Credit Framework for the Bachelor of Computer Applications (Cyber Security and Forensic)-NEP-2020
School of Computer Applications, BBD University, Lucknow

SEMESTER	Discipline Specific Core (DSC) (Major)	Discipline Specific Elective (DSE) (Major)	Generic Elective (GE) (Minor)	Co-Curricular (CC)	Vocational Course(VOC)	Survey/ Seminar/MOOC/Community Outreach (SSMC)	GP	Total Credit
1	4 Subjects 18 Credits (6+6+4+2 Credits)		1 Subject 4 Credits	1 Subject 3 Credits			1 Credit	26
2	4 Subjects 16 Credits (6+4+2+4 Credits)		1 Subject 4 Credits	1 Subject 3 Credits	1 Subject 2 Credits		1 Credit	26
Early Exit Option-1: Award of CERTIFICATE (After 1 Year: 52 Credits)								
3	4 Subjects 19 Credits (6+6+4+3 Credits)		1 Subject 4 Credits		1 Subject 2 Credits		1 Credit	26
4	3 Subjects 15 Credits (6+6+3 Credits)	1 Subjects 4 Credits	1 Subject 4 Credits		1 Subject 2 Credits		1 Credit	26
Early Exit Option-2: Award of DIPLOMA (After 2 Year: 104 Credits)								
5	3 Subjects 16 Credits (6+6+4 Credits)	2 Subjects 8 Credits (4+4 Credits)					1 Credit	25
6	1 Subject 4 Credit (Online Mode) Industrial Training Cum-Project 20 Credits						1 Credit	25
Early Exit Option-3: Award of Bachelor of Computer Applications (After 3 Year: 154 Credits)								
7	2 Subjects 12 Credits (6+6 Credits) Desertation-I 8 Credits	1 Subject 4 Credits					1 Credit	25
8	2 Subjects 10 Credits (6+4 Credits) Desertation-II 14 Credits						1 Credit	25
Award of Bachelor of Computer Applications With Research (After 4 Years: 204 Credits)								

Babu Banarasi Das University, Lucknow
School of Computer Applications
Bachelor of Computer Application (CS&F)
Evaluation Scheme (w. e. f. Academic Session 2023-24)

SEMESTER I

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN11101	Data Privacy Fundamentals	3	1	0	40	60	100	4	IBM
DSC	BCACSN11102	Fundamentals of Computer & Programming in 'C'	3	1	0	40	60	100	4	School
DSC	BCACSN11103	Web Designing	3	1	0	40	60	100	4	
DSC	BCACSN11104	Basic Mathematics	2	0	0	40	60	100	2	
GE		Generic Elective-I	3	1	0	40	60	100	4	
CC		Co-Curricular-I	2	1	0	40	60	100	3	
DSC	BCACSN11151	Programming in 'C' Lab	0	0	4	40	60	100	2	
DSC	BCACSN11152	Web Designing Lab	0	0	4	40	60	100	2	
	GPN1101	General Proficiency	0	0	0	100	0	100	1	
		Total	**16**	**5**	**8**	**420**	**480**	**900**	**26**	

SEMESTER II

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN12101	Cyber Security	3	1	0	40	60	100	4	IBM
DSC	BCACSN12102	Security Data Privacy Laws and Standards	2	0	0	40	60	100	2	IBM
DSC	BCACSN12103	Operating System	3	1	0	40	60	100	4	School
DSC	BCACSN12104	Basics of Python Programming	3	1	0	40	60	100	4	
GE		Generic Elective-II	3	1	0	40	60	100	4	
CC		Co-Curricular-II	3	0	0	40	60	100	3	
DSC	BCACSN12151	Basics of Python Programming Lab	0	0	4	40	60	100	2	
VC		Vocational Course-II	2	0	0	40	60	100	2	
	GPN1201	General Proficiency	0	0	0	100	0	100	1	
		Total	**19**	**4**	**4**	**420**	**480**	**900**	**26**	

Early Exit Option-1: Award of CERTIFICATE (After 1 Year: 52 Credits)

SEMESTER III

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN13201	Identity Access Management	3	1	0	40	60	100	4	IBM
DSC	BCACSN13202	Linux and Shell Programming	3	1	0	40	60	100	4	School
DSC	BCACSN13203	Computer Network Security	3	1	0	40	60	100	4	
DSC	BCACSN13204	Introduction to System Security	3	0	0	40	60	100	3	
GE		Generic Elective-III	3	1	0	40	60	100	4	
DSC	BCACSN13251	Network Programming Lab	0	0	4	40	60	100	2	
DSC	BCACSN13252	Linux and Shell Programming Lab	0	0	4	40	60	100	2	
VC		Vocational Course-III / SSMC	2	0	0	40	60	100	2	
	GPN1301	General Proficiency	0	0	0	100	0	100	1	
		Total	**17**	**4**	**8**	**420**	**480**	**900**	**26**	

SEMESTER IV

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN14201	Apply End to End Security to Cloud Application	3	0	0	40	60	100	3	IBM
DSC	BCACSN14202	Data Warehousing & Data Mining	3	1	0	40	60	100	4	School
DSC	BCACSN14203	Server Side Scripting	3	1	0	40	60	100	4	
GE		Generic Elective-IV	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-I	3	1	0	40	60	100	4	
DSC	BCACSN14251	Server Side Scripting Lab	0	0	4	40	60	100	2	
DSC	BCACSN14252	Data Warehousing & Data Mining Lab	0	0	4	40	60	100	2	
VC		Vocational Course-IV / SSMC	2	0	0	40	60	100	2	
	GPN1401	General Proficiency	0	0	0	100	0	100	1	
		Total	**17**	**4**	**8**	**420**	**480**	**900**	**26**	

Early Exit Option-2: Award of DIPLOMA (After 2 Year: 104 Credits)

SEMESTER V

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN15301	Deployment of Private Cloud	3	1	0	40	60	100	4	IBM
DSC	BCACSN15302	Mobile Application Development	3	1	0	40	60	100	4	School
DSC	BCACSN15303	Digital Image Processing	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-II	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-III	3	1	0	40	60	100	4	
DSC	BCACSN15351	Mobile Application Development Lab	0	0	4	40	60	100	2	
DSC	BCACSN15352	Digital Image Processing Lab	0	0	4	40	60	100	2	
	GPN1501	General Proficiency	0	0	0	100	0	100	1	
		Total	**15**	**5**	**8**	**380**	**420**	**800**	**25**	

SEMESTER VI

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN16301	Cyber Protection Practices (Online)	3	1	0	40	60	100	4	School
DSC	BCACSN16351	Industrial Training Cum-Project	0	0	0	240	360	600	20	
	GPN1601	General Proficiency	0	0	0	100	0	100	1	
		Total	**3**	**1**	**0**	**380**	**420**	**800**	**25**	

Early Exit Option-3: Award of Bachelor of Computer Applications (After 3 Year: 154 Credits)

SEMESTER VII

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN17401	Statistical & Optimization Techniques	3	1	0	40	60	100	4	School
DSC	BCACSN17402	Research Methodology	3	1	0	40	60	100	4	
DSC	BCACSN17403	Understanding Security & Forensics Through Case Stud	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-IV	3	1	0	40	60	100	4	
DSC	BCACSN17451	Statistical Package for Social Sciences(SPSS) Lab	0	0	4	40	60	100	2	
DSC	BCACSN17452	Dissertation-I	0	0	12	120	180	300	6	
	GPN1701	General Proficiency	0	0	0	100	0	100	1	
		Total	**12**	**4**	**16**	**420**	**480**	**900**	**25**	

SEMESTER VIII

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN18401	R Programming	3	1	0	40	60	100	4	School
DSC	BCACSN18402	Intellectual Property Right	3	1	0	40	60	100	4	
DSC	BCACSN18451	R Programming Lab	0	0	4	40	60	100	2	
DSC	BCACSN18452	Dissertation-II	0	0	28	200	300	500	14	
	GPN1801	General Proficiency	0	0	0	100	0	100	1	
Total			**6**	**2**	**32**	**420**	**480**	**900**	**25**	

Award of Bachelor of Computer Applications With Research (After 4 Years: 204 Credits)

DSC	Discipline Specific Core
DSE	Discipline Specific Elective
GE	Generic Elective
CC	Co-Curricular
VC	Vocational Course
GP	General Proficiency
L	Lecture
T	Tutorial
P	Practical

Generic Elective-I

1	BCACSN11111	Basics of Cyber Laws and Indian IT Act 2000
2	BCACSN11112	Basics of Cyber Security

Generic Elective-II

1	BCACSN12111	Digital Security and Forensic Fundamental
2	BCACSN12112	Forensic Incident Management

Generic Elective-III

1	BCACSN13211	Big Data Fundamentals
2	BCACSN13212	Emerging Technologies

Generic Elective-IV

1	BCACSN14211	Cloud Computing
2	BCACSN14212	Distributed Database Management

Discipline Specific Elective-I

1	BCACSN14221	Cyber Law & IT Act
2	BCACSN14222	Cryptography & Cyber Security
3	BCACSN14223	Data Communication and Network

Discipline Specific Elective-II

1	BCACSN15321	Biometric Security
2	BCACSN15322	Enterprise Architecture & Components
3	BCACSN15323	Physical Security

Discipline Specific Elective-III

1	BCACSN15324	Blockchain Technology
2	BCACSN15325	Internet of Things
3	BCACSN15326	Storage Area Network

Discipline Specific Elective-IV

1	BCACSN17421	Data Privacy & Fundamental
2	BCACSN17422	Soft Computing
3	BCACSN17423	Deep Learning

Note: 1. Student may select any subject from Co-Curricular list offered by the University

2. Student may selct any subject from Vocational Course list offered by the University

Bachelor of Computer Applications
(Cyber Security & Forensics)
In Collaboration with IBM

FIRST SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	I		Semester		I
Course Name	Data Privacy Fundamentals				
Code	BCACSN11101				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	Get an outline of data privacy laws and walk away with some guiding principles for how to stay out of trouble. Also Knowing how to hack a colleague's password will raise some ethical questions and review theories of data privacy as well as data privacy in the context of social media and artificial intelligence.				
Course Outcomes					
CO1	Identify foundational understanding of digital age privacy concepts and theories.				
CO2	Identify privacy implications of modern digital technology.				
CO3	Identify the rules and frameworks for data privacy in the age of technology.				
CO4	Learn the various data privacy acts and IT Acts				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Privacy in the Digital Age:** An overview of privacy laws in Canada Case Study: Student loans data breach (Canada) - A breach involving the personal information of about more than half a million clients of Human Resources and Skills Development Canada (HRSDC) and 250 departmental employees. Information and foundational concepts of digital age privacy. You will see some of the history of it and consider the quandary that comes with trying to define privacy. Questions about the realities of securing personal data information will also be considered.	15	CO1
2	**Risks in Data Privacy:** An overview of the Personal Information Protection and Electronic Documents Act (PIPEDA) Case Study: Target Corp. (USA) - A data breach involving information on 40 million payment cards (i.e., credit, debit, and ATM cards) and personally identifiable information (PII) on 70 million customers Contemplate what threatens our privacy in this digital age and the steps we can we take to protect it. Also, we will take a deep look into the growing influence of smart devices and artificial intelligence and consider whether or not they help or hinder human beings.	15	CO2
3	**Frameworks of Data Privacy Law:** Dr. Ann Cavoukian's 7 Foundational Principles of 'Privacy by Design' Case Study: Think W3 (UK) - A data breach involving 1.2 million credit and debit card details Case Study: Doritex Corp. (USA) - A data breach exposed the social security numbers of over 500 job applicants Privacy and the law and how it pertains to privacy in the media, in surveillance situations and in protecting personal data information. Finally, we will see how privacy regimes are functioning outside of the United States and make comparisons on approaches to privacy and how it is regulated.	15	CO3
4	**Data breaches and passwords:** Case Study: Home Depot (USA) - A data breach estimated to have put payment card information at risk for approximately 56 million unique payment cards Class Participation Questionnaire	15	CO4

Suggested Readings

1. Data Privacy and GDPR Hank book

2. Privacy and Data Protection Essentials by Ruben Zeegers and Theo Wanders

Online Resources

1. https://www.coursera.org/learn/northeastern-data-privacy
2. https://cognitiveclass.ai/courses/data-privacy
3. https://onlinecourses.nptel.ac.in/noc22_cs37/preview

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	3	1	1	2	2	1	1				1	1	2	2
CO2	2	1	2	2	2		1					1	2	2
CO3	2	2	1	2	2	1						1	2	2
CO4	1	1	1	2	2	1			1			1	2	2

Program	Bachelor of Computer Applications (CS & F)						
Year	I		Semester			I	
Course Name	Fundamentals of Computer & Programming in 'C'						
Code	BCACSN11102						
Course Type	DSC		L	T	P	Credit	
Pre-Requisite			3	1	0	4	
Course Objectives	The subject focuses on the fundamental of Computer and its peripherals with modern technology along with methodology of programming with concepts of C Programming.						
Course Outcomes							
CO1	Demonstrate the knowledge of the basic structure of computer, History of Computer, Hardware, Software, Input /Output devices, Computer languages, Language Translators.						
CO2	Describe the concept of data communication and networks along with the few concepts of modern technology.						
CO3	Learn various constructs of C Language along with programming constructs.						
CO4	Understand the concept of array, structure, functions, and pointers.						

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Computers:** Introduction to computer, Basics of computers and its operation, History of computer, Capabilities and limitations of computers, Types of computers; **Hardware:** CPU(Architecture & Related Technology); **Storage Devices:** Primary & Secondary; Auxiliary Storage Devices; Cache Memory; Memory Hierarchy; Buffering and Spooling; **Software:** System Software and Application Software; **Input devices; Output Devices; Operating System**: Functions, Types, Need of Operating System; **DOS; Translator**: Compiler, Interpreter & Assembler; **Types of Languages**: Machine Language, Assembly Languages, High level Languages; Loader, Linker, **Flowchart; Algorithms**: Introduction, Definition, Characteristics, Limitations.	15	CO1
2	**Computer Networks & Internet:** Data communication: Signaling & Transmission; Network Devices: HUB, Switches, Router, Gateways; Types of Network; Topology; Transmission Mode & Media; Switching Techniques, Internet and protocol, Internet services, OSI reference model; TCP/IP Reference Model. **Introduction to Data Science & Analysis**: Artificial Intelligence, Soft Computing, Cloud Computing, IOT, Digital Marketing.	15	CO2
3	**Introduction to C**: Introduction; Structure of C Program; Writing the first C Program; File used in C Program; Compiling and Executing C Programs; Comments; **Data Types, Tokens**: Keywords, Literals, Identifiers, Variables, Constants; I/O Statements; **Operators**: Types of operators, Precedence and Associativity of operators; Programming Examples; Type Conversion and Type Casting. **Decision Control Statements**: If, If-Else, Nested If, If-Else Ladder, Switch-Case; **Iterative Statements**: For Loop, While Loop, Do-While Loop; **Jump Statement**: Break, Goto and Continue.	15	CO3
4	**Introduction to Array, Structures, Union: Array** : Types of Array: Single Dimension Array, Two-Dimensional Array; Address Calculation of an Element in Array; Insertion and	15	

| | Deletion in an Array; **Functions:** User-Defined Functions; Function Declaration; Types of Arguments: Actual Arguments, Formal Arguments; Function Definition; Methods to Call a Function: Call by Value, Call by Reference; Passing Arrays as Parameters; Storage Classes; **Pointers:** Declaration of Pointer Variables; Pointer Arithmetic; Pointers and Arrays, Pointer and Character Strings, Array of Pointers, Pointers as Function Arguments; **Structure , Union & Enumeration.** | | CO4 |

Suggested Readings
1. E. Balagurusamy, "Fundamentals of Computers", McGraw Hill Education.
2. Thareja R., "Fundamentals of Computers", Oxford University Press.
3. Peter Norton's, "Introduction to Computers", TMH Publications
4. E. Balagurusamy, "Programming in ANSI C", TMH Publications.
5. Reema Thareja, "Programming in C", OXFORD University Press.
6. Raja Raman. V, "Fundamentals of Computers", PHI Publications, 3rd Edition, 2004.

Online Resources
1. https://nptel.ac.in/courses/106104128
2. https://archive.nptel.ac.in/courses/106/104/106104128/

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2			1	2	2		2	1		1	2	1
CO2	1	3	1		2	3	2		2	1		1	3	1
CO3	3	2	2	3	2	3	2		2	2		3	2	3
CO4	2	3	3	3	3	3	2		2	3		3	3	3

Program	Bachelor of Computer Applications (CS & F)						
Year	I		Semester			I	
Course Name	Web Designing						
Code	BCACSN11103						
Course Type	DSC		L	T	P	Credit	
Pre-Requisite			3	1	0	4	
Course Objectives	To focus on the process of Web Designing and build sound concepts of different languages like HTML, CSS, and JavaScript and tools used in Web Designing along with creating event-based web forms using advances features of JavaScript.						
Course Outcomes							
CO1	Understand the basic concept of HTML and application in web designing.						
CO2	Students develop static and dynamic website using HTML and CSS.						
CO3	Understanding the basic concept of Java Script and its application.						
CO4	Student able to develop personal and professional websites.						

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basics of Web Designing:** Introduction to Web (www), Uniform Resource Locator (URL), Hypertext Transfer Protocol (HTTP), Introduction to Internet, Web Browsers, Web Clients, Web Servers , Introduction to HTML: HTML tags and its attributes; Text Formatting tags; Various types of Lists: Ordered, Unordered, Definition lists ;Table tags: Methods to Create Tables, Attributes of table tag, Col span and Row span; Frame tags and its Attributes; Form tag: Creation of Forms, Textbox, Radio Button, Hidden ,etc.; Image, Anchor Tag ; Links to External Documents: Inter-page and Intra-page linking.	15	CO1
2	**DHTML and CSS:** Introduction to DHTML: Uses of DHTML, Features of DHTML, Components of Dynamic HTML, Advantages and disadvantage of DHTML; CSS (Cascading Style Sheet): Font Attributes, Color and Background Attributes Text Attributes, Border, Margin related Attributes, List Attributes; Types of Style Sheet-Inline, External and Embedded; CSSP (Cascading Style Sheet Positioning); Document Object Model; JSSS (JavaScript assisted Style Sheet); Browser objects; DHTML Events.	15	CO2
3	**Scripting languages(JavaScript):** Introduction to JavaScript: Basic Programming Techniques: Data Types, Creating Variables and JavaScript Array; Operators and Expressions in JavaScript: Arithmetic , Logical, Comparison , String and Conditional Operators; JavaScript Programming Constructs: Conditional checking, Loops; Functions in JavaScript: Built in Functions and User Defined Functions; Dialog Boxes: Alert , Confirm and Prompt Dialog Box; JavaScript Document Object Model (DOM):Object hierarchy in DOM, Event Handling; Form Object: Form Object's Methods and Properties, Text Element, Button Element; Other Built in Objects in JavaScript, String, Math and Date Object; Writing Client Side Validations from HTML Form Elements.	15	CO3
4	**Cookies and Browser data:** creating, reading, writing, deleting cookies, setting the expiration date of cookie; Browser: opening a window, giving the window focus, window position, changing the content of window, closing a window, scrolling a web page, multiple windows at once, creating a web page in	15	CO4

new window; JavaScript in URLs, JavaScript security, Timers, Browser location and history.		

