Lectures on Information Security, Privacy and Trust, Morgan and Claypool, 2008.
  - C. P. Pfleeger and S. L. Pfleeger, Security in Computing, Prentice Hall Professional, 2003.
  - W. Mauerer, Professional Linux Kernel Architecture, Wiley, 2008.
  - D. P. Bovet and M. Cesati, Understanding the Linux Kernel, Third Edition, O'Reilly Media, Inc., 2005.

<b>Semester: 5</b>	<b>24 BCA504BT</b>	<b>Principles of Virtualization</b>
<b>4 Credits</b>	<b>TPE:4:0:0</b>	<b>Discipline Specific Core - DSC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA504BT.1	Installing and configuring the SDDC using VMware products.
BCA504BT.2	Implementing Fault tolerance and High availability for the Virtual machines
BCA504BT.3	Securing the Virtual environment.
BCA504BT.4	Evaluate Resource Optimization and monitoring.

### Principles of Virtualization

#### Course Content:

#### Unit 1: Introduction

**(12 Hours)**

Introduction to Virtualization, Types of virtualization, Difference between cloud and virtualization, Physical infrastructure and virtual infrastructure, Virtualization approaches, Partitioning, Hosting, Isolation, Hardware independence, Virtual machine, Hypervisor, Types of hypervisor, Virtual machine manager, Types of hypervisor, Introduction to datacenter virtualization Esxi, Difference between Esxi and Esx, Versions of Esxi, Installation and configuration of Esxi 6.0, vSphere 6.0.

#### Unit 2: Components of vSphere 6.0

**(15 Hours)**

Components of VMware vSphere, vSphere 6.0: Overview and Architecture, Topology of vSphere 6.0 Data Center, vSphere 6.0 Configuration Maximumsv Center Server, vCenter Server Features, Certificate Management, Alarms and Alerts, Monitoring Features, Template Management, Linked Mode Deployment, Storage Features in vSphere, Shared Storage, Storage Protocols, Datastores, Virtual SAN, Virtual Volumes, Networking Features in vSphere, Virtual Networking, Virtual Switches and its types.

#### Unit 3: Features of vSphere and NSX

**(12 Hours)**

vSphere Resource Management Features, vMotion, Distributed Resource Scheduler (DRS), Distributed Power Management (DPM), Storage vMotion, Storage DRS, Storage I/O Control, Network I/O Control, vSphere Availability Features, vSphere Data Protection, High Availability, Fault Tolerance, vSphere Replication, Introduction to NSX.

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#### **Unit 4: VSphere Solutions to Data Center Challenges and vSphere Security (10 Hours)**

Challenges, Availability Challenges, Scalability Challenges, Management Challenges, Optimization Challenges, Application Upgrade Challenges, Cloud Challenges, Security, Describe the features and benefits of VMware Platform Services Controller, Configure ESXi host access and authorization, Secure ESXi, vCenter Server, and virtual machines, Upgrade ESXi and vCenter Server instances

#### **Unit 5: Resource optimization and resource management (11 Hours)**

Network Optimization, Configure and manage vSphere distributed switches, Migrate virtual machines from standard switches to distributed switches, Explain distributed switch features such as port mirroring, LACP, QoS tagging, and NetFlow, CPU Optimization – Explain the CPU scheduler operation, NUMA support, and other features that affect CPU performance, Monitor key CPU performance metrics, Memory Optimization, Explain ballooning, memory compression, and host swapping techniques for memory reclamation when memory is overcommitted, Monitor key memory performance metrics, Storage Optimization, Diagnose storage access problems, Configure VMware vSphere Flash Read Cache, Monitor key storage performance metrics.

