Credit Framework for the Bachelor of Computer Applications (Cyber Security & Forensics) 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)	Value Added Course (VAC)	GP	Total Credit
1	4 Subjects 16 Credits (4+5+5+2 Credits)		1 Subject 3 Credits	1 Subject 3 Credits	1 Subject 2 Credits		1 Subject 2 Credits	1 Credit	27
2	4 Subjects 16 Credits (4 +2+5+5 Credits)		1 Subject 3 Credits	1 Subject 3 Credits	1 Subject 2 Credits		1 Subject 2 Credits	1 Credit	27
Early Exit Option-1: Award of UG Certificate in Cyber Security & Forensics (After 1 Year: 54 Credits)									
3	5 Subjects 20 Credits (4+3+5+5+3 Credits)		1 Subject 3 Credits				1 Subject 2 Credits	1 Credit	26
4	3 Subjects 14 Credits (4+5+5 Credits)	1 Subjects 3 Credits	1 Subject 3 Credits		1 Subject 2 Credits			1 Credit	23
Early Exit Option-2: Award of UG Diploma in Cyber Security & Forensics (After 2 Year: 103 Credits)									
5	3 Subjects 14 Credits (4+5+5 Credits)	2 Subjects 6 Credits (3+3 Credits)						1 Credit	21
6	Industrial Training Cum-Project 20 Credits							1 Credit	21
Early Exit Option-3: Award of Bachelor of Computer Applications in Cyber Security & Forensics (After 3 Year: 145 Credits)									
7	3 Subjects 10 Credits (3+3+4 Credits) Minor Dissertation 6 Credits	1 Subjects 3 Credits						1 Credit	20
8	2 Subjects 8 Credits (5+3 Credits) Major Dissertation 12 Credits							1 Credit	21
Award of Bachelor of Computer Applications in Cyber Security & Forensics with Research (After 4 Years: 186 Credits)									

Babu Banarasi Das University, Lucknow School
of Computer Applications
Bachelor of Computer Applications (CS & F)
Evaluation Scheme (w. e. f. Academic Session 2025-26)

SEMESTER I

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN21101	Fundamental of Cyber Security & Ethical Hacking	3	1	0	40	60	100	4	IBM
DSC	BCACSN21102	Fundamentals of Computer & Programming in C	2	1	0	40	60	100	3	School
DSC	BCACSN21103	Computer Network	3	0	0	40	60	100	3	
DSC	BCACSN21104	Basic Mathematics	2	0	0	40	60	100	2	
GE		Generic Elective-I	3	0	0	40	60	100	3	
CC		Co-Curricular-I	3	0	0	40	60	100	3	
DSC	BCACSN21151	Programming in C Lab	0	0	4	40	60	100	2	
DSC	BCACSN21152	Computer Network Lab	0	0	4	40	60	100	2	
VC		Vocational Course-I	2	0	0	40	60	100	2	
VAC	UHV11101	Foundation of Universal Human Values	2	0	0	40	60	100	2	
	GPN2101	General Proficiency	0	0	0	100	0	100	1	
Total			**20**	**2**	**8**	**500**	**600**	**1100**	**27**	

SEMESTER II

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN22101	Network Security and Protocol Analysis	3	1	0	40	60	100	4	IBM
DSC	BCACSN22102	Blockchain Fundamentals	2	0	0	40	60	100	2	
DSC	BCACSN22103	Data Structure Using C	2	1	0	40	60	100	3	School
DSC	BCACSN22104	Web Designing	2	1	0	40	60	100	3	
GE		Generic Elective-II	3	0	0	40	60	100	3	
CC		Co-Curricular-II	3	0	0	40	60	100	3	
DSC	BCACSN22151	Data Structure Using C Lab	0	0	4	40	60	100	2	
DSC	BCACSN22152	Web Designing Lab	0	0	4	40	60	100	2	
VC		Vocational Course-II	2	0	0	40	60	100	2	
VAC	UHV12102	Understanding Harmony	2	0	0	40	60	100	2	
	GPN2201	General Proficiency	0	0	0	100	0	100	1	
Total			**19**	**3**	**8**	**500**	**600**	**1100**	**27**	

Early Exit Option-1: Award of UG Certificate in Cyber Security & Forensics (After 1 Year: 54 Credits)