Suggested Readings

1. Xavier, C, "Web Technology and Design", New Age International Publications.
2. Bayross Ivan," HTML, DHTML. JavaScript, and PHP", BPB Publications.
3. Achyut S Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill.
4. Ramesh Bangia, "Internet and Web Design", New Age International.
5. Steven M. Schafer, "HTML, XHTML, and CSS Bible, 5ed", Wiley India
6. Ian Pouncey, Richard York, "Beginning CSS: Cascading Style Sheets for Web Design", Wiley India

Online Resources

1. https://www.youtube.com/watch?v=h_RftxdJTzs
2. https://youtu.be/uUhOEj4z8Fo

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	3	2	2		2	2	1	3	2	2
CO2	2		3		2	2	2	1	2	2		1	3	3
CO3		2	2	2	2	3	2		1	3		2	3	3
CO4	2		3		2	2	2		3	2	2	3	3	3

Program	Bachelor of Computer Applications (CS & F)					
Year	I		Semester		I	
Course Name	Basic Mathematics					
Code	BCACSN11104					
Course Type	DSC		**L**	**T**	**P**	**Credit**
Pre-Requisite			2	0	0	2
Course Objectives	To introduce the fundamental concepts of Mathematics this will help and guide students to understand and make comprehensive rest of the course.					
Course Outcomes						
CO1	Understand the concept of Sequence, Matrices and Determinant.					
CO2	Understand the concept of Differentiation and Integration.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Finite and Infinite Sequences:** Definition, nth term, Sum of n terms of sequence, Arithmetic Progression, Geometric Progression and Harmonic Progression. **Matrices and Determinant:** Definition, Types of matrices, multiplication of matrix by scalar, Sum of matrices, difference of matrices, Product of matrices, Transpose of matrix. Determinant: definition and basic properties.	15	CO1
2	**Differentiation and Integration:** Meaning and geometrical interpretation of derivative, derivatives of simple algebraic and trigonometric function, derivatives of sum/difference, product and quotient of function, **Integration:** Integration as the inverse of differentiation, Integration of algebraic and trigonometric function, Definite Integral.	15	CO2

Suggested Readings
1. O.P. Malhotra, S. K. Gupta, "Mathematics", S. Chand, 2000 Edition
2. Shanti Narain, "Textbook of Matries", S. Chand

Online Resources
1. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ma04/
2. https://archive.nptel.ac.in/courses/111/106/111106146/

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1		1	1							1	1	1
CO2	1	1	1	2	2	1	1					2	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	I		Semester		I
Course Name	Basics of Cyber Laws and Indian IT Act 2000				
Code	BCACSN11111				
Course Type	GE		L	T	P	Credit
Pre-Requisite			3	1	0	4
Course Objectives	The objective of the Basics of Cyber Law and Indian IT Act course is to provide students with a comprehensive understanding of the legal principles, regulations, and provisions related to cybersecurity and information technology in India, enabling them to navigate legal issues and challenges in the digital domain in compliance with Indian laws.				
Course Outcomes					
CO1	Students will gain a thorough understanding of cyber law principles and the Indian IT Act.				
CO2	Students will be able to apply legal principles to address cybersecurity and IT-related issues.				
CO3	Students will develop skills to navigate legal challenges in the digital domain in compliance with Indian laws.				
CO4	Understand the legal provisions related to specific cybercrimes and liabilities attached to such crimes.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cyber Laws and Cyber Space:** Definition of Cyber Law, Cyber Space and Netizen, Origin/history & functioning of the Internet, Cyber World and the rule of Law in Cyber World, Significance of Law in Dealing with Challenges Faced by Cyber World, Issues of Jurisdiction and Applicable Law in Cyberspace, International Treaties, Conventions and Protocols Concerning Cyberspace.	15	CO1
2	**Intellectual Property Rights in Cyberspace:** Concept of Property in Cyber Space, Implication on Intellectual Property Rights – International & National Legal Preparedness, Interface with Copyright Law, Patent Law, Trademarks & Domain Names Related issues, The ICANN Uniform Domain Name Dispute Resolution Policy.	15	CO2
3	**Information Technology Act, 2000 – Cyber Law in India:** Historical background & Objectives, Legal Recognition of Electronic Records and Procedures, Legal Recognition of Digital Signature, Electronic & Digital Signatures – legal issues, E Commerce Certifying Authority and its Role, Cyber Appellate Tribunal, Grey Areas of Information Technology Act, 2000.	15	CO3
4	**Cyber Crimes & Legal Framework:** Kinds of Offences and Penalties defined under the IT Act, 2000, Cyber Crime against – Person, Property & Government, E-Evidence and Computer Forensic, Concept of E-Litigation, Right to Privacy and its Legal Framework.	15	CO4

Suggested Readings

1. Pavan Duggal, "Textbook on Cyber Law", Universal Law Publishing Co.
2. Dr. Jyoti Rattan, "Cyber Laws & Information Technology", Bharat Law House Pvt. Ltd.
3. Pavan Duggal, "Cyber Law- The Indian Perspective", Saakshar Law Publications
4. Farooq Ahmad, "Cyber Law in India (Internet)", New Ena Law Pub. Faridabad
5. Nandan Kamath, "Law Relating to Computers Internet & E-commerce - A Guide to Cyber laws & the Information Technology", Universal Law Publishers

6. Dr. Talat Fatima," Cyber Crimes", Eastern Book Company.

Online Resources
1. https://www.youtube.com/watch?v=F7mH5vz1qEI
2. https://www.youtube.com/watch?v=0zUpe_E2b4M.
3. https://www.youtube.com/watch?v=ejceoib0GUE
4. https://www.youtube.com/watch?v=czDzUP1HclQ
5. https://www.c-span.org/video/?117927-1/rescheduled-cyber-crime-modernizing-legal-framework-information-age

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1	1	1	2	1				1	1	2	1	1
CO2	1	1	2	1	2	1	1		1	1	1	2	2	
CO3		1	1	2	1	2	2	1			1	2	1	
CO4		1	2	2	2	3	2	2			1	2	2	

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**		I	
Course Name	Basics of Cyber Security				
Code	BCACSN11112				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course aims to provide students with a foundational understanding of cyber security principles, technologies, and practices. By the end of the course, students will be equipped with the knowledge and skills to identify and mitigate cyber threats, apply security controls, and effectively respond to security incidents.				
Course Outcomes					
CO1	Demonstrate understanding of cyber security principles.				
CO2	Apply security controls and practices effectively.				
CO3	To understand the basics of security policies appropriately.				
CO4	To understand the basics of Biometrics and its functionalities				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Information Security Fundamentals:** An Overview of Information Security: The Basic Components; CIA Trait, Threats; Virus, Worms, Phishing, DoS and DDoS, SQL Injection, Buffer Overflow, Spyware, Adware and Ransomware. Policy and Mechanism, Assumptions and Trust, Assurance, Operational Issues, Human Issues.	15	CO1
2	**System Security:** Introduction to System Security, Aspects of System Security, Need for Security, Goals of System Security, **Security Policies:** Confidentiality, Integrity, Availability Policies, and Hybrid Policies. Features of a Good Security Policy, Security Attacks, Security Services, and Mechanisms.	15	CO2
3	**Security Procedures and Practices:** Principles of Security, Steganography, Cryptographic Techniques: Symmetric Cryptography, Asymmetric Cryptography, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Block Cipher Principles, Block Cipher Modes of Operation, Encryption and Decryption.	15	CO3
4	**Authentication:** Basics of Authentication, 1Factor Authentication, 2 Factor Authentication, Multi Factor Authentication, One Time Password (OTP), Access Control, Types of Access Control Mechanism, Passwords: Attacking a Password System, Countering Password Guessing, **Biometrics:** Introduction to Biometric.	15	CO4

Suggested Readings
1. William Stallings, Computer Security: Principles and Practices, Pearson 6 Ed, ISBN 978-0-13-335469-0 2.
2. Matt Bishop, "Introduction to Computer Security", Addition Wesley, 2005
3. Nina Godbole, Sunit Belapure, Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiely India Pvt. Ltd, ISBN- 978-81-265-2179-1 1.
4. CK Shyamala et el., Cryptography and Security, Wiley India Pvt. Ltd, ISBN-978-81-265-2285-9.
5. Berouz Forouzan, Cryptography and Network Security, TMH, 2 edition, ISBN -978-00-707-0208-0.

Online Resources
1. https://www.youtube.com/watch?v=fQ3ESFfvchg
2. https://www.youtube.com/watch?v=_mxufDbcK5A
3. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
4. https://www.digimat.in/nptel/courses/video/106105031/L01.html
5. https://www.youtube.com/watch?v=tKDKagi5jqI

6. https://www.youtube.com/watch?v=kjbDHOAM8cw

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2	1	1	1	1	1						1	1	1
CO2	2	1	1	2	2	1	1					2	2	2
CO3	2	2	3	3	2	2	2	1	1	2	1	1	2	2
CO4	2	2	3	3	2	2	2	1	2	2	1	1	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	I		Semester		I
Course Name	Programming in 'C' Lab				
Code	BCACSN11151				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To provide the fundamental knowledge about various concepts of 'C' Programming using various constructs like if, if-else, switch case, for loop, do while, etc. and apply code reusability using functions and pointers.				
Course Outcomes					
CO1	Understand various constructs of the C Language along with proper syntax.				
CO2	Develop programs using functions, pointers, structure, union on various topics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Implementation of Fundamental Data Types. 2. Implementation of Fundamental Operators. 3. Implementation of Conditional Program such as if, switch etc. 4. Implementation of Basic Control Constructs such as For Loop, While Loop, Do While Loop. 5. Implementation of Functions. 6. Implementation of Functions using call by value and call by reference. 7. Implementation of This pointer.	15	CO1
2	1. Implementation of Structures, Union, and Enumeration etc. 2. Implementation of Pointers. 3. Implementation of Pointers as Function Arguments. 4. Implementation of Pointer to Pointer. 5. Implementation of Nested Structure.	15	CO2

Suggested Readings
1. E. Balagurusamy, "Programming in ANSIC", TMH Publications.
2. Reema Thareja, "Programming in C", OXFORD University Press.
3. Peter Norton's, "Introduction to Computers", TMH Publications
4. Kernighan, Ritchie,"The C Programming Language", PHI Publications
5. Yashwant Kanitakar, "Let us C", BPB Publications

Online Resources
1. https://nptel.ac.in/courses/106104128
2. https://cse02-iiith.vlabs.ac.in/

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	3	2	2	3		1	2	2	1	2	3
CO2			2	3	3								2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**		I	
Course Name	Web Designing Lab				
Code	BCACSN11152				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To provide practical implementation on the process of Web Designing and build sound concepts of different languages and tools used in Web Designing using Dreamweaver framework.				
Course Outcomes					
CO1	Visualize and recognize the basic concept of HTML, DHTML and CSS in web designing.				
CO2	Understanding the basic and advanced concept of Java Script to create personal and/or business websites following current professional and/or industry standards.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Implementation of List Tags in HTML. 2. Implementation of Table Tag in HTML. 3. Implementation of Frame Tag in HTML. 4. Implementation of Form Tags in HTML. 5. Implementation of CSS (Inline, External and Embedded) in DHTML. 6. Implementation of Class Concept in DHTML. 7. Implementation of DHTML Events. 8. Implementation of CSS positioning. 9. Implementation CSS tables and links. 10. Implementation of CSS navigation bar.	15	CO1
2	1. Implementation of basic variables in Java Script. 2. Implementation of User Defined Functions in Java Script. 3. Implementation of inbuilt functions in Java Script. 4. Implementation of Form validation in Java Script. 5. Develop JavaScript to implement the switch-case statement for the given problem. 6. Develop JavaScript to implement loop for solving the given iterative problem. 7. Perform the specified string manipulation operation on the given String(s). 8. Implementation of JavaScript to design a form to accept input values for the given problem. 9. Use JavaScript to implement form events to solve the given problem. 10. Develop JavaScript to dynamically assign specified attribute value to the given form control create cookies based on the given problem. 11. Develop JavaScript to manage a cookie in the given manner. 12. 12. Implementing JavaScript to manipulate the specified attributes of window object in the given manner.	15	CO2

Suggested Readings

1. Xavier, C, "Web Technology and Design", New Age International Publications.
2. Bayross Ivan," HTML, DHTML. JavaScript, and PHP", BPB Publications.
3. Achyut S Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill.
4. Ramesh Bangia, "Internet and Web Design", New Age International.

5. Steven M. Schafer, "HTML, XHTML, and CSS Bible, 5ed", Wiley India
6. Ian Pouncey, Richard York, "Beginning CSS: Cascading Style Sheets for Web Design", Wiley India

Online Resources
1. https://html-iitd.vlabs.ac.in/
2. https://www.cybrary.it/practice-lab/introduction-to-programming-using-java-script

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	3	2	2		2	2	1	3	2	2
CO2	2		3		2	2	2	1	3	2		1	3	3

Course Articulation Matrix

SECOND SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**		II	
Course Name	Cyber Security				
Code	BCACSN12101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course comprises a unique mix of cybersecurity technical and real-world industry skills, brought to provide awareness on the impact of cybersecurity threats in key industries and geographies, analyze top targeted industries and trends and explore how cyber criminals are using operating system tools to get control.				
Course Outcomes					
CO1	Analyze top targeted industries and trends and explore how cyber criminals are using operating system tools to get control.				
CO2	Uncover why cyber criminals are changing their techniques to gain illegal profits and determine what steps you can take to protect your organization against these threats.				
CO3	Understand tools used by penetration testers and ethical hackers (network CLI tools, Telnet, SSH, Nmap, Wireshark, and many others).				
CO4	Leverage high-end security enterprise solutions in high demand such as: IBM QRadar SIEM, Vulnerability Manager and Participate in Security Operation Center (SOC) role-playing scenarios.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Understand the current impact of cyber security threats**: Research global cyber security trends in different geographies, familiarize with the taxonomy of cyberattacks, Explore the enterprise cyber security domains, Explore the most frequently targeted industry sectors including Government, Energy and Utilities, Retail and Telecom Explore the cyber resilience framework understand the cyber resilience lifecycle.	15	CO1
2	**Understand the need for a cyber-threat hunting approach:** Explore cyber-attack adversary frameworks, Investigate enterprise threat protection methods, Explore industry case studies **Understand network attack trends in the financial sector using crypto miners:** Understand how cyber criminals use networks in the dark web to perform illicit crime activities, Learn network protection practices like DNS, VPN, Understand enterprise network security practices through the analysis of an advanced persistent threat.	15	CO2
3	**Explore the mobile and IoT global phenomena:** Understand mobile and IoT attack surface, Explore recent most threatening IoT cyber-attack scenarios, Learn to protect your home and organization with endpoint protection practices **Understand the wide adoption of industry applications:** Learn web application fundamentals, Investigate application security practices, Examine the anatomy of the most dangerous applications threats **Understand the impact of data breaches and ransomware in Government and Health sectors:** Research the anatomy and impact of Insider Threat and Phishing cyber-attacks, of Research the anatomy and impact Ransomware and Cyber Fraud cyber-attacks, Explore a Healthcare end-to-end industry case study	15	CO3
4	**Understand the reason of the global enterprise adoption of cloud computing:** Understand the cloud security challenges	15	

| | brought by an integrated data, network, access infrastructure, Review the key cloud security practices for the enterprise, Explore a Telco cloud data breach scenario **Understand the drivers behind the enterprise adoption of Security Intelligence methods and tools:** Explore the characteristics of Security Information and Event Management (SIEM) platforms, Explore SIEM in Action through a real-life Phishing attempt scenario **Understand the Incident Response and Threat hunting practice:** Explore the benefits of establishing a SOC (security Operation Center), understand the roles and responsibilities of SOC Operations team. | | CO4 |

Suggested Readings
1. Cyber Security Practitioner by IBM Corporation.
2. IBM QRadar SIEM Foundations by IBM Corporation.

Online Resources
1. https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
3. https://cognitiveclass.ai/courses/apply-end-to-end-security-to-a-cloud-application

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3	1	2			1	1	1	2	2
CO2	3	2	3	3	3	2	1		2	1	1	1	2	2
CO3	3	2	3	3	3	2	2		2	1	1	1	2	2
CO4	2	2	2	2	2	1	2		2			1	2	2

Program	Bachelor of Computer Applications (CS & F)					
Year	I		Semester		II	
Course Name	Security Data Privacy Laws and Standards					
Code	BCACSN12102					
Course Type	DSC		L	T	P	Credit
Pre-Requisite			2	0	0	2
Course Objectives	This course will examine legal, policy, and enterprise issues and problems related to security and privacy Learn about the Cyber Fraud and its Protection and Knowledge of laws and regulations concerning information security from both data protection and law enforcement perspectives, Knowledge and implementation of Cyber Laws with Electronic data will be the focus, but other forms of information also will be considered.					
Course Outcomes						
CO1	An understanding of concepts and expectations concerning privacy and the increasingly interconnected issue of security and Learn about Cyber Fraud and its Protection.					
CO2	Knowledge about internal and external audits and learn the various data privacy acts and IT Acts.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Cyber Law-Cybercrime:** Introduction to cybercrime and cyber law. Type of Cyber Crime. Law Enforcement and cybercrime, what is a Trusted system? Security Policies Methods of security, trusted operating system design, Assurance in Trusted Operated system, Knowing the basics of IP Addresses, Introduction to database, Security Requirements, Reliability and Integrity, Sensitive data, Inference, Multilevel databases, SQL Injections Vulnerability, Introduction, international cybercrime law and its case studies. Digital Piracy, Identity Theft, Cyber Bullying, Cyber Stalking, Cyber Harassment, Cyber Terrorism, Cyber Wars and Sex Crimes over Internet – Prostitution, Child Pornography.	15	CO1
2	**Security Implementation and Fraud Security Models:** Security planning, Risk analysis, Organization and security Policies, Physical Security. Securing the Operating System with Admin Privileges. Protecting Programs and data, Information and law, Rights of Employer Security, Case studies of Ethics, Digital Analysis, Digital Evidence and Forensic Tools, The Challenges of Password Management, Single Password v/s Multiple Passwords, Considerations for Using, Different Passwords for Different Applications, Good Password Management Policies and User System Security Features, Definition of Computer Fraud or Cyber Fraud – Characteristics Cyber Fraud Offense, fraud related Offenses. Law Enforcement Options, Methodologies for Hiding Evidence, Different methods for tracking down cybercrimes. Introduction to Security models, Multifactor authentication versus multi step authentication, Multifactor authentication methods; Time-based one-time password, Frameworks, Standards, Security Certification ISO 17799/ ISO 27001, System Security Engineering Capacity Maturity Model, Laws and Legal Framework for Information Security, Recovery, and risk analysis.	15	CO2

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

Online Resources
1. https://www.talend.com/resources/data-privacy/
2. https://www.varonis.com/blog/data-privacy
3. https://cognitiveclass.ai/courses/apply-end-to-end-security-to-a-cloud-application

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	1	1		1		1	1	2	2
CO2	1	2	1	2	2	1	2					1	2	2

Course Articulation Matrix

Program	Bachelor of Computer Applications (CS & F)						
Year	I		**Semester**			II	
Course Name	Operating System						
Code	BCACSN12103						
Course Type	DSC		**L**	**T**	**P**	**Credit**	
Pre-Requisite			3	1	0	4	
Course Objectives	To provide a good understanding of the underlying concepts of operating systems.						
Course Outcomes							
CO1	Understand the principles and techniques used to implement processes and threads as well as the different algorithms for process scheduling.						
CO2	Understand the mechanisms used for process synchronization & handling deadlock.						
CO3	Understand the concept of memory management and virtual memory.						
CO4	Understand the file system structure and storage management.						