#### **Suggested Readings:**

- Virtualization Essentials Paperback, 26 Apr 2012, Matthew Portnoy - wiley publications
- VMware Cookbook Paperback, 17 Jul 2012 by Troy - Shroff/O'Reilly; Second edition (17 July 2012).
- Mastering VMware vSphere 5.5 (SYBEX) Paperback – 2014 by Scott Lowe, Nick Marshall, Forbes Guthrie, Matt Liebowitz, Josh Atwell - Wiley (2014) edition



<b>Semester: 5</b>	<b>BCA504CT</b>	<b>IoT Architecture</b>
<b>4 Credits</b>	<b>TPE:4:0:0</b>	<b>Discipline Specific Core - DSC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA504CT.1	Examine the IoT Reference Architecture and Real-World Design Constraints
BCA504CT.2	Outline the various IoT Protocols (Datalink, Network, Transport, Session, Service)
BCA504CT.3	Demonstrate various Transport layer protocols
BCA504CT.4	Apply service layer protocols.
BCA504CT.5	Demonstrate 6LoWPAN and RPL in IoT

### **IoT Architecture**

#### **Unit 1 -Overview**

**9 Hours**

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management.

#### **Unit 2 - Reference Architecture**

**9 Hours**

IoT Architecture – Introduction, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization.

#### **Unit 3: IoT Data Link and Network Layer Protocols**

**9 Hours**

Data Link Layer Protocols: IEEE 802.15.4, IEEE 802.11, BLE, Zigbee, Z-Wave. Network Layer Protocols: IPv6, 6LoWPAN, RPL, 6TiSCH, DHCP, ICMP

#### **Unit 4: IoT Transport, Session, Service Layer Protocols and Security**

**9 Hours**

Transport Layer Protocols: TCP, UDP, MPTCP, TLS, DTLS. Session Layer Protocols: HTTP, CoAP, MQTT. Service Layer Protocols: oneM2M, OMA LwM2M. Security Protocols: MAC 802.15.4, 6LoWPAN Security, Application Layer Security.

#### **Unit 5 : Design and Implementation of IoT Systems with NodeMCU**

**9 Hours**

NodeMCU and Development Setup: Introduction to NodeMCU as a Wi-Fi-enabled microcontroller; Setting up the Arduino IDE and basic programming concepts for NodeMCU. Sensor Interfacing and

Data Acquisition: Concepts of sensor integration, data reading, and handling in embedded IoT systems. Cloud Communication and IoT Platforms: Fundamentals of MQTT protocol, cloud communication, and introduction to IoT platforms like ThingSpeak for real-time data visualization and device-cloud interaction.

**Suggested Reading:**

1. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications, 2016.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2015.

**Reference Books:**

1. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016.

<b>Semester: 5</b>	<b>BCA504DT</b>	<b>R Programming</b>
<b>4 Credits</b>	<b>TPE:4:0:0</b>	<b>Discipline Specific Core - DSC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA504DT.1	Apply fundamental statistical concepts (descriptive statistics, hypothesis testing, regression analysis) using R.
BCA504DT.2	Create informative and visually appealing plots and charts using R's graphics and ggplot2 package.
BCA504DT.3	Perform statistical modeling techniques (linear regression, logistic regression, ANOVA) using built-in functions and packages in R.
BCA504DT.4	Outline the application of these techniques in different domains (e.g., finance, healthcare, marketing).
BCA504DT.5	Outline R as a statistical programming language and its advantages in data analysis.

## R Programming

### Course Content

#### Unit 1 Beginning with R

**(12 Hours)**

Introduction, How To Run R, R Sessions And Functions, Basic Math, Variables, Data Types, Vectors, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.

#### Unit 2: Functions and Structure

**(12 Hours)**

R Programming Structures, Control Statements, Loops, - Looping Over Non-Vector Sets, If-Else, Arithmetic And Boolean Operators, Default Values For Argument, Return Values, Functions With No Pointers In R, Recursion, Sorting And Searching

#### Unit 3: R-Base Graphics

**(12 Hours)**

Graphics, Creating Graphs, The Workhorse Of R Base Graphics, The Plot() Function Customizing Graphs, Saving Graphs To Files.

#### Unit 4: T-Testing

**(12 Hours)**

Probability Distributions, Normal Distribution- Binomial Distribution- Poisson Distributions , Basic Statistics, Correlation And Covariance, T-Tests,-ANOVA.

#### Unit 5: Linear Optimization

**(12 Hours)**

Linear Models, Simple Linear Regression And Multiple Regression, Generalized Linear Models, Nonlinear Models, Splines- Decision- Random Forests.