SEMESTER III

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN23201	Malware Analysis and Reverse Engineering	3	1	0	40	60	100	4	IBM
DSC	BCACSN23202	Digital Security & Forensic Fundamentals	3	0	0	40	60	100	3	School
DSC	BCACSN23203	Database Management System	2	1	0	40	60	100	3	
DSC	BCACSN23204	Object Oriented Programming Using Java	2	1	0	40	60	100	3	
DSC	BCACSN23205	Operating System	3	0	0	40	60	100	3	
GE		Generic Elective-III	3	0	0	40	60	100	3	
DSC	BCACSN23251	Database Management System Lab	0	0	4	40	60	100	2	
DSC	BCACSN23252	Object Oriented Programming Using Java Lab	0	0	4	40	60	100	2	
VAC	IKS13201	Indian Knowledge System	2	0	0	40	60	100	2	
	GPN2301	General Proficiency	0	0	0	100	0	100	1	
Total			**18**	**3**	**8**	**460**	**540**	**1000**	**26**	

SEMESTER IV

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN24201	Security Intelligence	3	1	0	40	60	100	4	IBM
DSC	BCACSN24202	Operating System Security	3	0	0	40	60	100	3	School
DSC	BCACSN24203	Mobile Application Development	2	1	0	40	60	100	3	
GE		Generic Elective-IV	3	0	0	40	60	100	3	
DSE		Discipline Specific Elective-I	3	0	0	40	60	100	3	
DSC	BCACSN24251	Operating System Security Lab	0	0	4	40	60	100	2	
DSC	BCACSN24252	Mobile Application Development Lab	0	0	4	40	60	100	2	
VC		Vocational Course-IV / SSMC	2	0	0	40	60	100	2	
	GPN2401	General Proficiency	0	0	0	100	0	100	1	
Total			**16**	**2**	**8**	**420**	**480**	**900**	**23**	

Early Exit Option-2: Award of UG Diploma in Cyber Security & Forensics (After 2 Year: 103 Credits)

SEMESTER V

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN25301	Development of Private Cloud	3	1	0	40	60	100	4	IBM
DSC	BCACSN25302	Python Programming with Django	2	1	0	40	60	100	3	School
DSC	BCACSN25303	Web Application Security	3	0	0	40	60	100	3	
DSE		Discipline Specific Elective-II	3	0	0	40	60	100	3	
DSE		Discipline Specific Elective-III	3	0	0	40	60	100	3	
DSC	BCACSN25351	Python Programming with Django Lab	0	0	4	40	60	100	2	
DSC	BCACSN25352	Web Application Security Lab	0	0	4	40	60	100	2	
	GPN2501	General Proficiency	0	0	0	40	60	100	1	
Total			**14**	**2**	**8**	**320**	**480**	**800**	**21**	

SEMESTER VI

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
Theory										School
DSC	BCACSN26351	Industrial Training Cum-Project	0	0	0	280	420	700	20	
	GPN2601	General Proficiency	0	0	0	100	0	100	1	
Total			**0**	**0**	**0**	**380**	**420**	**800**	**21**	

Early Exit Option-3: Award of Bachelor of Computer Applications in Cyber Security & Forensics (After 3 Year: 145 Credits)

SEMESTER VII

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits	Mode
			L	T	P	CIA	ESE	Total		
DSC	BCACSN27401	Statistical & Optimization Techniques	2	1	0	40	60	100	3	School
DSC	BCACSN27402	Research Methodology	3	0	0	40	60	100	3	
DSC	BCACSN27403	Understanding Security and Forensic Through Case Studies	3	1	0	40	60	100	4	
DSE		Discipline Specific Elective-IV	3	0	0	40	60	100	3	
DSC	BCACSN27451	Minor Dissertation	0	0	12	100	200	300	6	
	GPN2701	General Proficiency	0	0	0	100	0	100	1	
Total			**11**	**2**	**12**	**360**	**440**	**800**	**20**	