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction and Process Management:** Operating System: System Components, System Calls and its types, System Programs; Types of Operating System; Operating System Structure: Simple Structure, Layered Approach, Microkernels, Exokernels; Virtual machine; Introduction to Process: Process States, Process Control Block; Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Scheduling Objectives, Scheduling Criteria; Scheduling Algorithms: First Come First Serve, Shortest Job First, Round Robin, Priority; Multiple-Processor Scheduling; Real-Time Scheduling; Multilevel Feedback Queue Scheduling; Threads.	15	CO1
2	**Process Synchronization and Deadlocks**: Critical- Section Problem; Peterson's Solution; Semaphore: Usage of Semaphore; Classical Problems of Synchronization: Producer Consumer, Readers-Writer, Dining Philosophers; Deadlock System Model; Deadlock Characterization: Necessary Condition, Resource- Allocation graph; Deadlock Handling Methods: Deadlock Prevention, Deadlock Avoidance Mechanisms: Resource Allocation graph Algorithm, Banker's Algorithm, Deadlock Detection and Recovery.	15	CO2
3	**Memory Management**: Memory Management Strategies: Address Binding, Logical and Physical Address Space, Dynamic Linking; Swapping; Contiguous and Non- Contiguous Memory Allocation; Paging; Segmentation; Virtual Memory Management Concept; Demand Paging; Page Replacement Policies: Basic Page Replacement, FIFO Page Replacement, LRU Page Replacement, Optimal Page Replacement, Counting Based Page Replacement; Allocation of Frames: Minimum Number of Frames, Allocation Algorithm, Global Versus Local Allocation; Thrashing: Cause of Thrashing, Working Set Model.	15	CO3
4	**Storage Management:** File Concept: File Attribute, File Operations, File Types**,** File Structure; File Access Method: Sequential Method, Direct Access Method; Directory Structure; File System Implementation: File System Structure, Allocation Methods**,** Free space Management; Secondary Storage Structure: Disk Structure**,** Disk Scheduling Algorithms**,** Disk Management.	15	CO4

Suggested Readings

1. Abraham Silberschatz and Peter Baer Galvin, "Operating System Concepts", Addison-Wesley.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall.
3. Milan Milankovic, "Operating Systems, Concepts and Design", TMH.
4. William Stallings, "Operating Systems: Internal and Design Principles", PHI.
5. D M Dhamdhere, "Operating System- a Concept based Approach", McGraw Hill Education.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105214/
2. https://onlinecourses.nptel.ac.in

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					2	2			1	1	3	2	
CO2	3	3		3	2	2	3			2	1	3	2	
CO3	2	2		2		1				2	2	3	2	
CO4	2	1		2	1	2	1			1	1	2	2	

Program	Bachelor of Computer Applications (CS & F)				
Year	I		Semester		II
Course Name	Basic of Python Programming				
Code	BCACSN12104				
Course Type	DSC		**L**	**T**	**P**	**Credit**
Pre-Requisite			3	1	0	4
Course Objectives	This subject provides in-depth knowledge of developing and debugging Python Programs using core data structures like Lists, Dictionaries, Tuples, and Strings as well as understand the concept of functions, modules and file handling and classes and objects.				
Course Outcomes					
CO1	Acquire programming skills in core Python using various programming constructs.				
CO2	Implement Python programs using functions and strings.				
CO3	Implement methods to create and manipulate lists, tuples, and dictionaries.				
CO4	Apply the concepts of file handling and basic introduction to object and classes.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Python:** Introduction to python ,History of python, Installing python, Executing python programs, Comments in python, Internal working of python, Python Implementations, Difference between Python2 and Python3, Indentation , Python character set, Tokens; **Core Data Types:** Integer, Floating Point Number, Complex Number, Boolean Type, String Type; print(), Assigning values to a variable, Multiple Assignments, input(), eval(), Formatting Number & String, Python inbuilt mathematical function, ord and chr Functions; **Python Operators & Expression:** Types of operators; Operator Precedence & Associativity. **Decision Statement:** if, if-else, nested if, multiway if-elif-else statement, conditional expression; **Loop Control Statement**: while Loop, for loop, range(), Nested Loops, break, continue, pass.	15	CO1
2	**Functions:** Syntax, use of function, return statement, parameters & arguments: Required argument, Default argument, Keyword Arguments, Variable length argument; Scope of a variable, Recursive function, Lambda function, Python Modules, Built-in Modules in Python: math, random, time & date module; **String:** str class, index[] operator, Traversing: for & while loop, Immutable strings, string operators: slicing, +, *; String operations: comparison, format(), split(), Built-in method: Testing String, search a substring, convert string from one to another, stripping String, Formatting String	15	CO2
3	**Lists:** Creation, list(), Accessing Elements in List, Negative List Indices , List Slicing[start: end], Built-in list class Methods, List operators, List Comprehension, List &Strings, Passing list to a function and returning from a function; **Tuple:** Creation, tuple(), Built-in tuple class methods, Indexing & slicing, Operations on tuple, Variable length tuple to functions, List & Tuple, Sort, Traverse, zip(), Inverse zip(*); **Sets**: Creation, set(), set operator, Built-in set class methods, Set operations: union(), intersection(), difference(), symmetric_difference().	15	CO3
4	**Dictionary**: Creation, dict(), Adding values, Replacing values, Retrieving Values, Formatting, Deleting items, Comparing,		

	Built-in dict class methods, Traversing, Nested Dictionary, Traversing Nested Dictionary; **File Handling:** File Path, Types of Files, Opening and closing files, reading and writing files, file positions, renaming and deleting files, directory methods; **Classes and Objects:** Defining Classes, Creating objects, self-parameter and adding methods to a class.	15	CO4

Suggested Readings

1. Ashok N. Kamthane & Amit A. Kamthane, "Programming and Problem Solving with Python", McGraw Hill Educations
2. Reema Thareja, "Python Programming using problem solving approach", Oxford University press, 2017. ISBN-13: 978-0199480173
3. Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning, ISBN: 978-1111822705.
4. Guido Van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011
5. Jake VanderPlas ,"Python Data Science Handbook", O'Reilly Publications
6. David Beazley, "Python Essential Reference (4th Edition) "Addison Wesley
7. Vernon L. Ceder," The Quick Python Book, Second Edition", Manning Publications

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106182/
2. https://mrcet.com/downloads/digital_notes/CSE/III%20Year/PYTHON%20PROGRAMMING%20NOTES.pdf
3. https://rajivbhandari.files.wordpress.com/2018/11/nptel-6.pdf

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2	1	2		2	3	1	1	3	3
CO2	2	2	1		2	1	2		2	2		2	2	2
CO3	1	2	2	2		2	1			1	1	2	3	2
CO4	2		2		2	2			3	1	1	3	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**		II	
Course Name	Digital Security and Forensic Fundamental				
Code	BCACSN12111				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective of this course is to provide students with a fundamental understanding of digital security and forensic concepts, including digital threats and attack methods, security measures and controls, incident investigation and response, and legal and ethical considerations in the digital domain				
Course Outcomes					
CO1	Students will be able to demonstrate a foundational understanding of digital security and forensic concepts.				
CO2	Students will be able to identify digital threats, apply security measures, analyze, and investigate security incidents.				
CO3	Students hand on practice with Open-source Digital Forensics Platform and tools.				
CO4	Evaluate and implement measures to secure digital systems and networks, including the ability to assess vulnerabilities, design and implement security controls				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Digital Security**: Digital Security Threats and Attack Methods, Principles of Information Security, Operational Security (OPSEC), People's Role in Information Security, Access Control and Authentication, Physical Security, Cryptography and Encryption, Public Key Infrastructure, Digital Signatures, Steganography and Covert Channels, Network Security Fundamentals	15	CO1
2	**Internet and Web Application Security:** IP level security, IPSEC, Transport Layer Security, Application Layer Security: PGP, Firewalls, VPN, Email security: PGP and SMIME, Email Forensics, Web Security: Web authentication, Injection Flaws, SQL Injection, Web Browser Security, E-Commerce Security, Physical Security.	15	CO2
3	**Digital Forensics:** Digital Forensics Fundamentals, Incident Response and Investigation Techniques, Preservation, Collection, and Analysis of Digital Evidence, Chain of Custody, Windows, UNIX file system, Computer Artifacts, Hardware Specific Acquisition—SIM cards, Cell Phone, USB storage, etc., Data Type Acquisition—audio files, video files, image files, network files, log files, Forensic Tools	15	CO3
4	**Digital Forensics Tools and Techniques**: Open-Source Digital Forensic Tool: Autopsy, The Sleuth Kit, Volatility, OpenStego, Wireshark, Ghiro, Log2Timeline, OSForensics, Understanding Forensic Imaging, DFF (Digital Forensics Framework) & LibreOffice, Introduction to memory forensics, Data Recovery, Legal and Ethical Considerations in Digital Forensics, Rules of evidence, Forensic Reporting.	15	CO4

Suggested Readings

1. M. E. Whitman and H. J. Mattord, "Principles of Information Security," 2018.
2. J. R. Vacca, "Computer Security and Digital Forensics: Fundamentals of Digital Forensics," 2016.
3. M. T. Britz, "Digital Forensics and Cyber Crime: An Introduction," 2013.
4. B. Nelson, A. Phillips, and C. Steuart, "Guide to Computer Forensics and Investigations," 2019.
5. Altheide and H. Carvey, "Digital Forensics with Open-Source Tools," 2011.

Online Resources

1. Volatility: https://github.com/volatilityfoundation/volatility
2. Autopsy: https://www.autopsy.com/
3. Redline: https://fireeye.market/apps/211364
4. Velociraptor: https://github.com/Velocidex/velociraptor

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2	2		2	2	1			1			1	2	2
CO2	2	3	2	3	2	1	1			1	1	1	2	2
CO3	3	2	1	2	2	1	1		1	1		1	2	2
CO4	2	3	1	1	2	1	1		1	1		2	3	2

Program	Bachelor of Computer Applications (CS & F)					
Year	I		Semester		II	
Course Name	Forensic Incident Management					
Code	BCACSN12112					
Course Type	GE		L	T	P	Credit
Pre-Requisite			3	1	0	4
Course Objectives	The objective of the Incident Management course is to equip students with the knowledge and skills required to effectively manage and respond to cyber incidents. Through a combination of theoretical learning and hands-on exercises, students will gain a comprehensive understanding of incident identification, assessment, prioritization, and response strategies within the field of cyber forensics.					
Course Outcomes						
CO1	Demonstrate a comprehensive understanding of incident management principles and processes within the cyber domain.					
CO2	Apply effective incident response strategies to minimize the impact of cyber incidents and mitigate further risks.					
CO3	Communicate and coordinate effectively with stakeholders during incident response activities, including IT teams, management, and law enforcement if necessary.					
CO4	Evaluate and improve incident management processes, including the ability to conduct post-incident analysis, identify lessons learned, and implement preventive measures.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Incident Response:** Seven Stage of Incident Response, Incident Response Life Cycle, Post Incident Activity, The Security Incident Response Team Members, Types of Technical Skills Needed, Types of Personal Skills Needed, Incident Evidence, Incident Response Tools, Incident Response Policies, and procedures, SIRT IR Policies, Corporate IR Strategy and General Use Security Polices.	15	CO1
2	Forensics Process, Forensics Team Requirements Members, Member Criteria, Member Expertise, Member Certification, Forensics Team Policies and Procedures, Forensics Analysis Process, Data Collection, Chain of Custody, Evidence Handling and Control, Evidence "Hand-Over" to External Parties, LEO. Hardware Specific Acquisition – SIM Card, Cell Phone, USB Storage, Data Type Acquisition – Audio Files, Video Files, Image Files, Network Files, Log Files, Forensics Tools, Types of Forensics Tools, Tools for Specific Operating Systems and Platforms,	15	CO2
3	Legal Requirements and Considerations, Privacy, Ethics, Governmental Law, Polices and Procedures. Legalities of Forensics, Reasons for Legal, Statutory, And Regulatory Compliance, National Level Institutions dealing with Cyber Crimes in India, **Cyber Crime Reporting Portal:** Introduction, Process of Reporting cyber fraud or complaint, Cyber Policing, **Cyber Crime Investigation:** Evidence Act, Sections 43, 65 to 78 of IT Act. Sections 107, 109, 120B, 201, 378, 410 415 417 and 420 of the Indian Penal Code (IPC)	15	CO3
4	General Management and Team, General Team Management, Cooperate Level Management Considerations, Corporate Need to Support the Team Activities, Third Party Support During and	15	CO4

After Events, Corporate IT-Related Security Relationship with SIR & FT, Relationship Management, Incident Response Team, CSIRT		

Suggested Readings

1. J. T. Luttgens, M. Pepe, and K. Mandia, "Incident Response & Computer Forensics," 2014.
2. Judicial Academy Jharkhand, "Cyber Crime: Investigation and Trail Under Under the Current Law", www.jajharkhand.nic.in
3. M. T. Britz, "Computer Forensics and Incident Response," 2014.
4. L. Johnson, "Computer Incident Response and Forensics Team Management: Conducting a Successful Incident Response," 2014.
5. E. C. Thompson, "The Art of Incident Response: A Comprehensive Guide to Modern Incident Response," 2018.

Online Resources

1. Volatility: https://github.com/volatilityfoundation/volatility
2. Autopsy: https://www.autopsy.com/
3. Redline: https://fireeye.market/apps/211364
4. Velociraptor: https://github.com/Velocidex/velociraptor

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	2			1	1		1	2	2
CO2	1	2	1	2	2	1	2		1	1			2	2
CO3	1	2		1	1	1	2					1	2	2
CO4	1	2		2	1	2	1					1	3	2

Program	Bachelor of Computer Applications (CS & F)					
Year	I		Semester		II	
Course Name	Basics of Python Programming Lab					
Code	BCACSN12151					
Course Type	DSC-Lab		L	T	P	Credit
Pre-Requisite			0	0	4	2
Course Objectives	It provides the practical implementation of developing and debugging Python Programs using core data structures like Lists, Dictionaries, Tuples, and Strings as well as understand the concept of functions, modules and file handling and classes and objects.					
Course Outcomes						
CO1	Acquire programming skills in core Python using various programming constructs, functions, and strings.					
CO2	Implement methods to create and manipulate lists, tuples and dictionaries, file handling and basic introduction to object and classes.					
Module	Course Contents				Contact Hrs.	Mapped CO
1	1. Installing and configuring Anaconda on windows, Linux or mac. 2. Introduction to Jupyter lab, Variables, keywords, basics operation in python, Taking input in jupyter, console. 3. Taking multiple inputs from user in Python operators' implementation 4. Displaying Output using print () function, using end parameter in print (), 5. Practical implementation of the constructs like if, else, if elif ladder. 6. Implementation of range function in for loop. 7. Implementation of Special keyword - in and is, 8. Implementation of looping constructs using for loop, range function, and examples use of enumerate, zip function. 9. Implementation of strings in python, single quoted/double quoted/triple quoted Strings, string functions - split, trim, join, format, replace, count, find, index, rjust, ljust, center, upper, lower.				15	CO1
2	1. Practical implementation of list, creation and traversal, list functions - append, insert, extend, remove, pop, clear, sort, count, index, copy. 2. Practical implementation of tuples, creation, and traversal, 3. Practical implementation of Set, creation, and traversal, set functions - add, update, remove, clear, pop, union, intersection, difference, disjoint, subset, superset. 4. Practical implementation of Dictionary, creation and traversal, dictionary function - get, update, keys, items, values. 5. Creating functions in Jupyter calling function, argument-based functions, different type of style for passing parameter in python. 6. Making module for functions and importing them different types of imports in python. 7. Implementing random and math module OS module for file and folder operation.				15	CO2

	8. Creating a python program to open a file and check what are the access permissions acquired by that file using OS module.
	9. Creating a python program to open and write "hello world" into a file.
	10. Creating a python program to write the content "hi python programming" for the existing file.
	11. Creating a python Program to display welcome to MRCET by using classes and objects.
	12. Creating a python Program to call data member and function using classes and objects.
	13. Creating a program to find sum of two numbers using class and methods

Suggested Readings

1. Ashok N. Kamthane & Amit A. Kamthane, "Programming and Problem Solving with Python", McGraw Hill Educations
2. Reema Thareja, "Python Programming using problem solving approach", Oxford University press, 2017. ISBN-13: 978-0199480173
3. Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning, ISBN: 978-1111822705.
4. Guido Van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
5. Jake VanderPlas "Python Data Science Handbook" O'Reilly Publications
6. David Beazley, "Python Essential Reference (4th Edition) "Addison Wesley
7. Vernon L. Ceder," The Quick Python Book, Second Edition", Manning Publications

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106182/
2. https://mrcet.com/downloads/digital_notes/CSE/III%20Year/PYTHON%20PROGRAMMING%20NOTES.pdf
3. https://python-iitk.vlabs.ac.in/

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2	1	2		2	3	1	1	3	3
CO2	2	2	1		2	1	2		2	2		2	2	2

THIRD SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	II	Semester	III		
Course Name	Identity Access Management				
Code	BCACSN13201				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	Defining and managing the roles and access privileges of individual network users thecircumstances in which users are granted (or denied) those privileges. Digital identity has been established, it must be maintained, modified and monitored throughouteach user access lifecycle.				
Course Outcomes					
CO1	To understand basics of Identity access management.				
CO2	To understand the single sign on, access control and password management.				
CO3	Learn about the Kerberos, certificate authorities and multi-factor authentication.				
CO4	To understand role of identity manager and privileged identity manager.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**INTRODUCTION TO IAM:** Identity Management (IdM), Access Management (AM), Five Elements of Security, Key concepts of Identity and Access Management, Uniting Identity and Access Management; **IAM FOR AN ENTERPRISE:** Business Challenge, IAM Strategy Framework, Identity Management Drivers, Cost of IAM Over Time, Business Drivers of IAM; **INTRODUCTION TO LDAP:** Directories, LDAP: Protocol or Directory, LDAP History and Standards, Directory Components; **LDAP CONCEPTS & ARCHITECTURE:** Overview of LDAP Architecture, The Informational Model, THE NAMING MODEL, Functional Model, Security model, Directory security.	15	CO1
2	**SINGLE SIGN-ON TECHNIQUES:** Introduction, Types of Single Sign-On, Single sign-on Protocols; **ACCESS CONTROL:** Discretionary Access Control (DAC), Mandatory Access Control (MAC), Role Based Access Control (RBAC), Attribute-based access control (ABAC), Static Separation of Duty (SSoD), Dynamic Separation of Duty(DSoD), Fine grained and coarse-grained access control; **PASSWORD MANAGEMENT:** The Challenges of Password Management, Single Password v/s Multiple Passwords, Considerations for Using Different Passwords For Different Applications, Good Password Management Policies and User, System Security Features.	15	CO2
3	**INTRODUCTION TO FEDERATION**: Kerberos and SPNEGO, Federated Identity Management Architecture, Security Assertion Markup Language, OAuth 2.0 concepts, OpenID Connect federations; **ORIGIN OF MULTI FACTOR AUTHENTICATION:** Multi-factor authentication versus multi-step authentication, multi-factor authentication methods, Time-based one-time password, HOTP vs TOTP: What's the Difference; **AUDITING & REPORTING:** Auditing, The Role of Internal Auditors, Reporting Audit Results, Protecting Audit Results, Using External Auditors.	15	CO3

4	**INTRODUCTION TO IDENTITY MANAGER:** Identity Manager, Centralized User Management, Simplify User Management, Lifecycle Management, Access Control Models of Identity Manager, Corporate Regulatory Compliance Using Identity Management, The Approach: Integrated IAM Governance with Intelligence and Accountability; **PRIVILEGED IDENTITY MANAGER:** Privileged IDs and why they are a problem, Privileged Identity Manager, Introducing IDaaS.	15	CO4

Suggested Readings:

1. Enterprise Identity & Access Management by IBM Corporation.
2. An Executive Guide to Identity and Access Management by Alasdair Gilchrist.

Online Resources:
1. https://nptel.ac.in/courses/106106222

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	1			1	2	1	2	1	1
CO2	2	1	1	1	2	2			1	2	1	2	1	1
CO3	2	2	1	1	2	1			2	1	1	2	2	2
CO4	2	2	1	1	3	2			2	2	1	3	2	2

Program	Bachelor of Computer Applications (CS & F)					
Year	II		**Semester**	III		
Course Name	Linux and Shell Programming					
Code	BCACSN13202					
Course Type	DSC		**L**	**T**	**P**	**Credit**
Pre-Requisite			3	1	0	4
Course Objectives	To present the fundamental concepts of LINUX. To get an understanding of Multiuser, Multitasking and Timesharing System. To introduce the significance of Open-Source Software. Introduction of GUI of LINUX. Introduction of Shell programming for solving various problems.					
Course Outcomes:						
CO1	Develop the understanding of LINUX Operating System.					
CO2	Get the understanding of Redirection, Filters and LINUX Utilities.					
CO3	Ability to understand the functioning of vi editor.					
CO4	Ability to write Shell Scripts using Linux commands.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to LINUX:** Difference between UNIX & LINUX, Features of LINUX, LINUX system organization (the kernel and the shell), Files and directories, Hierarchical File Structure, Basic LINUX Commands: PATH, man, echo, passwd, uname, who, date, stty, pwd, cd,mkdir, rmdir, ls, cp, mv, rm, cat, more, wc.; Introduction to LINUX file system: Boot block, super block, Inode table, data blocks; Library Functions versus System Calls.	15	CO1
2	**Input Output Redirection & LINUX Utilities:** Input Output Redirection, File handling utilities; Security by file permissions: chmod, umask, sticky bit; disk utilities-du, df; find & ulimit; Process utilities; Filters: Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count Characters, Words or Lines, Comparing Files.	15	CO2
3	**vi editor:** Types of editors, Basic features, modes of execution in vi editor, commands for Creating & saving a file and quitting from vi, Cursor movement, Text insertion, changing and replacing text, deleting text, searching the text, Pattern Matching of text, various options to: set command, Writing, Compiling and Running a C program on Linux.	15	CO3
4	**Shell Programming:** Types of shells, Shell Meta characters, Shell keywords, Shell variables, Scripting Basics , Creating Shell scripts, Shell commands, the environment, Environmental Variables, Integer arithmetic and string manipulation, Special command line characters; Decision making and loop control; File Tests, String Tests, continue and break; Using positional parameters, changing Positional Parameters, Generating Output, Handling Input, Exit Status of a Command, eval Command; Argument Validation, Debugging Scripts, Script Examples, Arrays; String Functions, Mathematical Functions, User Defined Functions, Applications.	15	CO4

Suggested Readings:
1. Sumitabha Das, "Unix Concepts and Applications", TMH.
2. Yashwant Kanetkar, "Unix Shell Programming", BPB.
3. Parata, "Advanced Unix–A Programmer's Guide", BPB.
4. Behrouz A. Forouzan, Richard F. Gilberg, "Unix and shell Programming", Thomson Asia.
5. M.G. Venkateshmurthy, "Unix & Shell Programming", Pearson Education.