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### Suggested Reading:

- The Art Of R Programming, Norman Matloff, Cengage Learning: Efficient R Programming: A Practical Guide To Smarter Programming 1st Edition - Colin Gillespie & Robin Lovelace - First Edition. Jared P. Lander,
- R For Everyone: Advanced Analytics And Graphics, Second Edition 2017.
- R Cookbook, Paulteetor, Oreilly: R Cookbook [R CKBK] [Paperback] R Cookbook [RKBK] [Paperback]Mar 31, 2011 By Paul Teetor.
- R In Action,Rob Kabacoff, Manning: R In Action: Data Analysis And Graphics With Rnov 5, 2018 | Unabridged By Robert Kabacoff And Dale Ogden

<b>Semester: 5</b>	<b>BCA504ET</b>	<b>2D and 3D Graphic Design</b>
<b>4 Credits</b>	<b>TPE:4:0:0</b>	<b>Discipline Specific Core - DSC</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA504ET.1	Define and explain the fundamental concepts of 2D and 3D graphics.
BCA504ET.2	Identify various 2D and 3D transformations.
BCA504ET.3	Analyse the impact of different transformations on graphical elements.
BCA504ET.4	Implement linear and affine transformations in 3D graphics.

## 2D and 3D Graphic Design

### Course Content:

#### Unit 1: Introduction to 2D and 3D graphics

**(12 Hours)**

Introduction, display devices- introduction to CRT, flat panel displays and their working, stereoscopic 3D displays. Overview of Cartesian Coordinate system. Geometric Data Types, Vectors, coordinate vectors and Bases. Basic Lighting and Reflection, Simple Reflection Models – Diffuse, Perfect Specular, General Specular. Shading – Flat Shading, Interpolative shading, shading in OpenGL, Texture Mapping, Aliasing. Ray Tracing and Path Tracing

#### Unit 2: 2D Transformations

**(12 Hours)**

Attributes – Line attributes, curve attributes, colour and grayscale levels, area fill attributes, character attributes. Two-Dimensional Transformation – Basic Translate, rotate, scaling, Matrix representations and Homogenous Coordinates Other transformations – Shear, reflection. Composite transformations between coordinate systems.

#### Unit 3: 2D Viewing & Clipping

**(12 Hours)**

Two-Dimensional viewing: The Viewing pipeline, viewing coordinate reference frame. Window-to-Viewport Coordinate Transformation. Transformations in Open GL Clipping operations, point clipping, line clipping- Cohen Sutherland line clipping, polygon Clipping-Sutherland-Hodgeman Polygon clipping

#### Unit 4: 3D Transformations

**(13 Hours)**

Linear Transformations and 3 by 3 Matrices, Rotations, Scales. Affine – points and frames, Affine Transformations and 4 by 4 Matrices, applying Linear transformations to points, translations. Frames

in Graphics – World Object and Eye Frame, Moving things around, Hierarchy. 3D World – Coordinates and Matrices, Drawing a Shape

#### **Unit 4: Pygame**

**(11 Hours)**

Introduction, Pygame libraries, import and initialize modules, window – create, size, resize, change window name, screen background color. Display modes, Colour Object, Event Objects, Keyboard events, Mouse events, Drawing Shapes, Load image, displaying a text in Window, Moving an image - with numeric key pads, mouse. Moving a rectangular objects, Use text as buttons, Transforming images, Set up a game loop, Surface – Create, load an image on surface. Time module, Load cursor. Errors and Exceptions. PyOpenGL – Elements of OpenGL and its functions.

#### **Suggested Readings:**

- Foundations of 3D Computer Graphics Steven J. Gortler, MIT Press, 2012
- Introduction to Computer Graphics Version 1.4, August 2023 David J. Eck Hobart and William Smith Colleges.
- Beginners guide to Graphic Design with freelance designer Gareth David.
- Practical Algorithms for 3d Computer Graphics, R Stuart Ferguson, Second Edition, CRC Press.