SEMESTER VIII										
Course Category	**Course Code**	**Course Title**	**Period Per Week**			**Evaluation Scheme**			**Credits**	**Mode**
			L	**T**	**P**	**CIA**	**ESE**	**Total**		
DSC	BCACSN28401	R Programming	2	1	0	40	60	100	3	School
DSC	BCACSN28402	Intellectual Property Rights	3	0	0	40	60	100	3	
DSC	BCACSN28451	R Programming Lab	0	0	4	40	60	100	2	
DSC	BCACSN28452	Major Dissertation	0	0	24	200	300	500	12	
	GPN2801	General Proficiency	0	0	0	100	0	100	1	
Total			**5**	**1**	**28**	**420**	**480**	**900**	**21**	
Award of Bachelor of Computer Applications in Cyber Security & Forensics with Research (After 4 Years: 186 Credits)										

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

Generic Elective-I		
1	BCACSN21111	Information & Data Security
2	BCACSN21112	Foundation of Machine Learning
Generic Elective-II		
1	BCACSN22111	Digital Security & Evidence
2	BCACSN22112	Machine Learning in Cyber Security
Generic Elective-III		
1	BCACSN23211	End to End Security
2	BCACSN23212	Big Data Security
Generic Elective-IV		
1	BCACSN24211	Mobile Forensics
2	BCACSN24212	IOT & Security

Discipline Specific Elective-I		
1	BCACSN24221	Introduction to System Security
2	BCACSN24222	Identity Access Management
Discipline Specific Elective-II		
1	BCACSN25321	Cryptography
2	BCACSN25322	Biometric Security
Discipline Specific Elective-III		
1	BCACSN25323	Cyber Law & IT Act 2000
2	BCACSN25324	Physical Security
Discipline Specific Elective-IV		
1	BCACSN27421	Soft Computing
2	BCACSN27422	Deep Learning

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

2. Student may select 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 Application (CS & F)				
Year	I	Semester	I		
Course Name	Fundamental of Cyber Security & Ethical Hacking				
Code	BCACSN21101				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	1. Understand fundamental cybersecurity concepts, principles, and frameworks essential for protecting data and infrastructure. 2. Develop proficiency in identifying, mitigating, and responding to various cybersecurity threats and vulnerabilities. 3. Master the use of tools and techniques for ethical hacking, cryptography, and network security. 4. Analyze the legal, ethical, and regulatory aspects of cybersecurity and the implications for individuals and organizations.				
Course Outcomes					
CO1	Identify and assess various cybersecurity threats, risks, and vulnerabilities.				
CO2	Apply cryptographic techniques to secure data and communication channels.				
CO3	Implement network security protocols and configurations to protect against cyber-attacks.				
CO4	Perform penetration testing and ethical hacking to evaluate system vulnerabilities.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Cybersecurity Fundamentals and Threat Landscape:** Understanding Cybersecurity, Importance of Cybersecurity, Current Trends in Cybersecurity, Types of Threats: Malware, Ransomware, Phishing, Social Engineering, Cybersecurity Frameworks and Standards: NIST, ISO/IEC, Cybersecurity in Different Domains: Cloud, IoT, Mobile, Key Concepts: Confidentiality, Integrity, Availability (CIA Triad).	15	CO1
2	**Network Security and Architecture:** Fundamentals of Network Security: Firewalls, IDS/IPS, Security Architectures: Zero Trust, Defense in Depth, Securing Wireless Networks, Network Segmentation, VPNs, Proxies, Secure Web Gateways, Network Monitoring, Traffic Analysis.	15	CO2
3	**Cryptography and Data Protection:** Basics of Cryptography: Symmetric and Asymmetric Encryption, Cryptographic Protocols: SSL/TLS, Public Key Infrastructure (PKI), Hashing Algorithms, Digital Signatures, Key Management, Encryption Standards: AES, RSA, Data Loss Prevention (DLP), Data Security in the Cloud.	15	CO3
4	**Ethical Hacking, Compliance, and Incident Response:** Introduction to Ethical Hacking, Penetration Testing, Phases of Ethical Hacking: Reconnaissance, Scanning, Exploitation, Reporting, Vulnerability Scanning and Management: Nessus, OpenVAS, Social Engineering Attacks, Defense Strategies, Tools for Hacking: Kali Linux, Metasploit, Wireshark, Regulatory Compliance: GDPR, HIPAA, CCPA, Security Policy Development, Incident Response Planning and Management, Disaster Recovery, Business Continuity Planning, Forensics, Post-Incident Analysis.	15	CO4

Suggested Readings

1. Stallings, W. (2022). Network Security Essentials: Applications and Standards, 7th Edition. Pearson.
2. Pfleeger, C. P., & Pfleeger, S. L. (2019). Security in Computing, 5th Edition. Prentice Hall.
3. Kaufman, C., Perlman, R., & Speciner, M. (2020). Network Security: Private Communication in a Public World, 3rd Edition. Pearson.
4. Easttom, C. (2021). Computer Security Fundamentals, 4th Edition. Pearson.
5. Whitman, M. E., & Mattord, H. J. (2021). Principles of Information Security, 7th Edition. Cengage Learning.