Online Resources:
1. http://www.nptel.com/computerscience/Linuxprogramming
2. http://manuals.bioinformatics.ucr.edu/home/linux-basics

<table>
<tr><td colspan="15" align="center">Course Articulation Matrix</td></tr>
<tr><td>PO-PSO</td><td>PO1</td><td>PO2</td><td>PO3</td><td>PO4</td><td>PO5</td><td>PO6</td><td>PO7</td><td>PO8</td><td>PO9</td><td>PO10</td><td>PO11</td><td>PO12</td><td>PSO1</td><td>PSO2</td></tr>
<tr><td>CO1</td><td>2</td><td></td><td>2</td><td>1</td><td>1</td><td>2</td><td></td><td></td><td>1</td><td></td><td></td><td>2</td><td>1</td><td>2</td></tr>
<tr><td>CO2</td><td>2</td><td></td><td>2</td><td>1</td><td>2</td><td>2</td><td></td><td></td><td>1</td><td></td><td></td><td>2</td><td>1</td><td>1</td></tr>
<tr><td>CO3</td><td>2</td><td></td><td>2</td><td>1</td><td>2</td><td>2</td><td>1</td><td></td><td>2</td><td></td><td></td><td>2</td><td>1</td><td>2</td></tr>
<tr><td>CO4</td><td>2</td><td></td><td>3</td><td>2</td><td>1</td><td>2</td><td>1</td><td></td><td>1</td><td></td><td></td><td>3</td><td>2</td><td>2</td></tr>
</table>

Program	Bachelor of Computer Applications (CS & F)				
Year	II	Semester		III	
Course Name	Computer Network Security				
Code	BCACSN13203				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	After studying this course, students should be able to understand and describe the layered protocol model, analyze and evaluate a number of data link, network, and transport layer protocols. They will understand and building the skills of sub netting and routing mechanisms along with the security features involved in networking.				
Course Outcomes					
CO1	Build an understanding of the fundamental concepts of computer networking and security.				
CO2	Familiarize with the basic taxonomy and terminology of the computer networking area.				
CO3	Describe how computer networks are organized with the concept of layered approach.				
CO4	Introduce to advanced networking concepts, preparing for advanced courses in computer networking and security.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Computer Network and Network Security:** Goals and Application of Network, Network Types, Protocols and Standards, Switched and Broadcast Network; Topology; Switching; Multiplexing; Transmission Medium; References Models: OSI Model, TCP/IP Protocol Suite; Example of Networks; Network Security Goals; Attack Threating; Cryptography; Stenography; Obfuscation; Security Services and Mechanism.	15	CO1
2	**Data Link Layer:** Functions of Data Link Layer: Error Detection and Correction; Framing, Flow and Error control, Stop-and-wait Protocol, Go-Back-N Automatics Repeat Request, HDLC; Random Access: ALOHA, CSMA/CD, CSMA/CA; Sliding Window protocols; Error Handling; Channelization; IEEE Standards; Ethernet; Intermediary Network Devices.	15	CO2
3	**Network Layer: Functions of Network Layer**: IPv4 Addresses, IPv6 Addresses; Mapping Logical to Physical Address; Mapping Physical to Logical Address; Routing Protocols; Tunnelling; Fragmentation; OSPF; Network Performance; Congestion Control Mechanism.	15	CO3
4	**Transport Layer, User Defined Layer and IP Security:** Function of Transport Layer; TCP; UDP; QoS; Security at Transport Layer; Function of Presentation and Session Layer; Application Layer: DNS, DDNS, TELNET, E-Mail, SMTP, FTP, WWW and HTTP; Architecture and Security of E-mail; SSL Architecture; Four Protocols; Firewall; IPSec: AH, ESP, IKE.	15	CO4

Suggested Readings:
1. Andrew S Tanenbaum, David. J. Wetherall, "Computer Networks", Pearson Education.
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill.
3. William Stallings, "Network Security Essentials: Applications and Standards", Prentice Hall.
4. Michael T. Goodrich and Roberto Tamassia, "Introduction to Computer Security", Addison Wesley.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/105/106105162/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	3	2	2	2	1	2	1		1	1	1	2	2	1
CO2	1	1		1	2	2	1		2	1	1	1		1
CO3	1	2	1	2	1	2	1		2	1	1	2	1	2
CO4	3	2	2	2	3	2	1		2	2	2	2	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II		Semester		III
Course Name	Introduction to System Security				
Code	BCACSN13204				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	0	0	3
Course Objectives	In this course, student will systematically study the fundamental principles of computer system security, including access control, security policies, software vulnerabilities, web security and various authentication mechanisms.				
Course Outcomes					
CO1	To understand the basic of system security.				
CO2	To learn about how to maintain the system's security i.e., confidentiality, integrity and availability through different cryptographic techniques.				
CO3	To understanding the basic concept of security policies.				
CO4	Student will be able to understand the basics of system security, policies, cryptographic algorithms, and its issues along with its countermeasures				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**System Security:** Introduction to System Security, Aspects of System Security, Need for Security, Goals of System Security, Features of a Good Security Policy, Security Attacks, Security Services and Mechanisms.	12	CO1
2	**Concepts of Security:** Principles of Security Steganography, Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Block Cipher Principles, Block Cipher Modes of Operation, Transposition Techniques, Encryption and Decryption, Conventional Encryption Model, Data Encryption Standard (DES) Algorithm, Strength of DES	12	CO2
3	**Security Policies:** Introduction to Security Policy, Types of Security Policies, Role of Trust, Types of Access Control. Security Policies: Confidentiality, Integrity, Availability and Hybrid Policies, Academic Computer Security Policy: General University Policies, Electronic Mail Policies.	12	CO3
4	**Authentication:** Basics of Authentication, Passwords: Attacking a Password System, Countering Password Guessing, Password Challenge-Response, Biometrics: Fingerprints, Faces, Voices, Eyes and Combinations, User Security, Program Security: Introduction to Program Security, Policy and Requirements.	12	CO4

Suggested Readings:
1. Matt Bishop, "Introduction to Computer Security", Addition Wesley.
2. William Stallings, "Computer Security: Principles and Practices", Pearson Education.
3. Berouz Forouzan, "Cryptography and Network Security", TMH.
4. John R. Vecca, "Network and System Security", Syngress.

Online Resources:

1. https://archive.nptel.ac.in/noc/courses/noc15/SEM1/noc15-cs03/

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1		1	1		1			1		1
CO2	1	2	1	1	1	1	1		1			1	1	2
CO3		1	2	2		1	1		1	1	1	1		1
CO4	2	2	3	2	2	2	1		3	2	2	2	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II	Semester	III		
Course Name	Big Data Fundamentals				
Code	BCACSN13211				
Course Type	GE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces the foundational concepts of big data, focusing on the technologies and methodologies used to process, store, and analyze large volumes of data. Students will learn about distributed computing, Hadoop ecosystem components, NoSQL databases and data visualization techniques. Students will develop practical skills in managing, querying, and analyzing big data, preparing them for roles in data engineering, data science, and analytics.				
Course Outcomes					
CO1	To understand the basic concept of Big Data.				
CO2	To understand the fundamentals of Apache Hadoop.				
CO3	To understand the basics of Apache Hadoop and Map Reduce.				
CO4	To understand the Hadoop eco system frameworks.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Big Data:** Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features, security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.	15	CO1
2	**Hadoop:** History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes; Map Reduce: Map Reduce framework and basics, how Map Reduce works, developing a Map Reduce application.	15	CO2
3	**Hadoop Eco System and YARN:** Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features, NameNode high availability, HDFS federation; NoSQL Databases: Introduction to MongoDB, data types, creating, updating and deleing documents, querying, introduction to indexing, capped collections.	15	CO3
4	**Hadoop Eco System Frameworks:** Applications on Big Data using Hive and HBase; Hive: Apache Hive architecture and installation, Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions, sorting and aggregating, Map Reduce scripts, joins & subqueries; HBase: Hbase concepts, clients, example, Hbase vs RDBMS, advanced usage, schema design, advance indexing,; Zookeeper: how it helps in monitoring a cluster, how to build applications with Zookeeper.	15	CO4

Suggested Readings:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley
2. DT Editorial Services, Big-Data Black Book, Wiley
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers and Techniques", Prentice Hall.
5. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)", John Wiley & Sons

Online Resources:
1. https://archive.nptel.ac.in/courses/106/108/106108058/

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	3	1		1	2	1	2	1	1
CO2	3	3	1	2	3	3	1		1	3	1	2	1	1
CO3	3	3	1	3	3	3	1		2	3	1	3	2	2
CO4	3	3	1	3	3	3	1		2	3	1	3	2	2

Program	Bachelor of Computer Applications (CS &F)				
Year	II		Semester	III	
Course Name	Emerging Technologies				
Code	BCACSN13212				
Course Type	GE	L	T	P	Credit
Pre- Requisite		3	1	0	4
Course Objectives	This course covers emerging technologies and cyber security challenges, equipping students to protect these technologies.				

Course Outcomes

CO1	To understand IoT and Cyber Security fundamentals, identify related threats, and apply solutions. To grasp the impact of cyber security incidents through case studies.
CO2	To understand Energy and Sustainability Technologies fundamentals and the role of Cyber Security, and to grasp the impact of cyber security incidents through case studies.
CO3	To understand AR & VR fundamentals, identify security challenges, and apply the best solutions. To grasp the impact of cyber security incidents in these technologies through case studies.
CO4	To Understand the fundamental concepts of Quantum Computing, role of cyber security, understanding the future of Quantum Computing in Cyber Security in through case study.

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Internet of Things (IoT):** Introduction to IoT, Cyber security versus IoT Security, Understanding IoT Architecture, The IoT Ecosystem, IoT Security Challenges, Vulnerabilities, attacks on IoT Systems, Common IoT attack types, Attack trees, IoT Security Solutions and Best Practices, Case Study: IoT Security Incidents.	15	CO1
2	**Energy and Sustainability Technologies:** Introduction to Energy Technologies, Types of energy technologies (fossil fuels, renewable energy, nuclear energy, energy storage, energy efficiency), Role of Cybersecurity in Energy Technologies (protecting energy infrastructure, securing data, ensuring operational continuity, compliance with regulations, building trust), Sustainability and Cybersecurity, Security Challenges in Green Technologies, Case Study: Cyber Attacks on Energy Infrastructure.	15	CO2
3	**Augmented Reality (AR) and Virtual Reality (VR) :** Introduction to AR and VR, Understanding AR/VR Technologies, perceptual aspect in AR/VR, Input devices and tracking, output devices in AR/VR, Security Challenges in AR/VR, Cybersecurity in AR/VR(protecting user data, securing AR/VR devices, ensuring privacy, promoting trust training and awareness), Case Study: Security Incidents in AR/VR.	15	CO3
4	**Quantum Computing and Cybersecurity:** Introduction to Quantum Computing, Quantum bits, Bras and kets, Quantum State Representation, Bloch Sphere, gates, Entanglement, Quantum Computing and Cybersecurity, Quantum Cryptography, Case Study: The Future of Quantum Computing in Cybersecurity.	15	CO4

4	**Quantum Computing and Cybersecurity:** Introduction to Quantum Computing, Quantum bits, Bras and kets, Quantum State Representation, Bloch Sphere, gates, Entanglement, Quantum Computing and Cybersecurity, Quantum Cryptography, Case Study: The Future of Quantum Computing in Cybersecurity.	15	CO4

Suggested Readings:

1. Russel, B., & Van Duren, "Practical Internet of Things Security". Packt Publishing Ltd.
2. Lea, P., "IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security", Packt Publishing Ltd.
3. Randolph, J., & Masters, G. M., "Energy for Sustainability: Technology, Planning, Policy". Island Press1718192021.
4. Patel, P. D, "A systematic literature review on Virtual Reality and Augmented Reality in terms of privacy, authorization and data-leaks". ArXiv222324.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/ 106105166/
2. https://archive.nptel.ac.in/courses/115/101 /115101092/
3. https://onlinecourses.nptel.ac.in/noc24_ma64/ preview

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	2	1	2	2		2	1	1	1	2
CO2	2	2	1	1	2	2	2	2		2	1	1	1	2
CO3	2	1	2	1	2	2	1			2	1	2	2	2
CO4	2	1	2	1	1	2	1			2	1	2	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	II	Semester		III	
Course Name	Network Programming Lab				
Code	BCACSN13251				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		0	0	4	2
Course Objectives	The objectives of a network programming course typically aim to equip students with the knowledge and skills necessary to design, develop, and troubleshoot networked applications.				
Course Outcomes					
CO1	To demonstrate the different networks with network devices, client- server application environment.				
CO2	To introduce routing protocols and socket programming.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Window based commands in order to investigate and configure the network. 2. Implement TCP and UDP sockets. 3. Study of TCP/UDP performance. 4. Simulation of ARP and RARP. 5. Perform encryption and decryption using substitution and transposition techniques. 6. To learn handling and configuration of networking hardware like RJ-45 connector, CAT-6 cables, crimping tool, etc. 7. Configuration of router, hub, switch etc. (using real devices or simulators) Note: Students will also perform all other exercises provided by course instructor.	30	CO1
2	1. Simulation of Sliding Window Protocol. 2. Study of Network IP. 3. Simulation of DNS using UDP sockets. 4. Performance evaluation of Routing Protocols. 5. Implementation of Subnetting. 6. Create a socket for HTTP for web page upload and download. Note: Students will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings:
1. Andrew S Tanenbaum, David. J. Wetherall, "Computer Networks", Pearson Education.
2. Douglas E. Comer, "Hands-on Networking with Internet Technologies", Pearson Education.
3. Richard Stevens, "Unix Network Programming", Prentice Hall/Pearson Education.
4. James F. Kurose and Keith W. Ross "Computer Networking: A Top-Down Approach", Pearson Education.

Online Resources:
1. https://nptel.ac.in/courses/106105080
2. https://nptel.ac.in/courses/117105076

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1	1	1	2	1		1	1		1	1	1
CO2	1		1	1	2	1	1		1			1	1	1

Program	Bachelor of Computer Applications (CS & F)				
Year	II	Semester		III	
Course Name	Linux and Shell Programming Lab				
Code	BCACSN13252				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		0	0	4	2
Course Objectives	To provide the fundamental knowledge about LINUX operating system, its diverse commands related to file handling, disk, process utilities, redirection etc. Also familiarize the students to do shell programming using vi editor.				
Course Outcomes					
CO1	To demonstrate the basic knowledge of Linux commands and file handling utilities by using Linux shell environment.				
CO2	To introduce shell scripting for various applications.				
Module	Course Contents			Contact Hrs.	Mapped CO

1	1. Use of Basic LINUX Commands: PATH, man, echo,who passwd, uname, date, stty, pwd, cd,mkdir, rmdir, cat, ls, cp, mv, rm, more, wc
	2. Commands related to Input Output Redirection
	3. Commands related to File handling and Process utilities
	4. Commands related to Security by file permissions: chmod, umask, stickybit
	5. Commands related to disk utilities-du, df, find & ulimit
	6. Implementation of Filters and Pipes
	7. Using vi editor do the following things:
	    i) Cursor movement
	    ii) Text insertion
	    iii) Changing and replacing text
	    iv) Deleting text
	    v) Searching the text
	    vi) Pattern Matching of text
	    vii) Various options to: set command
	    viii) Compiling and Running a C program
	Note: Student will also perform all other exercises provided by course instructor.
				30	CO1

2	1. Write interactive shell scripts based on following:
	    i) Positional parameters
	    ii) Arithmetic and Logical Operators
	    iii) If-then-fi, if-then-else-fi, nested if-else, elif, case structure
	    iv) While, until and for loop
	    v) Shell Meta characters
	2. Write a Shell script that accepts a filename, starting and ending line numbers as arguments and displays all the lines between the given line numbers.
	3. Write a Shell script that deletes all lines containing a specified word in one or more files supplied as arguments to it.
	4. Write a Shell script that displays list of all the files in the current directory to which the user has Read, Write and Execute permissions.
	5. Write a Shell script that receives any number of file names as arguments checks if every argument supplied is a file or a directory and reports accordingly. If the argument is a file, the number of lines on it is also reported.
	6. Write a Shell script that accepts a list of file names as its arguments, counts and reports the occurrence of each word present in the first argument file on other argument files.
	7. Write a shell program to accept user name and reports if user log has logged in.
	Note: Student will also perform all other exercises provided by course instructor.
		30	CO2

Suggested Readings:
1. Sumitabha Das, "Unix Concepts and Applications", TMH.
2. Yashwant Kanetkar, "Unix Shell Programming", BPB.
3. Parata, "Advanced Unix–A Programmer's Guide", BPB.
4. Behrouz A. Forouzan, Richard F. Gilberg, "Unix and shell Programming", Thomson Asia.
5. M.G. Venkateshmurthy, "Unix & Shell Programming", Pearson Education.