<b>Semester: 5</b>	<b>BCA505AT</b>	<b>Automation Devices</b>
<b>3 Credits</b>	<b>TPE:3:0:0</b>	<b>Discipline Specific Core – DSC / Discipline Specific Elective -DSE</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA505AT.1	Knowledge of different types of automation devices and their working principles.
BCA505AT.2	Analyse automation systems for industrial applications
BCA505AT.3	Use programming languages and software tools for automation devices
BCA505AT.4	Integrate different automation devices to build complex systems
BCA505AT.5	Troubleshoot and maintain automation systems in a timely and effective manner

### **Automation Devices**

#### **Course Content:**

#### **Unit 1: Introduction and Sensors**

**(13 Hours)**

Introduction to automation devices, Definition of automation devices, Types of automation devices, Benefits and limitations of automation devices, Applications of automation devices. Sensors-Types of sensors, Sensor characteristics, Sensor selection criteria, Sensor calibration

#### **Unit 2: Actuators and Controllers**

**(10 Hours)**

Types of actuators, Actuator characteristics, Actuator selection criteria, Actuator control. Controllers-Types of controllers, Controller characteristics, Controller selection criteria, Controller programming

#### **Unit 3: Machine Vision and Motion Control**

**(10 Hours)**

Machine vision system components, Machine vision system design, Machine vision system applications, Motion Control - Motion control principles, Motion control systems, Motion control applications

#### **Unit 4: Advanced Programming Techniques**

**(12 Hours)**

Programming languages for automation devices, Software tools for automation devices, Integration of Automation Devices, Integration of automation devices with other systems, Interfacing of automation devices with sensors, actuators, and controllers, Communication protocols for automation devices

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### **Suggested Readings:**

- Industrial Automation and Robotics, A.K. Gupta and S.K. Arora - Publisher: S.K. Kataria & Sons; 2013 edition
- Programmable Logic Controllers, W. Bolton - Publisher: Pearson; 2016 edition
- Automation, Production Systems, and Computer-Integrated Manufacturing by Mikell P. Groover - Publisher: Pearson; 2019 edition



<b>Semester:</b>	<b>BCA505BT</b>	<b>Threat Hunting</b>
<b>3 Credits</b>	<b>TPE:3:0:0</b>	<b>Discipline Specific Core – DSC/ Discipline Specific Elective</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA505BT.1	Identifying and mitigating potential threats within an organization's networks and systems.
BCA505BT.2	Use of specialized tools and technologies for threat detection and analysis, equipping you with hands-on experience
BCA505BT.3	Demonstrate the methods of an attacker, which is crucial for anticipating and responding to evolving threats effectively.
BCA505BT.4	Illustrate the advanced techniques of network security

## Threat Hunting

### Course Content:

#### Unit 1: An Introduction

**(6 Hours)**

Threat Hunting and Its Goals, What Threat Hunting Is, Why Threat Hunting Matters, Who Threat Hunting Is For: The SOCS, The Threat Hunting Process as a Research Process.

#### Unit 2: Prerequisites and Preparations for OS Security Hunting

**(9 Hours)**

Should You Hunt? Data Requirements, When You're Not Ready: Data, Operational Requirements, When You're Not Ready: Operations, Personnel Requirements, When You're Not Ready: Personnel

#### Unit 3: The Process of Hunting

**(10 Hours)**

A Hunting Process, Long-Term Preparation, Triggers, Starting the Hunt, The Hunt Itself, Ending the Hunt, Output from the Hunt

#### Unit 4: Threat Hunting Techniques

**(10 Hours)**

A Dictionary of Threat Hunting Techniques, Core Concepts, The Cyber Kill Chain, Ranking Versus Detection, Finite Cases, Basic Techniques, Searching and Cross-Source Correlation, Lookup, Stack Counting, Histograms and Barplots, Watchlist Refinement: Indicators and Signatures, Indicator Webwalk.

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## **Unit 5: Advanced Techniques for Network Security Monitoring and Analysis (10 Hours)**

Techniques for Discovering Indicators, Configuration Tracking and Baselining, Honey, Situational Awareness of Your Network: Mapping, Blindspots, Endpoint Detection, Identifying Weird Port Behavior, Producer/Consumer Ratio and Services, Know Your Calendar, Watch Invocation Sequences, Be Aware of Physical Locations, Data Analysis and Aggregation Techniques, Approximate String Matching, LRU Cache Depth Analysis, Leaky Buckets, Machine Learning, Visualization Techniques, Trellising and Sparklines, Radial Plots, Heat Mapping and Space Filling Curves.