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	1				2	2	1
CO2	3	2	2	2	3	1		1		1		2	3	3
CO3	3	3	3	3	3	2		2	2	2	2	3	3	3
CO4	2	2	3	2	2	3	1	3	3	3	3	3	3	2

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	I		
Course Name	Fundamentals of Computer & Programming in C				
Code	BCACSN21102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	1	0	3
Course Objectives	The subject focuses on the fundamental concepts of Computer and its peripherals 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	Understand basic concepts of C programming including tokens, operators and and programming construct.
CO3	Learn concepts of function, arrays, structure, union in C language.
CO4	Understand the concept of pointers and file handling in C language.

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Computers:** Basics of computers and its operation, History of computer, Generation of computer, Capabilities and limitations of computers, Types of computers; **Hardware:** Block Diagram of Computer, CPU, Input devices & Output Devices**; Storage Devices:** Primary & Secondary, Auxiliary Storage Devices; **Memory:** Cache Memory, Memory Hierarchy, Buffering and Spooling; **Software:** System Software and Application Software; **Operating System:** Functions, Need of Operating System**; Types of Languages**: Machine Language, Assembly Languages, High level Languages; **Translator**: Compiler, Interpreter & Assembler; Loader; Linker; **Algorithms & Flowchart**: Introduction, Definition, example.	10	CO1
2	**Introduction to C**: Definition, History, 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 Making 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.	11	CO2
3	**Array:** Array Notation and Representation, Types of Arrays, Single Dimension Array, Two-Dimensional Array, Address Calculation of an Element in Array, operation on array; **Structures, Union:** Structure, Union, Enumerated Data Types, Array of Structures; **Functions:** Built-in and User-Defined Functions, Function Declaration, Function Definition, Actual Arguments, Formal Arguments; Call by Value, Call by Reference, Passing Arrays as Parameters, Storage Classes, Preprocessor Directives.	12	CO3

4	**Pointers:** Definition, Declaration of Pointer Variables, Pointer Arithmetic, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Array of Pointers; **String:** Character Arrays and Strings, Built-in String functions, Pointer and String; **File Handling:** Definition of file, types of files, mode of opening files, file pointer, file handling built-in functions, reading and writing files.	12	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	Computer Networks				
Code	BCACSN21103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	This course builds an understanding of the fundamental concepts and layered architecture of computer networking. It familiarizes students with the core taxonomy, terminology, and organization of networks. Additionally, it introduces advanced networking topics to prepare students for higher-level courses in networking and security.				
Course Outcomes					
CO1	To understand and describe the layered protocol model.				
CO2	To understand, analyze and evaluate a number of data link, network, and transport layer protocols.				
CO3	To understand and build the skills of sub netting and routing mechanisms.				
CO4	To understand the security features involved in data transfer				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Computer Network:** 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; **Introduction to Network Security:** Network Security Goals; Attack Threating; Cryptography; Stenography; Obfuscation; Security Services and Mechanism.	10	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.	12	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.	11	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.	12	CO4

Suggested Readings

1. Andrew S Tanenbaum, David. J. Wetherall, “Computer Networks”, Pearson Education, 5th Edition,
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, Fourth Edition
3. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010
4. Dayanand Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, “Advance Computer Network”, Wiley India.