Online Resources:
1. http://www.nptel.com/computerscience/Linuxprogramming
2. http://manuals.bioinformatics.ucr.edu/home/linux-basics

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2	1	1	2	1		1			2	1	1
CO2	2		2	2	2	2	1		1			2	1	1

FOURTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	II		Semester	IV	
Course Name	Apply End to End Security to Cloud Application				
Code	BCACSN14201				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	0	0	3
Course Objectives	To understand Cloud concepts, IBM cloud, ISO 27017-Cloud Security, PCIDSS Controls, Flips Levels, Cloud Data Life Cycle (CSUSAD), Physical and environmental protection and Audit Mechanism and Cloud Secure Development Life Cycle.				
Course Outcomes					
CO1	Able to deploy application on IBM Cloud.				
CO2	Able to understand how to work on containerization concept using Docker as a Tool and will work on Kubernetes.				
CO3	To learn basic concepts of Web-Application security.				
CO4	To get overview of Virtual Private Cloud and Network Delivery.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Security in cloud model:** Cloud Security Model, Cloud Broker Services, Introduction to IBM Cloud, Network Perimeter, What is Encryption, Cloud Foundry, Cryptographic Erasure, ISO 27017-Cloud Security 11114, NIST DP 800-53, PCI DSS Controls, FIPS Levels; **Enterprise Cloud management:** Management plan implementation, what is Forensic Science, Evidence Management, OECD Privacy Principles, eDiscovery, GDPR's Key Points, Gap Analysis, ISO 27001: 2013 Domains, Risk Terminology, The CSA STAR components, Supply Chain Risk.	12	CO1
2	**Cloud Data Life Cycle (CSUSAD) &DLP (data LossPrevention):** Key data function: Access Process and Store,Data functions mapping to the data life cycle, Controls,Data dispersion in cloud storage, Erasure Coding, Threat to storage types, Database encryption, Gateway encryption, Key storage in cloud.	12	CO2
3	**Containerization,** Container Orchestration, Data De-identification/anonymization, Tokenization, DLP (data Loss Prevention), Data Discovery, DRM (digital rights management), Crypto-shredding, Chain of Custody, Software-Defined Networking (SDN), Data center design standards, ENISA, Data protection risk, Risk assessment/Analysis, Automation of Controls, iSCSI.	12	CO3
4	**Audit Mechanism &Application Security:** Key regulations for CSP facilities, IAM, VPC, Understanding of Cloud environment, BCDR planning factors, Businessimpact analysis (BIA),Design phase, API types, Phases and methodologies, Cross-site scripting, Security misconfiguration , Threat Modelling, Software Supply- chain (API) management, ISO/IEC 27034-1; **IAM on Cloud:** Federated Identity management, SAML, WS federation, OAuth2.0, OpenID Connect, Reduced Sign-on (RSO), Database activity Monitor, Application Virtualization, Cloud Secure Development Life Cycle, Open Web Application Security Project (OWASP), VLANs, Distributed Resource Scheduling (DRS), Patch Management, Performance Monitoring, Intrusion Detection System.	12	CO4

Suggested Readings:

1. Ronald L. Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley.
2. John R. Vacca, Cloud Computing Security, CRC Press.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/106/106106129/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2	2	1	2	2	3	1		1	2	1	2	1	1
CO2	1	1	1	2	3	3	1		1	1	2	2	1	1
CO3	2	3	1	1	3	3	1		2	1	3	3	2	2
CO4	1	3	1	3	3	3	1		2	3	2	1	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	II		**Semester**	IV	
Course Name	Data Warehousing & Data Mining				
Code	BCACSN14202				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course provides an in-depth exploration of data mining and data warehousing techniques, methodologies, and applications. Students will learn how to extract valuable insights from large datasets, design and implement data warehouses, and apply data mining algorithms for knowledge discovery.				
Course Outcomes					
CO1	To understand the basic concept Data Warehousing and Data Mining.				
CO2	To understand the concept of preprocessing, OLAP and Frequent pattern Mining.				
CO3	To understand the concept of Classification.				
CO4	To understand the Concept of Clustering.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Mining and Data Warehousing:** Overview of data mining and knowledge discovery process, Role and importance of data warehouses, Key concepts and components of data mining and data warehousing; **Multi-Dimensional Data Model:** Introduction, Elements, steps in dimensional modeling, Multi-Dimensional Schema; **Data Warehouse Architecture:** The 3-Tier Data Warehouse Architecture, The Bus Architecture.	15	CO1
2	**Data Preprocessing:** Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Discretization; **Data Warehouse Modeling:** Data Cube, Typical OLAP Operations, Role of Concept Hierarchies, OLAP Server Architectures; **Mining Frequent Patterns:** Basic concepts Frequent Item set mining method: the Apriori Algorithm, Generating Association Rules from frequent item sets, FP Growth Algorithm.	15	CO2
3	**Classification:** General Approach to solving classification problems, Classification by decision Tree Induction: Attribute selection measure, Tree pruning; Bayesian Classification: Bayes' Theorem; Rule based classification, Model Evaluation and Selection.	15	CO3
4	**Cluster Analysis:** Cluster Analysis, Partitioning Methods: K-means clustering; Hierarchical Methods: BIRCH clustering; Density Based Methods: DBSCAN; Grid Based Methods: STING, Outlier Analysis; **Data Mining Ethics and Privacy:** Ethical considerations in data mining, Privacy-preserving data mining techniques.	15	CO4

Suggested Readings:
1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Elsevier.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", PHI
3. Max Bramer, "Principles of Data Mining", Springer.
4. Arun K Pujari, "Data Mining Techniques", University Press.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105174/

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	1	2	2	1		1	1	1	2	3	1
CO2	2	2	1	1	2	2	1		1	3	1	2	3	1
CO3	3	3	2	1	3	3	1		1	3	1	3	3	3
CO4	3	3	2	2	3	3	1		2	3	1	3	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II		Semester	IV	
Course Name	Server Side Scripting				
Code	BCACSN14203				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of this subject is to understand about server-side scripting languages, applying PHP programming principles and techniques for effective web development, developing form handling, validation and creating databases using MySQL.				
Course Outcomes					
CO1	To use different data types to design programs involving control flow and looping statements.				
CO2	To utilize the concept of Strings and arrays in PHP.				
CO3	To create functions in HTML forms and handling HTML forms using PHP.				
CO4	Able to understand MYSQL database and perform insert, update and delete operations and implementing and debugging programs in PHP and MYSQL for a specific application.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Server Side Scripting:** Role of web server software, server side scripting languages; **Introduction to PHP**: Structure, Syntax, Comments, Data Types, Variables, Operators, Assignments, Multiple Line Commands, Constants, Predefined Constants, echo& print statements; Built- in Functions; Expressions, Literals and Variables; **Operators:** Operator Precedence, Associativity; Conditional Statements; Looping Statements; Break, Continue; Implicit and Explicit Casting, Dynamic Linking.	15	CO1
2	**Strings:** Creating Strings, Concatenating Strings, Handling Newlines, HTML and PHP, Encoding and Decoding Strings, Finding Substrings, Replacing Parts of a String; **Arrays:** Creation, Adding Items, Accessing Array Elements, Multidimensional Arrays, Sorting Arrays, Transforming Between Strings and Arrays; **Graphics:** Creating Images, Images with text, Scaling Images, Creating pdf document.	15	CO2
3	**Functions:** Creating Functions, Functions with Arguments, Setting Default Argument Values, returning values from functions, Variable Scope; **Creating forms using PHP:** Simple Form, different Form Method, Receiving Form Data, Displaying Errors, Error Reporting; **Cookies:** Use of cookies, Attributes of Cookies, Modify and Delete Cookies.	15	CO3
4	**Creating Web Applications using Server-Side Scripting:** Templates, Constants, Working with Date and Time; **Database Handling:** Introduction to SQL, Connecting MySQL, Creating and Selecting Database, Creating Table, Inserting, Retrieving, Deleting and Updating Data in Database.	15	CO4

Suggested Readings:
1. Robin Nixon," Learning PHP, MySQL & JavaScript_ with jQuery, CSS & HTML5", O' Reilly Media.
2. Larry Ullman, "Php for the Web Visual Quickstart Guide", Peachpit Press.
3. Alan Forbes, "The Joy of PHP Programming: A Beginner's Guide to Programming Interactive Web Applications with PHP and MySQL", Plum Island.
4. Vikram Vaswani, "PHP: A Beginner's Guide", McGraw-Hill.

Online Resources:

1. https://spoken-tutorial.org/tutorial-search/?search_foss=PHP+and+MySQL&search_language=English

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2	2	2	2	2	2	1		3	3	1	2	2	3
CO2	2	2	2	1	2	2	1		3	2	1	2	2	2
CO3	2	3	2	1	2	3	1		3	2	1	2	3	2
CO4	3	3	2	2	2	3	1		3	2	1	2	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II	Semester	IV		
Course Name	CLOUD COMPUTING				
Code	BCACSN14211				
Course Type	GE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of this subject is to introduce the basic concept, types and characteristics of cloud computing with architecture and service models, familiarize the concepts Virtualization and its types in cloud computing and learn fundamental concepts and architecture of cloud computing security.				
Course Outcomes					
CO1	To understand basic concepts, principles and paradigm of Cloud Computing.				
CO2	To interpret various Cloud computing models and services.				
CO3	To identify the significance of implementing virtualization techniques.				
CO4	To understand the need of security in Cloud computing.				
Module	Course Contents		Contact Hrs.		Mapped CO
1	**Cloud Computing Basics:** History of Cloud Computing, Need for Cloud computing, Advantages and Possible Disadvantages of cloud computing; **Cloud Characteristics:** On-demand service, pay as per usage pricing, elasticity, resource pooling, scalability Grid vs Parallel Computing, Challenges of Cloud Computing, Impact of cloud computing: Business perspective.		15		CO1
2	**Cloud Deployment Models:** Public, Private, Hybrid, Community, Other deployment Models; **Cloud Architecture:** Layered, NIST Cloud Computing Reference architecture**; Cloud Services:** Types of Cloud services: Software as a Service- Platform as a Service – Infrastructure as a Service, Hypervisor, Type 1 and Type 2.		15		CO2
3	**Virtualization for Cloud:** Need for Virtualization – Pros and cons of Virtualization, Software Virtualization, Memory Virtualization, Storage Virtualization, Server Virtualization and Network Virtualization; **Types of Hardware Virtualization:** Full, Partial and Para, Virtualization. **Cloud Service Providers:** Google Cloud, Microsoft Azure, and Amazon Web Services (AWS).		15		CO3
4	**Overview of Cloud Security:** Introduction to Cloud Security, **Cloud Security Fundamentals:** Confidentiality, Integrity, Authenticity, Availability, Threat, Vulnerability, Risk, Cloud Security Threats. Security Governance, Security Standards, Introduction to Green Cloud; **Securing Data:** Encryption, Hashing, Digital Signature, Identity and Access Control.		15		CO4

Suggested Readings:
1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India.
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley.
3. Nikos Antonopoulos, Lee Gillam, "Cloud Computing: Principles, Systems and Applications", Springer.
4. Ronald L. Krutz, Russel lDeanVines ,"Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India.

Online Resources:
1. https://nptel.ac.in/courses/106105167
2. https://onlinecourses.nptel.ac.in/noc22_cs20/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	1	1	1	2		1	1	1			1	1		1
CO2	2	1	2	1	2	2	2	1		1			1	2
CO3	1	2	1	1		2	2			2	2	2	1	3
CO4	1	2	3	2	2	2	1			3	2	2	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**		IV	
Course Name	Distributed Database Management				
Code	BCACSN14212				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The purpose of the course is to exposing the need for distributed database technology to confront with the deficiencies of the centralized database systems and implementation techniques of distributed database systems.				
Course Outcomes					
CO1	To understand distributed database systems architecture and design.				
CO2	Able to apply methods and techniques for distributed query processing and optimization.				
CO3	To understand the concepts of distributed transaction process and concurrency control methods.				
CO4	To understand the concept of database reliability and database administration.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Distributed Data Base an Overview**: Distributed Database Management System, Defining Distributed Database System, Problem Areas, distributed versus Centralized Database, Levels of Distributed Transparency; **Heterogeneity DDBMS Architecture:** Client/Server, Peer to peer, Types of Data Fragmentation, Distributed Transparency, Integrity Constraints, Framework for Distributed Database Design, Fragment Allocation.	15	CO1
2	**Query Transformation & Optimization:** Query processing objectives, characterization of query processors, query decomposition, Equivalence Transformation for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries, centralized query optimization, distributed query optimization Framework for Query Optimization, Join Queries, General Queries.	15	CO2
3	**Transaction Management & Concurrency control:** Framework for Transaction Management, Definition, properties, Transaction Supporting Atomicity; **Distributed Concurrency Control:** Foundation of Distributed Concurrency Control, Locking based Concurrency Control, Time stamp-based Concurrency Control, Distributed Deadlock, Concurrency Control Based on Timestamps.	15	CO3
4	**Reliability & Distributed Transaction:** Reliability and Concurrency Control, Determining a Consistent View of Network, Detection and Resolution of Inconsistency, Checkpoint and Cold Restart; **Distributed Database Administration:** Catalog Management in Distributed Database, Authorization and Protection.	15	CO4

Suggested Readings:

1. S. Ceri, G. Pelagatti, "Distributed Database: Principles and Systems", McGrawHill.
2. M. Tamer Ozsu, "Principles of Distributed Database Systems", Pearson Education.
3. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGrawHill.
4. David Bell, Jane Grimson, "Distributed Database Systems", Addison-Welley.

Online References:

1. https://onlinecourses.nptel.ac.in/noc22_cs80/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1	1	2			1	1	1	1	1	1
CO2	1	3	3	2	2	3	1		1	2	1	1	1	2
CO3	1	3	1	3	3	2	1		2	3	1	2	3	2
CO4	2	2	2	1	2	2	1		3	2	2	2	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	IV		
Course Name	Cyber Law & IT Act				
Code	BCACSN14221				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Enable learners to understand, explore, and acquire a critical understanding of Cyber Law. Develop an understanding for Intellectual Property Rights in Cyberspace. Make learners conversant with the social and intellectual property issues emerging from 'Cyberspace'. Understand the legal provisions related to specific cybercrimes and liabilities attached to such crimes.				
Course Outcomes					
CO1	Explore the legal and policy developments in various countries to regulate cyberspace.				
CO2	Develop the understanding of relationship between intellectual property and cyberspace.				
CO3	Give learners in depth knowledge of Information Technology Act and legal frame work of Right to Privacy, Data Security and Data Protection.				
CO4	Analyze and apply cyber law to issues related to Intellectual Property law.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cyber Laws and Cyber Space:** Definition of Cyber Law, Cyber Space and Netizen, Origin/history & functioning of internet, Cyber World and the rule of Law in Cyber World, Significance of Law in Dealing with Challenges Faced by Cyber World, Issues of Jurisdiction and Applicable Law in Cyberspace, International Treaties, Conventions and Protocols Concerning Cyberspace.	15	CO1
2	**Intellectual Property Rights in Cyberspace:** Concept of Property in Cyber Space, Implication on Intellectual Property Rights – International & National Legal Preparedness, Interface with Copyright Law, Patent Law, Trademarks & Domain Names Related issues, The ICANN Uniform Domain Name Dispute Resolution Policy.	15	CO2
3	**Information Technology Act, 2000: Cyber Law in India:** Historical background & Objectives, Legal Recognition of Electronic Records and Procedures, Legal Recognition of Digital Signature, Electronic & Digital Signatures – legal issues, E Commerce Certifying Authority and its Role, Cyber Appellate Tribunal, Grey Areas of Information Technology Act, 2000.	15	CO3
4	**Cyber Crimes & Legal Framework:** Kinds of Offences and Penalties defined under the IT Act, 2000, Cyber Crime against – Person, Property & Government, E-Evidence and Computer Forensic, Concept of E- Litigation, Right to Privacy and its Legal Framework, **National & International Legal:** National & International Legal Framework for Protecting Privacy, Freedom of Speech & Expression vis-à-vis Cyber Law (Sec 66A of IT Act, Declared unconstitutional by Supreme Court).	15	CO4

Suggested Readings:

1. Pavan Duggal, "Textbook on Cyber Law", Universal Law Publishing Co.
2. Dr. Jyoti Rattan, "Cyber Laws & Information Technology", Bharat Law House Pvt. Ltd.
3. Pavan Duggal, "Cyber Law- The Indian Perspective", Saakshar Law Publications.

Online Sources:

1. https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. https://archive.nptel.ac.in/courses/129/106/129106001/#

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1	1	1		1		1	1	1	1	2	2
CO2	1	1	2	1	2	1			1	1	1	2	1	2
CO3	2	1	1	1	1	1	1		2	1	1		1	2
CO4	1	2		1	1	1	2		1	1		1	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	IV		
Course Name	Cryptography & Cyber Security				
Code	BCACSN14222				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To understand basics of Cryptography and Cyber Security and gaining knowledge of Cryptographic Theories and Algorithms.				
Course Outcomes					
CO1	To understand basics of Cryptography and Network Security.				
CO2	To be able to secure a message over insecure channel by various means				
CO3	To learn about how to maintain the Confidentiality, Integrity and Availability of a data				
CO4	To understand various protocols for cyber security to protect against the threats in the networks.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cryptography**: Definition, Symmetric and Asymmetric Cryptography, Steganography, Types of Steganography, Substitution Techniques, Transposition Techniques, Conventional Encryption Techniques: Conventional Encryption Models, Modern Technique, Block Ciphers Data Encryption Standard (DES), Triple DES, Advance Encryption Standard.	15	CO1
2	**Public Key Cryptography**: Principles of Public Key Crpto- Systems, IDE Algorithm, RC5, CAST, RC2, RSA Algorithms, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography.	15	CO2
3	**Security Fundamentals**: An Overview of Information Security, Basic Components, Threats, Security Mechanism, Assumptions and Trust, Operational Issues, Human Issues, Security nomenclature. Access Control Matrix; **Security Policies**: Confidentiality, Integrity, Availability Policies and Hybrid Policies.	15	CO3
4	**Security Attacks**: Introduction, Classification, Phishing, Password Cracking, Key-loggers, Virus, Worms, DoS and DDoS, SQL Injection, Buffer Overflow, Spyware, Adware and Ransomware; **Malicious Logic and Countermeasures**: Antivirus and other Security Measures, Intrusion Detection System: IDS fundamentals, Different types of IDS. Intrusion Prevention System.	15	CO4

Suggested Readings:

1. William Stallings, "Computer Security: Principles and Practices", Pearson Education.
2. Nina Godbole, Sunit Belapure, "Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiely India Pvt. Ltd.
3. C.K Shyamala et el., "Cryptography and Security", Wiley India Pvt. Ltd.
4. Berouz Forouzan, "Cryptography and Network Security", Tata McGraw Hill.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/105/106105162/

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	3	2		2	2	2	3	3	3
CO2	2	2	2	3	1	3	1		1	1	1	3	3	3
CO3	2	2	2	3	1	3	2		1	1	2	3	3	3
CO4	2	2	2	3	2	3	1		1	2	1	3	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II		Semester	IV	
Course Name	Data Communication and Network				
Code	BCACSN14223				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To introduce basic elements of communication system. To understand channels, techniques and devices used to transmit data between distant locations through different devices. To introduce the functions of different layers of reference model. Understand different protocols and network components.				
Course Outcomes					
CO1	To describe and analyze the hardware, software, and various components of a communication network.				
CO2	Able to explain networking protocols models and devices with their hierarchical relationship. Compare protocol models and select appropriate protocols for a particular design.				
CO3	Able to classify networks, transferring of data, address of data packets, analyzing performance, and understanding concepts of data connection and transfer.				
CO4	Able to Identify infrastructure components and their roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Communications:** Basic Data Communication System: Data, Signaling and Transmission System; Synchronous and Asynchronous Transmission; Transmission modes and media. **Introduction to Computer Network:** Definition; Goals and Application of Computer Network; Types of Networks: Point to point, Multipoint, Types of Topologies (PAN, LAN, MAN, WAN), Centralized, Distributed and Collaborative; Type of Data Communication System: Wired and Wireless communication.	15	CO1
2	**Introduction to Network Connections:** Introduction to Internet, Intranet, Extranet, VPNS; Bandwidth, Band and Channel Capacity: Nyquist Capacity and Shannon Capacity Formula. **Network Architecture:** Monolithic v/s Layered Approach; Design Issues of Layered approach; Services, Interfaces, Standards and Protocols; ISO- OSI Reference Model and TCP/IP Model; Multiplexing: SDM, FDM, TDM, WDM; Switching: Circuit, Message, Packet; PSTN & ISDN: Narrowband and Broadband. **Subnet Communication:** Concept of Subnet & Host-to-Host Communication; Intermediate Devices: Repeaters and Regenerators, Hub, Switch, Router, Gateway. **Physical Layer:** Design Issues, Services, Protocols.	15	CO2
3	**Data Link Layer:** Framing, Error Control-VRC,LRC,CRC, Checksum, Flow Control- Hamming Code; LLC and MAC Sub-layer; DLL Protocols: Stop-and-wait Protocol, Sliding Window Protocols, Go-Back-N protocol; LAN Protocols: IEEE protocol. **Network Layer:** Routing, Congestion Control, QoS, Internetworking; Routing Algorithms: Distance Vector Routing, Link State; IP Addressing: IPV4 & IPV6, Firewalls. **Transport Layer:** Connection Management, Multiplexing, Segmentation and Reassembly Host- to-Host Flow Control, Acknowledge and Error Control; Transport Protocol: Connection-oriented TCP and Connection-less UDP.	15	CO3

4	**Session Layer** Logical Session Management, QoS, Token Management; Synchronization; Event Management; Exception Handling. **Presentation Layer:** Data Presentation, Compression and Encryption; Data Compression; Cryptography; Symmetric and Asymmetric Encryption; Private Key and Public Key Encryption. **Application Layer:** HTTP, HTTPS, Internet Browser, FTP, Telnet, DNS, Email System.	15	CO4

Suggested Readings:

1. W. Stallings, "Data and Computer Communication", Pearson Education.
2. A. S. Tanenbaum, "Computer Network", Pearson Education.
3. Behrouz A. Forouzan, "Data Communication and Networking", Tata McGraw Hill.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105183/

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	2		1		2	1	1	2	2	2
CO2	2	2	2	1	2	1	1		2	1	1	2	2	2
CO3	2	1	3	1	2		1		2	1		2	2	2
CO4	2		2		2	2	1		1		1	2	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	IV		
Course Name	Server Side Scripting Lab				
Code	BCACSN14251				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The course demonstrates an in depth understanding of the tools and server side scripting language using PHP which is necessary for design and development of web applications, developing form handling, validation and creating databases using MySQL.				
Course Outcomes					
CO1	To apply the concept of loops, Conditional statements, functions, Arrays, Strings using PHP to develop interactive web pages.				
CO2	Able to understand the concept of HTML forms in designing web pages including form validation, error correction, and connecting the forms to database using MySQL.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Develop a Program in PHP to implement different built-in functions. 2. Develop a Program in PHP to implement if and nested if Statements. 3. Develop a Program in PHP to implement while loop. 4. Develop a Program in PHP to implement do-while loop. 5. Develop a Program in PHP to show use of break and Continue statement. 6. Develop a Program in PHP to implement switch case. 7. Develop a Program in PHP to implement for & nested for Loop. 8. Develop a Program in PHP to implement strings functions. 9. Create a program in PHP to implement array. 10. Design a program in PHP to implement array using function. Note: - Students will also perform all other exercises provided by course instructor.	30	CO1
2	1. Design a program in PHP to implement Error handling. 2. Design a program in PHP to show how to define your own functions. 3. Design a program in PHP to show how to return values from functions: these can be variables, arrays, etc. 4. Design a program in PHP to show how to named constants. 5. Design a program in PHP to show how to use math functions. 6. Design a program in PHP to show how to use "printf" function for formatted output. 7. Design a personal information form, Submit & Retrieve the Form Data Using $_GET(), $_POST() and _REQUEST() variables 8. Design A Login Form and Validate that Form using PHP Programming. 9. create a PHP Code to make database connection, Create DataBase, Create Table in Mysql. 10. Design a PHP code to Insert, Delete, Update, Select the Data from Database. Note: - Students will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings:
1. Robin Nixon," Learning PHP, MySQL & JavaScript with jQuery, CSS & HTML5", O' Reilly Media.
2. Larry Ullman, "Php for the Web Visual Quickstart Guide", Peachpit Press.
3. Alan Forbes, "The Joy of PHP Programming: A Beginner's Guide to Programming Interactive Web Applications with PHP and MySQL", Plum Island.
4. Vikram Vaswani, "PHP: A Beginner's Guide", McGraw-Hill.