### **Suggested Readings:**

- Threat Hunting by Michael Collins Released May 2018 Publisher(s): O'Reilly Media
- The Foundations of Threat Hunting: Organize and design effective cyber threat hunts to meet business needs by Chad Maurice (Author), Jeremy Thompson (Author), William Copeland (Author), Anthony Particini (Foreword), Packt Publishing (June 17, 2022)

<b>Semester: 5</b>	<b>BCA505CT</b>	<b>Natural Language Processing</b>
<b>3 Credits</b>	<b>TPE:3:0:0</b>	<b>Discipline Specific Core – DSC/ Discipline Specific Elective</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA505CT.1	Explain the basic concepts and challenges in natural language processing.
BCA505CT.2	Outline the structure and properties of human language (syntax, semantics, pragmatics) and their relevance to NLP
BCA505CT.3	Apply tokenization, stemming, lemmatization, and part-of-speech tagging to preprocess text data.
BCA505CT.4	Demonstrate the importance of text normalization and feature extraction in NLP tasks.

### Natural Language Processing

#### Course Content:

#### Unit 1: Overview and Language Modelling (7 Hours)

Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages-NLP Applications-Information Retrieval. Language Modelling: Various Grammar based Language Models-Statistical Language Model.

#### Unit 2: Word Level and Syntactic Analysis (7 Hours)

Word Level Analysis: Regular Expressions-Finite State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word Classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing Probabilistic Parsing.

#### Unit 3: Extracting Relations from Text (9 Hours)

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.

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#### **Unit 4: Evaluating Self-Explanations in iSTART**

**(14 Hours)**

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modelling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically Based Text Mining: Related Work, A Semantically Guided Model for Effective Text Mining.

#### **Unit 5: Information Retrieval and Lexical Resources**

**(8 Hours)**

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net-Stemmers-POS Tagger- Research Corpora.

#### **Suggested Readings:**

- Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press, 2008.
- Natural Language Processing and Text Mining. Anne Kao and Stephen R. Poter, Springer-Verlag London Limited. 2007
- Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Daniel Jurafsky and James H Martin. Prentice Hall, 2008 2nd Edition.
- Natural Language Processing with Python. Steven Bird, Ewan Klein, Edward Loper. O'Reilly Media, 2009.

<b>Semester: 5</b>	<b>BCA505DT</b>	<b>Predictive Analysis</b>
<b>3 Credits</b>	<b>TPE:3:0:0</b>	<b>Discipline Specific Core - DSC/ Discipline Specific Elective - DSE</b>

**Course Outcomes:** On successful completion of the course the learner will be able to

CO#	Course Outcomes
BCA505DT.1	Know the fundamentals of statistical methods and predictive strategies.
BCA505DT.2	Know how to validate models and analyse outcomes.
BCA505DT.3	Solving analytics difficulties by using systems and critical thinking.

### Predictive Analysis

#### Course Content:

#### Unit 1: Linear Methods for Regression and classification (9 Hours)

Linear Methods for Regression and Classification: Overview of supervised learning, Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection, Ridge regression, Lasso regression, Linear Discriminant Analysis, Logistic regression, Perceptron learning algorithm

#### Unit 2: Model Assessment and Selection (9 Hours)

Model Assessment and Selection: Bias, Variance, and model complexity, Bias - variance trade off, Optimism of the training error rate, Estimate of In-sample prediction error, Effective number of parameters, Bayesian approach and BIC, Cross- validation, Boot strap methods, conditional or expected test error.