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	2	1		1	2	1	1			1	1	1	2	1
CO2	2	1		1	2	2	1		1	1	2	2	2	2
CO3	2	1		1	2	3	1		1	1	2	3	2	2
CO4	3	2		2	3	3	1		1	1	2	3	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	I		
Course Name	Basic Mathematics				
Code	BCACSN21104				
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 basics 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, 2000Edition.
2. Shanti Narain, "Text book of Matrices", 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		2	2	1	1					2	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**		I	
Course Name	Information & Data Security				
Code	BCACSN21111				
Course Type	GE	**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 basics of information security.				
CO2	To learn about how to maintain the information and data security i.e., confidentiality, integrity and availability.				
CO3	Understanding the basic concept of security policies.				
CO4	The student will be able to understand the basics of security, policies, cryptographic algorithms, and its issues along with its countermeasures.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Information Security:** Principles, CIA (Confidentiality, Integrity, Availability), Aspects of Information Security, Need for Security, Goals of Information Security, Features of a Good Security Policy, Security Attacks, Virus, DoS, Worms, Spyware, Ransomware, Security Services and Mechanisms, Security Standards.	10	CO1
2	**Principles of Security**: Steganography, Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Types of Substitution Techniques, Transposition Techniques, Types of Transposition Techniques, Block Cipher Principles, Block Cipher Modes of Operation, Encryption and Decryption, Data Encryption Standard (DES) Algorithm, Strength of DES.	11	CO2
3	**Introduction to Security Policies:** Confidentiality, Integrity, Availability and Hybrid Policies, Academic Computer Security Policy: General University Policies, Information Risk Management, Risk Mitigation, Risk Handling Strategies and Risk Assessment, Information Classification – Guidelines, Types, Criteria for data Classification, Data Classification procedures, Classification Controls.	12	CO3
4	**Authentication:** Basics of Authentication, One Factor Authentication, Two Factor Authentication, Multi Factor Authentication, Passwords: Attacking a Password System, Countering Password Guessing, Biometrics: Fingerprints, Faces, Voices, Eyes and Combinations, Access Control, Types of Access Control.	12	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/

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
CO2	1	2	1	1	1	1	2		1			1	1	2
CO3		1	2	2		1	1		1	1	1	1		1
CO4	2	2	3	2	2	2	3		3	2	3	2	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**		I	
Course Name	Foundation of Machine Learning				
Code	BCACSN21112				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	To acquire the fundamental knowledge of Machine Learning.				
Course Outcomes					
CO1	To understand the basics of machine learning concepts.				
CO2	To understand the basics of statistical description of Data.				
CO3	To understand the core machine learning models.				
CO4	To understand the basics of Neural Network, Responsible AI and Ethics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Definition, Learning from data, Machine Learning vs Traditional Programming, Importance and Impact of machine learning, Types of machine learning, Applications, Key concept and terminologies, Types of Data, Common Data Problems; **Data Preprocessing Concepts:** Cleaning, Transformation, Integration, Reduction, Feature Selection.	10	CO1
2	**Basic Statistical Description of Data:** Central Tendency, Measuring the Dispersion of Data, Five-Number Summary, Variance and Standard Deviation, Correlation, Basics of Probability, Events, Conditional Probability; **Graphic Displays of Basic Statistical Description of Data:** Quantile Plot, Scatter Plots, Correlation Heatmaps, Histograms, Boxplots.	11	CO2
3	**Machine Learning Models:** Linear Regression, K-Nearest Neighbors, Naïve Bayes Classifier, Decision Tree Induction, K means clustering; **Model Training and Testing:** Train-Test splitting, Overfitting and Underfitting, Bias-variance tradeoff; **Model Evaluation:** Accuracy and Mean Absolute Error, Error Distribution plots, Confusion Matrix.	12	CO3
4	**Model Tuning:** Cross-Validation Concept, Hyperparameter tuning; **Introduction to Neural Networks:** Neural Network Structure, Neurons, Layers, Activation Functions, Learning in Neural Networks, Feed Forward Neural Network; **Responsible AI and Ethics:** Bias in machine learning models, data privacy and protection, Explainability of AI decisions, Importance of building fair, ethical AI systems.	12	CO4

Suggested Readings

1. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.
2. Jiawei Han, Micheline Kamber, Jian Pie, “Data Ming Concept and Techniques”, Morgan Kaufmann, 3rd Addition, 2011.
3. Fengxiang He and Dacheng Tau, “Machine Learning Foundation, Methodologies and Application”, Springer 2023.
4. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, O'Reilly, 2017.