Online Resources:
1. https://spoken-tutorial.org/tutorial-search/?search_foss=PHP+and+MySQL&search_language=English.

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2
CO1	2	2	2	2	2	2	3		3	3	2	2	2	3
CO2	2	2	2	3	2	2	2		3	2	2	2	2	2

Course Articulation Matrix

Program	Bachelor of Computer Applications (CS & F)				
Year	II		Semester	IV	
Course Name	Data Warehousing & Data Mining Lab				
Code	BCACSN14252				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		0	0	4	2
Course Objectives	The objective of this lab syllabus is to provide students with hands-on experience in designing, implementing, and analyzing data warehousing and data mining solutions. The lab exercises will cover various aspects of data warehousing, including data modeling, ETL processes, OLAP cube design, and data mining techniques.				
Course Outcomes					
CO1	To design and implement Data Warehouse.				
CO2	To implement data mining techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO

1	1. Overview of Data warehousing tools and platforms.
	2. Setting up the Data Warehousing Environment.
	3. Design and Implements Dimensional Model of Data warehouse.
	4. Implement ETL Process.
	   i. Extract
	   ii. Transform
	   iii. Load
	5. Building OLAP Cube.
	6. Querying OLAP Cube.
	Note: Student will also perform all other exercises provided by course instructor.
		30	CO1

2	1. Implementation of Apriori and Implementation of FP-Growth Algorithm. 2. Implementation of Decision Tree. 3. Implementation of Bayesian Classification. 4. Implementation of K-Means Clustering. 5. Implementation of Birch Clustering. 6. Implementation of DBSCAN, Sting Clustering. Note: Student will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings:
1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Elsevier.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", PHI
3. Max Bramer, "Principles of Data Mining", Springer.
4. Arun K Pujari," Data Mining Techniques", University Press.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/105/106105174/

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		1	3	3	1		3	3	3	3	2	2
CO2	3	3		1	3	3	1		1	3	2	3	2	2

FIFTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**	V		
Course Name	Deployment of Private Cloud				
Code	BCACSN15301				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Understanding Docker images, persistent storage and Network for OpenShift Deploy containerized application on an OpenShift cluster.				
Course Outcomes					
CO1	Able to understand OpenShift basic concepts.				
CO2	Able to understand containers and images.				
CO3	To prepare server for installation.				
CO4	To Understand the change log in identity provider.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**About OpenShift**- Introduction to OpenShift; Three kindsof Platform; advantages of using OpenShift; OpenShift architecture; OpenShift components benefits of OpenShift; **Core Concepts**-Understand containers and images; podsand services; Builds and streams Routes & Templates; Deployments Storage concepts; OpenShift networking concept.	15	CO1
2	**Installation of OpenShift platform** - The servers for installation; Steps to install and configure an OpenShift cluster; post-installation step; **Configuration of OpenShift platform**-change log in identity provider; Create and manage users and accounts; Deploy an OpenShift router; Deploy an internal registry.	15	CO2
3	**Use of web interface -** Fork a sample repository; Create projects and applications; Verify if the application us running; Configuring automated builds; code change and manually rebuild images; **Use of command line interface**- Create projects and applications using CLI; Verify if the application Runnings; Configuring automated build; code change and manually rebuild image; **Creating custom container images**- Custom docker imagecreation approaches; basics of a docker file; Design considerations for a custom docker file; Building custom images using a docker file.	15	CO3
4	**Controlling access to OpenShift resources-** Access control on OpenShift resources; secrets and their application; security policies and their application; **Allocation persistent storage**-persistent storage concepts such as PVs and PVCs; Implement persistent storage for use by the application; persistence is configured for internal registry; **Managing application deployment**-Understand pod replicas and how to scale them; control pod scheduling; Manage image; image streams templates.	15	CO4

Suggested Readings:

1. Jamie Duncan Jamie, "OpenShift in Action", manning.
2. Artemii Kropachev, "Learn OpenShift: Deploy, build, manage, and migrate applications with OpenShift Origin", Packt Publishing.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/105/106105223/

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	3	2		1	2	1	2	1	1
CO2	1	1	1	2	3	1	2		1	1	2	2	1	1
CO3	2	3	1	1	1	3	1		2	1	1	1	2	2
CO4	1	3	1	1	3	3	2		2	3	2	1	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**		V	
Course Name	Mobile Application Development				
Code	BCACSN15302				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The capabilities and limitations of mobile platforms that affect application development and deployment. The technology and business trends impacting mobile application development. The characterization and architecture of mobile applications. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability.				
Course Outcomes					
CO1	To understand the basic concepts of Mobile application development				
CO2	Able to design and develop user interfaces for the Android platforms.				
CO3	Able to design and develop mobile applications using Components.				
CO4	Able to design and develop mobile applications using a chosen application development framework.				
Module	**Course Contents**		**Contact Hrs.**		**Mapped CO**
1	**Introduction:** introduction to android, history and versions of android, android API, Various mobile platforms, android architecture, android runtime, Dalvik virtual machine, features of android, introduction and installation of eclipse and ADT plugin and/or introduction and installation of android studio, requirements and installation of android SDK, SDK manager, emulator, AVD, android virtual device manager, Google play account, installing android app from google play, APK file.		15		CO1
2	**Development Environment**: Setting up Development Environment, Installing Packages using SDK Manager, Android Project Structure, Creating Hello Android App, deploy it on USB-connected Android device, setting up an Emulator, Android Tool Repository, Manifest File, Installing and Running Android - Hello App, Activity Life Cycle and its methods, Logcat, Components of an Android App: Activity, Service, Broadcast Receiver, Content Provider.		15		CO2
3	**Layout**: Linear Layout, Relative Layout, Scroll View: Vertical, Horizontal Layout, Table Layout, Frame Layout, **Views**: Text view, Edit Text, Button, Check Box, Radio Button, Image View, Grid View, Web View, Video View, Toast, Rating Bar, Seek Bar, Date Picker.		15		CO3
4	**Intent**, Types of Intents**; Fragments**: Lifecycle, Methods **Service**: Features of Service, Android platform service, Defining new service, Service Lifecycle, Permission, example of service. **Android Menu:** Option, context, popup Menu; Data persistency using SQLite.		15		CO4

Suggested Readings:
1. Michael Burton, Donn Felker, "Android Application Development for Dummies", Dummies.
2. Pradeep Kothari, " Android Application Development (with Kitkat Support)", Kogent Learning Solutions Inc.
3. W. Frank Ableson, Robi Sen, Et. Al., " Android in Action", Manning.
4. Charlie Collins, Michael Galpin, Et. Al., " Android in Practice", Manning.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/106/106106156/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2		2		2	1	2		1			2	1	1
CO2	2		2		2	2	2		1			2	1	1
CO3	2	2	2	2	3	2	3		2	2	2	2	2	2
CO4	2	2	3	2	2	2	3		3	2	2	2	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	III		Semester	V	
Course Name	Digital Image Processing				
Code	BCACSN15303				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces fundamental concepts and techniques in digital image processing. Topics include image enhancement, filtering, segmentation, feature extraction, and image restoration.				
Course Outcomes					
CO1	To become familiar with digital image fundamentals.				
CO2	To get exposed to simple image enhancement techniques in Spatial and Frequency domain.				
CO3	To learn concepts of degradation function and restoration techniques.				
CO4	To study the image segmentation and representation techniques.				
Module	Course Contents			Contact Hrs.	Mapped CO
1	**Digital image fundamentals:** Steps in Digital Image Processing, Components, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, Color image fundamentals, RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms, DFT, DCT.			15	CO1
2	**Image Enhancement:** Spatial Domain: Gray level transformations, Histogram processing, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering; Frequency Domain: Introduction to Fourier Transform, Smoothing and Sharpening frequency domain filters, Ideal, Butterworth and Gaussian filters.			15	CO2
3	**Image Restoration:** Image Restoration, degradation model, Properties, Noise models, Mean Filters, Order Statistics, Adaptive filters, Band reject Filters, Band pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering.			15	CO3
4	**Image Segmentation:** Edge detection, Edge linking via Hough transform, Thresholding, Region based segmentation, Region growing, Region splitting and merging, Morphological processing, erosion and dilation.			15	CO4

Suggested Readings:
1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education.
3. Kenneth R. Castleman, "Digital Image Processing", Pearson Education.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education.
5. D, E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference.

Online Resources:
1. https://archive.nptel.ac.in/courses/117/105/117105135/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1		2	1	1	1		1			2	3	1
CO2	2	2		2	2	2	1		1	1	1	2	3	1
CO3	2	3	1	2	2	2	1		1	1	1	3	3	2
CO4	2	3	1	3	2	2	1			1	1	3	3	2

Program	Bachelor of Computer Applications (CS & F)				
Year	III		Semester	V	
Course Name	Biometric Security				
Code	BCACSN15321				
Course Type	DSE	L	T	P	Credit
Pre- Requisite		3	1	0	4
Course Objectives	Enrich the knowledge of students with the understanding of biometrics and standards applied to security. Help students understand various prevalent Biometric technologies and various feature extraction techniques for biometric systems. Also, help them to understand various biometric security issues.				
Course Outcomes:					
CO1	To understand the basic concepts of Biometrics and Biometric Standards				
CO2	To understand Physiological Biometric Technologies				
CO3	To understand Behavioral and Multimodal Biometric Technologies				
CO4	To understand to evaluate the performance of a Biometric System and Security issues				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**INTRODUCTION TO BIOMETRICS:** Introduction and Background; Biometric Modalities; Biometric Technologies; Passive Biometrics; Active Biometrics; Types of Biometric Systems: Unimodal and multimodal; Modes of operation: Identification and Verification; Biometric parameters; Templates; Biometric Applications; Biometric Standards; Stages of working of a biometric system in general.	15	CO1
2	**PHYSIOLOGICAL BIOMETRIC TECHNOLOGIES:** **Fingerprint Recognition:** Minutiae based Fingerprint Matching; Non-Minutiae based Fingerprint Recognition, Fingerprint Enhancement and Fingerprint Classification; **Face Recognition:** data acquisition, Feature extraction techniques for face Recognition.	15	CO2
3	**BEHAVIORAL BIOMETRIC TECHNOLOGIES:** **Speech Recognition, Gait Recognition, Keystroke dynamics:** Data Acquisition; Feature Extraction methods; Characteristics; Strengths & Weaknesses; **MULTIMODAL BIOMETRICS:** Introduction to Multimodal biometric system; Types of multimodal biometric systems, Integration strategies; Architecture; levels of fusion; score fusion techniques score normalization, user-specific parameters.	15	CO3
4	**PERFORMANCE EVALUATION AND SECURITY:** **Performance Evaluation Metrics:** Confusion Matrix -TP, FP, TN, FN; Statistical Measures of Biometrics - FAR, FRR, EER, Recall, Specificity, Accuracy, Precision, F1-score: AUC-ROC Curve; **Security:** Two-Factor Authentication; Adversary Attack-Attacks on user interface; Attacks on biometric processing; Attacks on template database.	15	CO4

Suggested Readings:

1. Anil K. Jain, Arun A. Ross and Karthik Nanda Kumar, "Introduction to Biometrics", Springer Science & Business Media.
2. Rud Bolle, Jonathan Connell, Sharanth Chandra Pankanti, Nalini Ratha and Andrew Senior, "Guide to Biometrics", Springer Professional Computing (SPC).
3. James L. Wayman, Anil K. Jain, Davide Maltoni and Dario Maio, "Biometric Systems Technology, Design and Performance Evaluation", Springer London Ltd.
4. Paul Reid, "Biometrics for Network Security", Pearson Education.

Online Resources:

1. http://nptel.ac.in/courses/106104119/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	3			1	2		2	2	2
CO2	2	2	3	2	3	2			1	3		2	1	2
CO3	2	2	1	2	2	2			1	2		2	1	1
CO4	2			2	2	1				1		1	2	2

Course Articulation Matrix

Program	Bachelor of Computer Applications (CS & F)				
Year	III		Semester		V
Course Name	Enterprise Architecture & Components				
Code	BCACSN15322				
CourseType	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To provide the students with a critical understanding of key enterprise architecture concepts, issues and constraints. To presents the basic concepts and methodologies for the discipline known as Enterprise Architecture within a framework, structure, and methodology. To design enterprise architectures at scale, and develop considerations about architecture in relationship to an organization's vision and strategy, and create a process for establishing an ongoing enterprise architecture.				
Course Outcomes					
CO1	Able to describe Enterprise Architecture, components, principles, its importance and Architecture Development Process.				
CO2	Able to identifying the relationship between vision, strategy and architecture. Describe enterprise architectural development in IT frameworks and portfolio management.				
CO3	Able to classify the Target Architectural development elements of an enterprise architecture				
CO4	Able to explain Architecture Transition, challenges faced by enterprise architects ERP Architecture, Technology Architecture, and Security Architecture.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Enterprise Architecture Introduction:** Basic Terminology and Definitions, Architectural Framework Components such as architectural views, architectural principles, technical reference model, set of standards, Architecture Development Process Overview: plan the EA process, characterize the baseline architecture, Develop the target architecture vision, Architecture Development Process: Develop the transition and implementation plans, Touch points with the system development lifecycle.	15	CO1
2	**Baseline Architecture Development**: Gathering Current Inventory, Analyzing current architecture, documenting Strengths and Weaknesses of the architecture, Architecture Development: Vision for Business architectures, Techniques to document Business architectures; Portfolio Management.	15	CO2
3	**Target Architecture Development**: Data architectures; Process models, Techniques to document both, Target Architecture Development Vision for the Service, Application and Technical Infrastructure architectures. Techniques to document Service, Application and Technical Infrastructure architectures. Target Architecture Development Integrating the Business, Data, Application and Technical architectural perspectives.	15	CO3
4	**Architecture Transition and Implementation Planning**: Laying out an initiative roadmap, dependencies, architectural risk definition, and resource and cost estimation. Component of Enterprise Architecture, Business Architecture, Data Architecture, Application Architecture, Technology Architecture, Security Architecture. **Client Server and ERP Architecture and Open Technology:** Introduction to Client Server, Advantages and Disadvantages, N tier Architecture, ERP Architecture, Background of Open Technology: Introduction, Proprietary v/s Open source, Need for Open-Source Solutions, Open-Source ERP.	15	CO4

Suggested Readings:
1. Alexis Leon, "Enterprise Resource Planning Demystified", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. Jeanne W. Ross, Peter Weill, and David Robertson, "Enterprise Architecture As Strategy", Harvard Business Review Press.
3. Vinod Kumar Garg and N.K. Venkitakrishnan, "Enterprise Resource Planning– Concepts and Practice", Prentice Hall of India, New Delhi.
4. Rahul V. Altekar "Enterprise-wide Resource Planning", Tata McGraw Hill.

Online Resources:
1. https://www.coursera.org/articles/what-is-erp

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2	2	2	1	2				2	2	1	2	2	2
CO2	2	2	2	1	2	1			2	2	1	2	2	2
CO3	2	2	2	1	2	1			1	2	1	1	2	2
CO4	2	1	2		2						1		2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**		V	
Course Name	Physical Security				
Code	BCACSN15323				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre -Requisite		3	1	0	4
Course Objectives	To understand the relationship between physical and cyber security, and the role of corporate security, IT security, and network security and to develop a physical security plan, including the integration of physical IT security and cyber security planning and to gain knowledge on the development of physical security methods and procedures, including auditing and testing procedures.				
Course Outcomes					
CO1	To evaluate the financial resources required for establishing a physical IT security function and understand the interdepartmental relationshipsfor physical security.				
CO2	Able to utilize existing risk exposure analysis in developing thephysical security plan and understand the regulatory requirements involved.				
CO3	Able to develop and document methods and procedures for physical security in various areas.				
CO4	To understand the basics of training, build awareness about physical security for IT assets, identify potential threats and vulnerabilities, and perform the administrative aspects of a training program.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Physical Security Overview, The Relationship Between Physical and Cyber Security, establishing a Physical IT Security Function, Interdepartmental Relationships for Physical Security, Evaluating Financial Resources, The Role of Corporate Security, IT Security, and Network Security, Action Steps to Improve Physical IT Security.	15	CO1
2	**Physical Security Plan:** Introduction to the Planning Process, Developing the Physical Security Plan, Utilizing Existing Risk Exposure Analysis, Integrating Physical IT Security and Cyber Security Planning, Evaluating RegulatoryRequirements, Action Steps to Improve Physical Security, Elements of a Physical IT Security Plan, Security Proceduresfor Data Centers, Wiring and Cabling, Remote Computers, Desktops, Department-Based Servers, Telecom and Datacom Equipment, Manufacturing Control Equipment,Surveillance and Alarm Systems.	15	CO2

3	**Development of Physical Security Methods and Procedures:** The Process of Developing Methods and Procedures for Data Centers, Wiring and Cabling, Remote Computers, Desktops, Department-Based Servers, Telecomand Datacom Equipment, Manufacturing Control Equipment, Surveillance and Alarm Systems; **Auditing and Testing Procedures:** How to develop Audit and Test Procedures for Data Centers, Wiring and Cabling Security, Remote Computer Procedures, Desktop Procedures, Department-Based Servers, Telecom and Datacom Equipment Security, Manufacturing Control Equipment Security, Surveillance and Alarm System; **The Role of the Incident Response Team:** The First Report, The Confirmation Process, Mobilizing the Response Team, Notifying Management, Using the Alert System, The Preservation of Evidence, When to Call Law Enforcement, Returning to Normal Operations, Analyzing Lessons Learned, The Role of the Incident Response Team During Disasters.	15	CO3
4	**Building Awareness About Physical Security for IT Assets**: Testing and Evaluating the Module, How to Identify Potential Threats and Vulnerabilities, policies and strategies for Disgruntled and Angry Former Employees, Social and Political Activists, Random Vandals, Professional Saboteurs, Thieves and Spies, Domestic and International Terrorists, Natural Disasters, Data Center Security.	15	CO4

Suggested Readings:

1. Erbschloe, M. "Physical Security for IT". Elsevier.
2. Baker, P. R., & Benny, D. J. "The Complete Guide to Physical Security". Auerbach Publications.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106234/

Course Articulation Matrix													
PO -PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	2	1	2	1			2	1	2	1	1
CO2	2	2	2	2	2	2	1			2	1	2	2	2
CO3	2	3	2	2	2	2	1			2	1	3	3	3
CO4	2	3	2	2	1	2	1			2		3	3	3

Program	Bachelor of Computer Applications (CS & F)					
Year	III		Semester		V	
Course Name	Blockchain Technology					
Code	BCACSN15324					
Course Type	DSE		L	T	P	Credit
Pre-Requisite			3	1	0	4
Course Objectives	To Gain a comprehensive understanding of Blockchain and Distributed Ledger Technologies, covering fundamental concepts and functionalities. Delve into Alternative Blockchains to grasp the workings of Distributed Ledger Technology beyond conventional paradigms					
Course Outcomes						
CO1	Students will learn fundamental concepts of Blockchain and Distributed Ledger Technologies					
CO2	To acquire the insights into Blockchain functionality.					
CO3	To explore Blockchain implementation through Bitcoin and Merkle Root etc.					
CO4	To get knowledge about Distributed Ledger Technology in Alternative Blockchains.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Blockchain and Distributed Ledger Fundamentals**: Blockchain, Growth of Blockchain technology, Cryptographic basics for cryptocurrency: signature schemes, encryption schemes; Categories of Blockchain: Public Blockchain, Private Blockchain, Permissioned Ledger, Tokenized Blockchain, Token less Blockchain.	15	CO1
2	**Blockchain Functionality:** Distributed identity and Digital identification: Public and private keys, Decentralized network, Permissioned distributed Ledger, Digital identification and wallets; Blockchain data structure and security: Double spending, Network consensus, Sybil attacks, Block rewards and miners, Forks and consensus chain, Sharding based consensus algorithms to prevent attack, Finality, Limitation of proof-of-work, Alternatives to Proof of Work.	15	CO2
3	**Blockchain Implementation:** Bitcoin and Merkle Root; Eventual Consistency and Bitcoin; Byzantine Fault Tolerance and Bitcoin; Bitcoin block-size; Bitcoin Mining; Blockchain Collaborative Implementations: Hyperledger, Corda; Ethereum's ERC 20 and token explosion; Blockchain and full ecosystem decentralization: Smart contract, Decentralized autonomous organization (DAO), Decentralized applications.	15	CO3
4	**Distributed Ledger Technology in Alternative Blockchain:** Blockchain Governance Challenges: Bitcoin Blocksize Debate, The Ethereum DAO Fork, Ethereum's Move to PoS and Scaling Challenges; Blockchain Technical Challenges: Denial-of-Service Attacks, Security in Smart Contracts, Ripple, Stellar; Decentralized Network manager: Tezos.	15	CO4

Suggested Readings:
1. Iyer, Kedar, et al., "Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions", McGraw-Hill Education.
2. Wattenhofer, R., "Distributed Ledger Technology: The Science of the Blockchain", Create Space Independent Publishing Platform.