#### Unit 3: Additive Models, Trees, and Boosting (9 Hours)

Additive Models, Trees, and Boosting: Generalized additive models, Regression and classification trees , Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting, Examples ( Spam data, California housing , New Zealand fish, Demographic data)

#### Unit 4: Neural Networks (9 Hours)

Neural Networks (NN), Support Vector Machines (SVM), and K-nearest Neighbour: Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest –Neighbour classifiers (Image Scene Classification)

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## Unit 5: Unsupervised Learning and Random Forests

(9 Hours)

Unsupervised Learning and Random forests: Association rules, Cluster analysis, Principal Components, Random forests and analysis

### Suggested Readings:

- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning- Data Mining, Inference, and Prediction ,Second Edition , Springer Verlag, 2009.
- G.James,D.Witten,T.Hastie,R.Tibshirani-An introduction to statistical learning with applications in R, Springer,2013..
- E.Alpaydin, Introduction to Machine Learning, Prentice Hall Of India,2010.
- C.M.Bishop –Pattern Recognition and Machine Learning,Springer,2006.
- L.Wasserman-All of statistics

<b>Semester: 5</b>	<b>BCA505ET</b>	<b>UI and UX Design</b>
<b>3 Credits</b>	<b>TPE:3:0:0</b>	<b>Discipline Specific Core – DSC/ Discipline Specific Elective -DSE</b>

**Course Outcomes:** On successful completion of the course the learner will be able to:

CO#	Course Outcomes
BCA505ET.1	Define the Interaction – Models of Interaction, Framework
BCA505ET.2	Explain Software Life Cycle, Using Design Rules
BCA505ET.3	Design Interactive mobile UI

### **Unit 1: Introduction to HCI**

**(10 Hours)**

The human – Input Output Channels, Human Memory, Thinking: Reasoning and Problem Solving, The Computer – Text Entry Devices, Positioning, Pointing and Drawing, Display Devices, Memory, The Interaction – Models of Interaction, Frameworks & HCI. Cognitive Models, Communication & Collaboration Models, Task Analysis, Dialog Analysis & Design, Interaction Models, Programming Interactive System.

### **Unit 2: User Interface Design**

**(12 Hours)**

The Software Life Cycle – Activities in the Life Cycle, Validation & Verification, Interactive Systems & Software Life Cycle, Using Design Rules Standards, Guidelines, Usability Engineering – Problems with usability engineering, Iterative Design and Prototyping, Design Rationale – Process-oriented design rationale, Design space analysis, Psychological design rationale. Direct Manipulation and Virtual Environments, Menu Selection Form Filling and Dialog Boxes, Command and Natural Languages, Interaction Devices, Collaboration and Social Media Participation, Naming and Abbreviations

### **Unit 3: Mobile UI Design**

**(12 Hours)**

Non-Perceptual Technologies – Keypads, Touchpad, Gesture: Classification of Gesture based HCI – Application Domains: Multimodal interactions, Desktop, Virtual and Augmented Reality – Communication, Gesture Styles – Deictic, Gesticulation, Manipulation, Semaphores, Sign Language, Disruptive Innovation. UX Tools for Wire raming and Prototyping – UXPin, Wireframe.cc, Pixate, Sketch, Invision, P.O.P. app, UX Tools for User Research and User Testing – LookbackWufoo, Typeform, Usabilla, Morae, UX, Recorder, UX Tools for Organizing Information – Lucid Chart, Mind Meister, Coggle.it, Gliffy

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## Unit 4: Best Practices in UI Design

(11 Hours)

Views and Layout Tools – Paragraph Tag, Image Tag, Table Tag, Layout Tag, Frame Tag, Interaction – Links, Buttons, Text Fields, Radio Buttons, Check Boxes, CSS Syntax, Colors and Background, Text and Fonts, Icons and Links, List. JavaScript Syntax, Statements, Variables, Data Types, Operators, Events, JS Forms – Forms API, JS Objects – Object Definition, Object Properties, Object Methods, Object Prototypes, JS Functions – Function Definition, Function Parameters, Function Invocation, Function Closures

### Suggested Readings:

- Human Computer Interaction by Alan Dix, Janet Finlay, Pearson Education (2004)
- Designing the User Interface - Strategies for Effective Human Computer Interaction by Ben Shneiderman, Pearson Education (2010)
- The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques by Wilbert O. Galitz, Wiley (2007)
- Usability Engineering: Scenario-Based Development of Human-Computer Interaction by Rosson, M. and Carroll J.
- The Essentials of Interaction Design by Cooper, Wiley Publishing (2007)
- Usability Engineering by Nielsen, J. Morgan Kaufmann
- The Resonant Interface: HCI Foundations for Interaction Design by Heim, S., Addison-Wesley. (2007)