3. Mark Gates, "Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money", CreateSpace Independent Publishing Platform.
4. Bahga, Vijay Madisetti, "Block chain Applications: A Hands-On Approach", Arshdeep Bahga.

Online Resources:
1. https://nptel.ac.in/courses/106105184/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2	2	2		2	1			1	1		1	2	
CO2	2	2	2	1	2	1			1	1		1	2	1
CO3	2	1	2	1	2	2			1	1		1	1	1
CO4	2	2	2	1	1	2			1	1		1	2	1

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**		V	
Course Name	Internet of Things				
Code	BCACSN15325				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To study fundamental concepts of IoT, understand roles of sensors and hardware in IoT, learn different Wireless Technologies and protocols for IoT, Understand the role of IoT in various domains of Industry.				
Course Outcomes					
CO1	To Understand the various concepts, terminologies and architecture of IoT systems.				
CO2	To Understand the use of sensors, actuators and IoT supported hardware for design of IoT system.				
CO3	To Understand and apply various wireless technology and protocols for design of IoT systems.				
CO4	To Understand the various security aspects for IoT system.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of IoT:** Concepts and Definition of IoT, Characteristics, Conceptual Framework, Architectural view, technology behind IoT, M2M Communication; **Design Principles for Connected Devices:** IoT/M2M systems layers and design standardization, Application of IoT.	15	CO1
2	**Hardware for IoT:** Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology; **Embedded Platforms for IoT:** Embedded computing basics, Overview of IoT supported Hardware platforms such as Arduino, Net Arduino, and Raspberry pi.	15	CO2
3	**Wireless Technologies for IoT:** IEEE 802.15.4, Bluetooth, Wi-Fi, Zigbee, RFID, HART, LoRaWAN, NFCZ-Wave, Z-Wave; **IP Based Protocols for IoT:** IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, QTT.	15	CO3
4	**Overview of IoT Security:** Introduction Securing the Internet of Things, Architecture, Requirements, Security Protocols for IoT Access Networks, Attack, Defense, and Network Robustness of Internet of Things; **Case Studies/Industrial Applications:** Home Automation, Smart Cities, Smart Parking, Agriculture and Health Sector, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	15	CO4

Suggested Readings:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press.
2. Arsheep Bahga, Vijay Madisetti, "INTERNET OF THINGS - A HANDS-ON APPROACH", Orient Black swan Private Limited.
3. Raj Kamal, "INTERNET OF THINGS (IOT): Architecture and Design Principles", McGraw Hill.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105166/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2	1	2	1	1	1			2	1	1	1	1	1
CO2	2	1	3	1	1	2	1		1	3	1	2	2	1
CO3	1	3	3	2	3	2			1	2	1	2	3	1
CO4	3	3	1	3	1	1	1	1	3	1	3	2	1	2

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**		V	
Course Name	Storage Area Network				
Code	BCACSN15326				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces fundamental principles, architectures, technologies, and management practices of Storage Area Networks (SANs). Students will gain hands-on experience with SAN components, protocols, and administration tools.				
Course Outcomes					
CO1	To understand the basic concept of SAN and Underlying Technologies.				
CO2	To understand the Architecture and Components of SAN.				
CO3	To understand the basic concept Storage in SAN				
CO4	To understand the network components used in SAN and Data Center Application.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Information Storage:** Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing; **Data Center Environment:** Application Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application; **Storage Area Network:** Introduction, Features, Importance and Capabilities; NAS Vs SAN.	15	CO1
2	**Storage Networking Architecture:** Components of SAN-based client-server systems; Basic SAN System, NAS appliance with local storage, Network-attached storage model with SAN-attached storage, In-Band SAN Appliance, Out-of-Band SAN Appliance, Cluster File System withCentral Metadata, Symmetric Cluster File System, RAID Subsystem-Based Volume Replication, Server-Based Volume Replication, File-Based Data Replication.	15	CO2
3	**Storage in Storage Networking:** Challenges, Cost, Disk Aggregation and Virtualization, Mirroring versus RAID versus Data Striping; RAID: Protection AgainstDisk Failures, Mirroring and Parity, Controller Failures, Tolerance, Operations and Data Integrity.	15	CO3
4	**Fibre Channel:** The Standards, Storage area network devices: Fibre Channel bridges, Arbitrated loop hubs and switched hubs, Switches and directors; Infrastructure, Fibre Channel Variations; **Emerging SAN Interconnect Technologies:** ipStorage and Infiniband; **Software for Storage Networking:** Data Center I/O Stack, Discovering Devices, Controlling Access to Storage Devices and Data Objects, Shared Access Data Managers, Computer System I/O Performance, Load Balancing, High performance Volumes.	15	CO4

Suggested Readings:
1. EMC Education Services, "Information Storage and Management", Wiley India Publications.
2. Paul Massiglia, Richard Barker, "Storage Area Network Essentials: A Complete Guide to Understanding and Implementation SANs Paperback", Wiley India Publications.
3. Marc Farley, "Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems", Cisco press.
4. Robert W Kembel, "Fiber Channel a Comprehensive Introduction", Northwest Learning Associates.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/108/106108058/

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1	1	1	1		1	1	1	2	3	1
CO2	2	3	1	1	3	3	1		1	3	1	2	3	1
CO3	2	3	1	1	3	3	1		1	3	1	3	3	2
CO4	3	3	1	1	3	3	1		1	3	1	3	3	2

Program	Bachelor of Computer Applications (CS & F)				
Year	III	Semester	V		
Course Name	Mobile Application Development Lab				
Code	BCACSN15351				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		0	0	4	2
Course Objectives	The capabilities and limitations of mobile platforms that affect application development and deployment. The technology and business trends impacting mobile application development. The characterization and architecture of mobile applications. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability.				
Course Outcomes					
CO1	To understand the basic concepts of Mobile application development Design and develop user interfaces for the Android platforms.				
CO2	Able to designing and develop mobile applications using a chosen application development framework.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Creating "Hello world" Application. 2. Creating an application that displays message based on the screen orientation. 3. Create an application to develop Login window using UI controls. 4. Create an application to implement new activity using explicit intent, implicit intent and content provider. 5. Create an application that displays custom designed Opening Screen. 6. Create an UI with all views. 7. Create Calculator in Application 8. Read/ write the Local data. Note: Students will also perform all other exercises provided by course instructor	30	CO1
2	1. Create an UI with all Layouts. 2. Develop an application that makes use of Notification Manager 3. Display Map based on the Current/given location. 4. Create a sample application with login module (check user name and password) On successful login change Textview "Login Successful". On login fail alert using Toast "login fail" 5. Learn to deploy Android applications. 6. Create menu in Application 7. Develop a Mobile application for simple needs (Mini Project) Note: Students will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings:
1. Michael Burton, Donn Felker, "Android Application Development for Dummies", Dummies.
2. Pradeep Kothari, " Android Application Development (with Kitkat Support)", Kogent Learning Solutions Inc.
3. W. Frank Ableson, Robi Sen, Et. Al., " Android in Action", Manning.
4. Charlie Collins, Michael Galpin, Et. Al., " Android in Practice", Manning.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/106/106106156/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2		2		2	1	2		1			2	1	1
CO2	2		2		2	2	2		1			2	1	1

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**	V		
Course Name	Digital Image Processing Lab				
Code	BCACSN15352				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	This lab complements the theoretical concepts covered in the Digital Image Processing course by providing hands-on experience with image processing techniques using software tools.				
Course Outcomes					
CO1	To become familiar with digital processing and applying Fourier transform and Histogram equalization.				
CO2	To apply image enhancement in spatial and frequency domain.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. To acquire an image, store in different formats and display the properties of the images. 2. To find the discrete Fourier transform of a gray scale image and perform inverse transform to get back the image 3. Analyze the rotation and convolution properties of the Fourier transform using any gray scale image 4. Find the discrete cosine transform of a given image. Compare discrete Fourier transform and discrete cosine transforms **5.** Apply histogram equalization for enhancing the given images Note: Student will also perform all other exercises provided by course instructor.	30	CO1
2	1. Perform image enhancement, smoothing and sharpening, in spatial domain using different spatial filters and compare the performances 2. Perform image enhancement, smoothing and sharpening, in frequency domain using different filters and compare the performances 3. Perform noise removal using different spatial filters and compare their performances 4. For the given image perform edge detection using different operators and compare the results 5. For a given image, compress and decompress using wavelets. Study and compare the efficiency of the scheme with any two schemes. Note: Student will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings:
1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education.
3. Kenneth R. Castleman, "Digital Image Processing", Pearson Education.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education.
5. D, E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference.

Online Resources:
1. https://archive.nptel.ac.in/courses/117/105/117105135/

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2	3	3	2	1			3	1	3	3	3
CO2	3		2	3	3	2	1			3	1	3	3	3

SIXTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	III		**Semester**	VI	
Course Name	Cyber Protection Practices				
Code	BCACSN16301				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To understand the concept of cyber security and issues and challenges associated with it. Students, at the end of this course, should be able to understand the cybercrimes, their nature, legal remedies and as to how report the crimes.				
Course Outcomes					
CO1	After completion of this course, students would be able to understand the concept of cyber security and issues and challenges associated with it.				
CO2	Students should be able to understand the cyber-crimes, their nature, legal remedies and as to how report the crimes through available platforms.				
CO3	On completion of this course, students should be able to appreciate various privacy and security concerns on online social media and understand the reporting procedure of inappropriate content, underlying legal aspects and best practices for the use of social media platforms.				
CO4	Students, after completion of this module will be able to understand the basic security aspects related to current era.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cyber security:** Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.	15	CO1
2	**Data Privacy and Data Security:** Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations (GDPR), Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues.	15	CO2
3	**Social Media Overview and Security:** Introduction to Social networks, Types of social media, social media platforms, social media monitoring, Hashtag, Viral content, social media marketing, social media privacy, challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, best practices for the use of social media, case studies.	15	CO3
4	**Cyber-crime and Cyber law:** Classification of cybercrimes, Common cyber-crimes- cyber-crime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi, Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act 2000 and its amendments, Cyber-crime and offences, Organisations dealing with Cyber-crime and Cyber security in India, Case studies.	15	CO4

| 4 | **Cyber-crime and Cyber law:** Classification of cybercrimes, Common cyber-crimes- cyber-crime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi, Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act 2000 and its amendments, Cyber-crime and offences, Organizations dealing with Cyber-crime and Cyber security in India, Case studies. | 15 | CO4 |

Suggested Readings:
1. R. C Mishra, "Cyber Crime Impact in the New Millennium", Auther Press.
2. Sumit Belapure and Nina Godbole, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd.
3. Henry A. Oliver, "Security in the Digital Age: Social Media Security Threats and Vulnerabilities", Create Space Independent Publishing Platform, Pearson.
4. K. Kumar, "Cyber Laws: Intellectual Property & E-Commerce Security", Dominant Publishers.

Online Resources:
1. https://onlinecourses.nptel.ac.in/noc24_cs121/preview

Course Articulation Matrix													
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	1	1	2	1		1	1	1	2	1	1
CO2	1		1	2	2	1	1			1	1	2	1	1
CO3	2	1	2	2	3	2	2		2	2	2	2	2	2
CO4	1		1	2	1	2	1			1	1	2	1	1

SEVENTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	Semester		VII	
Course Name	Statistical & Optimization Techniques				
Code	BCACSN17401				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The course provides a holistic understanding of statistical analysis, optimization, logistics, and project management. Students will learn to interpret data, solve optimization problems, manage logistics efficiently, and plan projects effectively, preparing them for analytical roles in diverse industries.				
Course Outcomes					
CO1	To gain proficiency in basic statistical analysis and interpretation.				
CO2	To master problem-solving techniques for linear programming and optimization.				
CO3	To develop skills to solve transportation and assignment problems efficiently.				
CO4	To apply inventory management and job sequencing principles effectively in real-world scenarios.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Statistics:** Introduction, Review of Basic Statistics; Different **Frequency Chart:** Histogram, Frequency Curve, Pi-Chart etc.; **Measurement of Central Tendency:** Mean, Median, Mode; **Measures of dispersion:** Absolute Measure of Dispersion, Range, Inter Quartile Range; **Relative Measure of Dispersion:** Mean Deviation, Standard Deviation.	15	CO1
2	**Linear Programming Problem**: Introduction to LPP, Components of LPP, Formulation of LPP, Graphical Solution of LPP, Slack and Surplus Variable, Basic Feasible Solution, Unbounded Solution, Optimal Solution, Simplex Method, Artificial Variables, Two-Phase Method, Big-M Method, Duality, Dual Simplex Method, Revised Simplex Method, Problem of Degeneracy.	15	CO2
3	**Transportation Problem:** Introduction, Basic Feasible Solution of TP, North-West Corner Method, Matrix Minima Method, Row Minima Method, Column Minima Method, Vogal's Approximation Method, Degeneracy in TP, Loops in TP, Optimal Solution, Unbalanced TP. **Assignment Problem:** Introduction and Application of AP, Hungarian Algorithm for AP, Unbalanced AP.	15	CO3
4	**Inventory Management:** Introduction, Types of Inventories, Costs Involved in Inventory Decisions, Economic Order Quantity (EOQ), Determination of EOQ, EOQ Model without Shortage and with Shortage, Inventory Model with Price- Break, Replacement Problem, **Job Sequencing:** Introduction, N-Jobs Two Machines, N-Jobs Three Machines, N-Jobs M Machines. **CPM and PERT:** Introduction, Application of CPM/PERT, Network Diagram, Floats, Critical Path, Project Evaluation and Review Technique (PERT).	15	CO4

Suggested Readings:

1. Gillet B.E., "Introduction to Operation Research, Computer Oriented Algorithmic approach", Tata McGraw Hill Publishing Co. Ltd.
2. P.K. Gupta & D.S. Hira, "Operations Research", S. Chand & Co.
3. J.K. Sharma, "Operations Research: Theory and Applications", Mac Millan.
4. S.S. Rao "Optimization Theory and Application", Wesley Eastern.
5. S.S. Shastri., "Numerical Analysis", PHI.

Online Resources:

1. https://archive.nptel.ac.in/courses/111/105/111105039/

<table>
<tr><td colspan="15">Course Articulation Matrix</td></tr>
<tr><th>PO-PSO</th><th>PO1</th><th>PO2</th><th>PO3</th><th>PO4</th><th>PO5</th><th>PO6</th><th>PO7</th><th>PO8</th><th>PO9</th><th>PO10</th><th>PO11</th><th>PO12</th><th>PSO1</th><th>PSO2</th></tr>
<tr><td>CO1</td><td>2</td><td>2</td><td>1</td><td>1</td><td>2</td><td>1</td><td></td><td></td><td>1</td><td>1</td><td></td><td>2</td><td>1</td><td>1</td></tr>
<tr><td>CO2</td><td>1</td><td>2</td><td>1</td><td>2</td><td>2</td><td>1</td><td></td><td></td><td>1</td><td>1</td><td></td><td>2</td><td>1</td><td>1</td></tr>
<tr><td>CO3</td><td>1</td><td>2</td><td>2</td><td>2</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>2</td><td></td><td>2</td><td>1</td><td></td></tr>
<tr><td>CO4</td><td>2</td><td>2</td><td>2</td><td>3</td><td>2</td><td>1</td><td>1</td><td></td><td>1</td><td>2</td><td></td><td>2</td><td>1</td><td>1</td></tr>
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Program	Bachelor of Computer Applications (CS & F)				
Year	IV		Semester	VII	
Course Name	Research Methodology				
Code	BCACSN17402				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The course aims to develop research aptitude skills among the learners and to enable them to prepare a research report. To identify the relevance and role of research and differentiating between different kinds of research available, data models, data handling and analysis.				
Course Outcomes					
CO1	To Understand the basic concepts of research and outlining the significance of research and research methodology.				
CO2	To Formulate research process for solving the business-related problems. To develop ability to determine qualitative and quantitative methods of collection of data and sampling				
CO3	Able to examining the concept of measurement, sampling and hypothesis testing. Reconcile various types of charts, diagrams and statistical techniques used to analyze data.				
CO4	Able to prepare and present an effective research report.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Research Methodology:** Scope, Purpose, Need, Functions and Application of research; Types of research, Criteria of research. **Process of Research:** Steps of research process, Unit of Analysis: Individual, and organizational, Group and data series; Concept, Construct, Attributes, Variable and Hypotheses. **Research Design:** Various Methods of Research Design, Review of literature; Planning research: Preparing the Research Proposal, Elements of Research Proposal, Evaluating Research Proposal; Problem identification and formulation; Research design; Applications of Research.	15	CO1
2	**Data Collection:** Primary and Secondary source of data; Qualitative Vs Quantitative data; Methods of Data Collection. **Sampling theory with applications:** types of sampling, steps in sampling, sampling and non-sampling error: sample size, advantage and limitations of sampling; Precautions in Preparation of Questionnaire, Collection of Data, Significance and Reliability of Questionnaire.	15	CO2
3	**Research Modelling:** Field study, laboratory study, survey method, observational method, existing data-based research; Scaling techniques. **Data Handling and Analysis:** Coding, Editing and Tabulation of Data, Measurement Scales. Various Kinds of Charts and Diagrams Used in Data Analysis: Line, Bar and Pie, Histogram Graphs and their Significance; Basics of Hypothesis and hypothesis testing.	15	CO3
4	**Report/ Thesis Writing:** Pre writing consideration; Formulation of research projects/ proposals; Format of Report; Presentation of Research report; Review articles, bibliography norm & plagiarism.	15	CO4

Suggested Readings

1. C. R. Kothari, "Research Methodology Methods &Techniques", New Age International Publishers.
2. Cooper, "Donald R and Schindler" Business Research Methods, Tata McGraw Hill.
3. Naresh Malhotra, "Market Research", Pearson Education.
4. Kumar, Ranjit, "Methodology: A Step by Step guide for Beginners", Pearson Education

Online References:

1. https://onlinecourses.nptel.ac.in/noc23_ge36/preview

							Course Articulation Matrix							
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	2	1	2	2		1	2	1	2		1
CO2	1	1	1	1	1	2	2		1	2	1	1		3
CO3	1	1	1	1	1	2	1		1	2	1	1		3
CO4	2	3	3	2	2	2	2		3	3	1	2	1	2

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	**Semester**	VII		
Course Name	Understanding Security & Forensics Through Case Stud				
Code	BCACSN17403				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective of this course is to provide students with a fundamental understanding of digital security and forensic concepts, including digital threats and attack methods, security measures and controls, incident investigation and response, and legal and ethical considerations in the digital domain				
Course Outcomes					
CO1	Students will be able to demonstrate a foundational understanding of security and its concepts.				
CO2	Students will be able to identify digital threats, apply security measures, analyze, and investigate security incidents.				
CO3	Students hand on practice with open-source digital forensics platform and tools.				
CO4	Students, after completion of this module will be able to understand the basic security aspects related to current era.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Case Studies on Data Security:** Data Privacy and Data Security, Personal Data Protection Bill and Its Compliance, Data Protection Principles, Big Data Security Issues and Challenges, Data Protection Regulations of Other Countries; GDPR, PIPEDA, **Case Study:** WhatsApp Pegasus Spyware (2019). **Case Study:** The Equifax Data Breach (2017).	15	CO1
2	**Case Studies on Concepts of Security:** Principles of Security, Encryption and Decryption, Authentication, Security Standards, Security Services, Importance of Security Services, Security Mechanism. **Case Study:** Uber Data Breach (2016). **Case Study:** Capital One Data Breach (2019).	15	CO2
3	**Case Studies on Digital Forensics and Tools:** Digital Forensics Fundamentals, Chain of Custody, Introduction Open-Source Digital Forensic Tools, Introduction to Memory Forensics, Data Recovery, Legal and Ethical Considerations in Digital Forensics. **Case Study:** Facebook-Cambridge Analytica Scandal (2018) **Case Study:** Colonial Pipeline Ransomware Attack (2021)	15	CO3
4	**Case Studies on Cyber-crime and Cyber Law:** Classification of Cybercrimes, Malware and Ransomware Attacks, Social Engineering Attacks, Legal perspective of Cybercrime, IT Act 2000 and its amendments. **Case Study:** Sony Pictures Entertainment Hack (2014) **Case Study:** WannaCry Ransomware Attack (2017)	15	CO4

Suggested Readings:

1. R. C Mishra, "Cyber Crime Impact in the New Millennium", Auther Press.
2. Sumit Belapure and Nina Godbole, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd.
3. Henry A. Oliver, "Security in the Digital Age: Social Media Security Threats and Vulnerabilities" by, Create Space Independent Publishing Platform, Pearson.
4. K Kumar, "Cyber Laws: Intellectual Property & E-Commerce Security", Dominant Publishers

Online Resources:

1. https://archive.nptel.ac.in/courses/128/106/128106006/

						Course Articulation Matrix								
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	2	1		1	1	1	2	1	1
CO2	1		1	2	2	1	1			1	1	2	1	1
CO3	2	1	2	2	3	2	2		2	2	2	2	2	2
CO4	1		1	2	1	2	1			1	1	2	1	1

Program	Bachelor of Computer Applications (CS & F)				
Year	IV		Semester		VII
Course Name	Data Privacy & Fundamental				
Code	BCACSN17421				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course will examine fundamentals of data privacy include data confidentiality, data security, limitation in data collection and use, transparency in data usage, and compliance with the appropriate data privacy laws.				
Course Outcomes					
CO1	To understand the basic concept of digital age privacy concepts and theories.				
CO2	Understanding the basic concept of privacy implications of modern digital technology.				
CO3	Understanding the basic rules and frameworks for data privacy in the age of technology.				
CO4	Understanding the basic concept of various data privacy acts and IT Acts				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction Data Privacy**: Fundamental Concepts, Definitions, Data Privacy Attacks, Types of Attacks, Phishing, Ransomware, SQL Injection, DoS, DDoS, Password Attack, Malicious Insiders, Access Control Models: Role Based Access Control, Rule Based Access Control. Privacy Policies: Introduction, General Data Protection Regulation (GDPR), California Privacy Right Act (CPRA), Personal Information Protection and Electronic Documents Act (PIPEDA) Privacy in Different Domains-Medical, Financial.	15	CO1
2	**Concepts of Security:** Basic Components of Security, Principles of Security, Encryption and Decryption, Authentication: Introduction, 1FA Authentication, 2FA Authentication, MFA Authentication, Security Standards, Types of Security Standards, Security Services, Importance of Security Services, Security Mechanism, Encipherment, Digital Signatures, Authentication Exchange, Notarization.	15	CO2
3	**Introduction to Cryptography:** Definition, Symmetric and Asymmetric Cryptography, Steganography, Types of Steganography, Plain Text and Cipher Text, Conventional Encryption Techniques: Substitution Techniques, Types of Substitution Techniques, Transposition Techniques, Types of Transposition Techniques, Modern Technique, Block Ciphers Block Cipher Principles, Block Cipher Modes of Operation Data Encryption Standard (DES), Triple DES, Strength of DES, Advance Encryption Standard.	15	CO3
4	**Data Privacy Law:** Cyber-crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cyber-crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and social media, Cyber Laws of other countries, Case Studies.	15	CO4

Suggested Readings:
1. Matt Bishop, "Introduction to Computer Security", Addition Wesley.

2. William Stallings, "Computer Security: Principles and Practices", Pearson Education.
3. Timothy Morey Andrew Burt, Thomas C. Redman, Christine Moorman, "Customer Data and Privacy: The Insights You Need from Harvard Business", Harward Business Press.

Online Resources:
1. https://archive.nptel.ac.in/courses/106/106/106106146/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2		2	1	2		1			2	1	1
CO2	2		2		2	2	2		1			2	1	1
CO3	2	2	2	2	3	2	3		2	2	2	2	2	2
CO4	2	2	3	2	2	2	3		3	2	2	2	3	3

Course Articulation Matrix

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	**Semester**		VII	
Course Name	Soft Computing				
Code	BCACSN17422				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of the soft computing techniques to improve data analysis solution is to strengthen the dialogue between the statistics and soft computing research communities in order to cross pollinate both fields and generate mutual improvement activities.				
Course Outcomes					
CO1	To understand how soft computing and ANN approach influences various modern developments.				
CO2	To understand learning rule and activation function.				
CO3	To understand different types of Fuzzy System used in real world.				
CO4	To understand type II fuzzy set and genetic algorithms.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Soft Computing, Differences between Soft Computing and Hard Computing, Requirements of Soft Computing, Applications of Soft Computing; Introduction to Artificial Intelligence, Models of Artificial Neural Network, Feed forward artificial neural networks, Perceptron and Multilayer Perceptron neural networks, Radial basis function artificial neural networks, Recurrent neural networks, Modular neural networks.	15	CO1
2	**Learning Rules and Various Activation Functions**, Hebbian Learning Rule, Perception Learning Rule, Delta Learning Rule, Widrow, Hoff Learning Rule, Correlation Learning Rule, Winner take All Learning Rule, Associative Memories**.**	15	CO2
3	**Introduction to Fuzzy System:** Fuzzy System, Fuzzy Logic, Fuzzy Sets and Crisp Sets, Evolution of Fuzzy System, Fuzzy Set Operations, Fuzzy to Crisp Conversion, Inference in Fuzzy Logic, Fuzzy Rule Base, Fuzzy Knowledge Base, Fuzzyfication and Defuzzyfication**.**	15	CO3
4	**Type II Fuzzy Set:** Need of Type II Fuzzy Set, Type II Fuzzy Set, Generalized Type II Fuzzy Set, Interval Type II Fuzzy Set, Fuzzy System; Genetic Algorithm, Basic Concept, Working Principle of Genetic Algorithm, Flow Chart of Genetic Algorithm, Genetic Representation (Encoding), Initialization and Selection.	15	CO4

Suggested Readings:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India.
2. N.P.Padhy,"Artificial Intelligence and Intelligent Systems", Oxford University Press.
3. Siman Haykin,"Neural Networks", Prentice Hall of India.
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105173/

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1		1	1		1	2	1	2	2	2
CO2	2	1	2	1		2	1		1	2	1	2	2	1
CO3	2	2	2	2		2	1		2	2	1	2	2	2
CO4	2	2	2	2	2	2	1		2	2		2	2	2

Program	Bachelors of Computer Applications (CS & F)					
Year	IV	**Semester**		VII		
Course Name	Deep Learning					
Code	BCACSN17423					
Course Type	DSE	**L**		**T**	**P**	**Credit**
Pre-Requisite	Machine learning	3		1	0	4
Course Objectives	The subject provides the fundamental concepts of Deep Learning and its applications in various fields as well as the training procedures for neural networks and their applications.					
Course Outcomes						
CO1	Able to understand deep learning models and how to apply.					
CO2	Able to understand the architecture of convolutional neural networks.					
CO3	Able to understand the concept of Recurrent Neural Network and their application.					
CO4	Able to understand the encoder/decoder and attention network.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Deep Learning**: Basic concept of deep learning and its applications, Introduction to scaler, vectors, matrices, and tensors, Special types of matrices, matrix operations, linear Dependence, Span, Norms, Eigen Decomposition, Singular value Decomposition, Determinant, Principal Component Analysis; **Concepts of Neural Network**: Perceptron, Multi-Layer Perceptron, Activation function, Feedforward process, Error function, Optimization algorithms, Back propagation.	15	CO1
2	**Convolutional Neural Network:** Convolution and its type, Layers of CNN and its working (Convolution layer, Pooling layer, Fully Connected Layer), Advance CNN architecture: LeNet, Alexnet, VGGNet, GoogleNet, ResNet, Train network for image classification, Semantic Segmentation, Hyperparameter optimization, Transfer learning, Difference between CNN and Feed Forward Neural Network; **Application of CNN**: Case Study-Segmentation of BrainTumor from MRI using CNN or any other similar case Study.	15	CO2
3	**Recurrent Neural Network**: Introduction, Architecture, Deep RNNs, Bi-RNN; **Algorithm to train the RNN**: Backpropagation through time, Truncated Backpropagation Through Time, Challenges in training the RNN, Vanishing gradient Types of RNN: LSTM, Gated RNN; Application of RNN; **Case Study:** Sequence classification or any other similar case study.	15	CO3
4	**Encoder/Decoder**: Introduction, Architecture, Application: A case study on image captioning or sentiment analysis, or translation; **Attention Network**: Introduction, Attention mechanism, Types of Attention, Architecture, Application: A case study on the addition of attention layer in Encoder/Decoder.	15	CO4

Suggested Readings:
1. Goodfellow, Benjio Corivilli, "Deep Learning", Mit Press.
2. Bishop, "Pattern Recognition and Machine Learning", Springer.
3. Chollet, "Deep Learning with Python", Manning Publications.

Online Resources:
1. https://onlinecourses.nptel.ac.in/noc19_cs54/preview

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	2		2	1	2	1			1			2	1	1
CO2	2		2	1	2	2			1			2	1	1
CO3	2	2	2	1	3	2	1		2	2	1	2	2	2
CO4	2	2	3	1	2	2	1		3	2	1	2	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	**Semester**		VII	
Course Name	Statistical Package for Social Sciences (SPSS) Lab				
Code	BCACSN17451				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite	MS-EXCEL	0	0	4	2
Course Objectives	To familiarize students with data analysis using a statistical software package like SPSS or any other equivalent. To provide skills for research analysis and increase employability.				
Course Outcomes					
CO1	Students' familiarity with the tool box of SPSS, Data transformation and Descriptive Statistics.				
CO2	A strong theoretical and empirical foundation in statistical analysis.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**1. Familiarization with SPSS Environment** a) Overview of SPSS interface, data editor, output viewer, syntax editor, Data view window, SPSS Syntax b) Data creation and Importing data c) Defining variables d) Creating a Codebook in SPSS. **2. Data cleaning and transformation** a) Recoding (Transforming) Variables: -Recoding Categorical String Variables using Automatic Recode, Rank Cases b) Computing Variables c) Sorting Data d) Grouping or Splitting Data. **3. Descriptive Statistics** a) Frequency distribution b) Measures of central tendency and dispersion Note: Student will also perform all other exercises provided by course instructor	30	CO1
2	**1. Correlation and Regression** a) Correlation Coefficient b) Univariate Regression c) Multivariate regression **2. Inferential Statistics** a) Sampling for a problem domain and analysis using a Case Study b) Hypothesis testing, t - distribution, chi- square distribution, f- distribution, normal distribution c) ANOVA test d) Central charts and Graphs e) Time series f) One-tailed and Two-tailed tests Note: Student will also perform all other exercises provided by course instructor	30	CO2

Suggested Readings:

1. Brian C. Cronk, (2018). "HOW TO USE SPSS ® A Step-By-Step Guide to Analysis and Interpretation", 10th edition, Routledge.
2. Field, A., (2019). "Discovering Statistics Using IBM SPSS Statistics", SAGE Publications, Inc.
3. McCormick, K., & Salcedo, J. (2015). "SPSS for Dummies", 3rd Edition. John Wiley & Sons.
4. Pandya, K., Bulsari, S., Sinha, S. (2011). "SPSS in Simple Steps", KoGENT Learning.

Online Resources:

1. https://www.ibm.com/docs/en/spss-statistics

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	1	1		2	1		1	2	2
CO2	2	2	2	2	2	2	2		2	2		2	2	2

EIGHTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	IV		**Semester**	VIII	
Course Name	R Programming				
Code	BCACSN18401				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective is to provide fundamental understanding of R Programming/RStudio. Also able to understand needs and usages of graphical tools and statistical functions, correlations, and other R Programming related aspects.				
Course Outcomes					
CO1	Able to understand R Programming/RStudio, commands, conditional and Iterative statements.				
CO2	Able to identify and manage data Structures, utilizing inbuilt functions and custom functions using R Programming				
CO3	Able to identify and manage and implementation of Data management and data frames, reading and writing data in files.				
CO4	Able to understand the implementation of statistical functions, handling data with graphical tools.				
Module	**Course Contents**			**Contact Hrs.**	**Mapped CO**
1	**Fundamentals of R Programming:** Basic fundamentals of R Programming, installation and use of Base-R/RStudio software, data editing, and use of R as a calculator, Writing R scripts in an editor, Vector and scalar, missing data and logical operators, Conditional executions and iterative statements /loops.			15	CO1
2	**Data Structures and Functions:** Data management with sequences. Data management with repeats, sorting, ordering, and lists, Vector indexing, factors, Data management with strings, display and formatting, inbuilt function support, creating custom functions.			15	CO2
3	**Matrices and Data Frames:** Creating matrices and Data frames, Matrices and dataframe functions, slicing data frame, combining slicing with functions, data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames. Advanced Data frames manipulations, import of external data in various file formats.			15	CO3
4	**Plots and Statistical function:** Graphics and plots, Colors, plotting arguments, Scatterplot, Histogram, Barplot, pirateplot, Low level plotting functions, Saving plot to pdf, jpg, png file formats, statistical functions (linear and nonlinear modeling, classical statistical tests, time-series analysis, classification, clustering) for central tendency, variation, skewness and kurtosis, handling of bivarite data through graphics, correlations, Data persistency, Hypothesis test (T Test, Correlations Test, Chi Square Test).			15	CO4

Suggested Readings:

1. Christian Heumann, Michael Schomaker and Shalabh "Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R", Springer.
2. Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet "The R Software-Fundamentals of Programming and Statistical Analysis", Springer.

3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters "A Beginner's Guide to R (Use R)", Springer.

Online Resources:
1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://home.iitk.ac.in/~shalab/sprs.htm

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					1								
CO2	2	1				1				1				
CO3	2	2		1	1	2				1		1		
CO4	2	2		1	1	2				1		1	1	

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	**Semester**	VIII		
Course Name	Intellectual Property Right				
Code	BCACSN18402				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations.				
Course Outcomes					
CO1	To understand the need of intellectual property rights.				
CO2	To understand the concepts Patent and Copyrights.				
CO3	To understand the concept of Trade Mark and Design.				
CO4	To understand the Geographical indications and Plant Variety Protection.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction of intellectual property right (IPR):** Meaning, nature and basic concepts of intellectual property, Types of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design, IPR in India: Genesis and development, IPR in abroad, Introduction to TRIPS and WTO, Introduction to IT Act.	15	CO1
2	**PATENT:** Objectives, Rights, Patent Acts 1970 and its amendments. Procedure of obtaining patents, working of patent, Industrial Application: Non-Patentable Subject Matter, Registration Procedure, Rights and duties of Patentees, Infringement, Restoration of lapsed Patents, Surrender and Revocation of Patents; **Copyright:** Definition &Types of Copyright, Registration procedure, Assignment & license, Terms of Copyright, Piracy, Infringement, Remedies, Copyrights with special reference to software.	15	CO2
3	**Trademarks:** Concept of Trademarks, Types of trademarks: brand names, logos, signatures, symbols, well-known marks, certification marks and service marks, Non-Registrable Trademarks, Registration of Trademarks, Rights of holder, assignment and licensing of marks Trademark Infringement, Remedies & Penalties - Trademarks registry and appellate board; **Design:** meaning and concept of novel and original, Procedure for registration, effect of registration and term of protection.	15	CO3
4	**Geographical indication:** Concept of GI, Procedure for registration, effect of registration and term of protection; **Plant Variety Protection**: Concept of Plant variety protection, Procedure for registration, effect of registration and term of protection. India`s New National IP Policy, Govt. of India step towards Promoting IPR, Govt. Schemes in IPR – Career Opportunities in IPR.	15	CO4

Suggested Readings:

1. Neeraj, P., & Khusdeep, D., "Intellectual Property Rights. India, IN", PHI learning Private Limited.
2. B.L. Wadera, "Patents, trademarks, copyright, Designs and Geographical Judications", PHI.
3. Nityananda, K.V, "Intellectual Property Rights: Protection and Management. India, In" Cengage Learning India Private Limited.

Online Resources:

1. http://www.ipindia.nic.in/
2. http://cipam.gov.in/

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Course Articulation Matrix														
CO1	1		1			1	1			2	1	2	1	1
CO2	1	2	1	1	2	1	2		2	3	1	2	2	2
CO3	1	2	3	1	2	1	2		2	3	1	2	2	2
CO4	1	2	2	1	2	1	1	2	1	2	2	2	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	**Semester**	VIII		
Course Name	R Programming Lab				
Code	BCACSN18451				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The objective of this course is to provide students with a practical understanding of R Programming/RStudio. It will dive deep in managing the concept and significance of Data Management and Data Frames, and to understand need and usages of graphical tools and relevant statistical functions, correlations.				
Course Outcomes					
CO1	Able to work on RStudio and learn basics of R Programming, control & iterative, matrix, list, vector manipulations, inbuilt and custom Functions				
CO2	Able to Use data management through excel file, CSV File, Graphical tools and statistical functions.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Introduction to R and RStudio, Working with commands and variables 2. Implementation of various Data Structures in R (Vectors, Matrices, lists, data frames) 3. Implementation of various Control Structure (If-else statements, loops) 4. Implementations and usage of various inbuilt functions, writing custom functions and apply family functions in R Programming 5. Performing data manipulation with dplyr and tidyr packages 6. Performing Data visualization with ggplot2 for creating plots, scatter plots, histogram, box plots, customizing plots with themes, colors and labels 7. Introduction to Statistical Analysis in R Programming, Implementation of basic regression analysis. 8. Implementations of various inferential statistics (T-tests, ANOVA, Correlation) 9. Implementation of importing and exporting data to and from sources (CSV, Excel, database etc) 10. Introductions and demonstrate the use of readr and readxl packages. **Note:** Students will also perform all other exercises provided by course Instructor.	30	CO1
2	1. Creating and managing R Packages 2. Introduction to Probability and its implementation in R Programming 3. Simulation and Implementation of the Normal Curve using R Programming 4. Simulating and implementation of Measures of Central Tendency and Dispersion 5. Simulating and implementation Standard Deviations, Standard Scores and the Normal Distribution 6. Simulating and implementation Hypothesis Testing: Testing the Significance of the Difference Between Two Means	30	CO2

		7.	Simulating and implementation Hypothesis testing: One and Two-tailed Tests		
		8.	Simulating and implementation Bivariate Statistics for Nominal Data		
		9.	Simulating and implementation Bivariate Statistics for Ordinal Data		
		10.	Simulating and implementation Bivariate Statistics for Interval / Ratio Data		

Note: Students will also perform all other exercises provided by course Instructor.

Suggested Readings:

1. Christian Heumann, Michael Schomaker and Shalabh, "Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R", Springer.
2. Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet, "The R Software-Fundamentals of Programming and Statistical Analysis", Springer.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, "A Beginner's Guide to R", Springer.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://home.iitk.ac.in/~shalab/sprs.htm

Course Articulation Matrix													
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					1								
CO2	2	1				1				1				