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106139/

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

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	I		
Course Name	Programming in C Lab				
Code	BCACSN21151				
Course Type	DSC	**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	Develop programs using decision making, looping & jump statements and user defined function.				
CO2	Develop programs using pointers, structure, union, string, file handling & preprocessor directives.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Developing programs based on fundamental data types and basic input/output function. 2. Writing program based on fundamental operators. 3. Developing program based on decision making statement such as if and switch statements. 4. Developing program based on looping statements such as for loop, while loop, do while loop. 5. Developing program based on single & two-dimensional array. 6. Implementation of user defined functions including call by value and call by reference. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO1
2	1. Developing programs using pointer concept. 2. Developing program based on pointer and array. 3. Implementation of structures, union, and enumeration. 4. Writing program based on passing pointers as function arguments. 5. Developing program based on string functions. 6. Performing read & write operation on text file & binary file. **Note: -** Students will also perform all other exercises provided by	15	CO2

Suggested Readings

1. E. Balagurusamy, "Programming in ANSI C", TMH Publications.
2. Reema Thareja, "Programming in C", OXFORD University Press.
3. Yashvant Kanetkar, "Let Us C", BPB Publications.
4. S. K. Srivastava & Deepali Srivastava, "C in Depth", BPB Publications.

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	2	1		3	2	2	3		1	2	2	1	2	2
CO2				3	3								2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	I		
Course Name	Computer Network Lab				
Code	BCACSN21152				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To equip students with foundational and advanced networking skills through hands-on configuration of Cisco devices and simulation tools. Focus areas include IP addressing, VLANs, routing protocols, WAN technologies, NAT, and network security aligned with CCNA objectives.				
Course Outcomes					
CO1	To introduce students to basic networking concepts and device configurations using Cisco routers and switches. Emphasis is on IP addressing, VLANs, routing, and foundational troubleshooting using simulation tools.				
CO2	To develop skills in advanced routing, WAN protocols, NAT, and network security in simulated enterprise environments. Focus is on integrating and managing multiple network services using tools like Cisco Packet Tracer.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1.	1. Introduction to Networking Tools and Cisco Packet Tracer 2. Basic Switch and Router Configuration 3. Configuring IP Addressing (IPv4 & Subnetting) 4. Configuring and Verifying VLANs 5. Implementing Static Routing 6. Configuring RIP Routing Protocol 7. Configuring OSPF (Single Area) 8. DHCP Configuration on Router 9. Implementing Access Control Lists (ACLs) 10. Troubleshooting Basic Network Issues **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO1
2	1. NAT Configuration (Static, Dynamic, PAT) 2. STP (Spanning Tree Protocol) Configuration and Analysis 3. EtherChannel Configuration 4. Inter-VLAN Routing with Router-on-a-Stick 5. WAN Topology Simulation and PPP Configuration 6. Frame Relay Simulation (if supported by tool) 7. Configuring and Verifying EIGRP 8. Basic Network Security Configurations 9. Configuring Wireless LAN in Packet Tracer 10. Simulating a Small Enterprise Network Scenario (Capstone Lab) **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO2

Suggested Readings

1. "CCNA 200-301 Official Cert Guide, Volume 1", Wendell Odom, Cisco Press
2. "CCNA 200-301 Official Cert Guide, Volume 2", Wendell Odom, Cisco Press
3. "CCNA 200-301 Portable Command Guide", Scott Empson, Cisco Press

Online Resources

1. https://www.netacad.com/

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		3	1	1	2	2	3
CO2	2	2		3	2	3	2		3	2	2	3	2	3

SECOND SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	II		
Course Name	Network Security and Protocol Analysis				
Code	BCACSN22101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Understand the fundamentals of computer networks and core communication protocols used in network environments, analysis of protocol behaviors and identify network-based threats and vulnerabilities, evaluate different network security architectures and defense mechanisms, exploring advanced network security concepts including secure protocol design and incident response, Interpret and apply real-world case studies to understand evolving network threats and mitigation strategies.				
Course Outcomes					
CO1	Explain the structure and functionality of computer networks and identify key security principles.				
CO2	Analyze network traffic and recognize protocol-based vulnerabilities and common reconnaissance methods.				
CO3	Evaluate and design secure network architectures using firewalls, VPNs, and authentication mechanisms.				
CO4	Critically assess and respond to modern network threats through advanced protocol analysis and forensic investigation.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Network Security and Protocol Fundamentals**: OSI and TCP/IP Models, Protocol Stack Overview, Network Devices: Routers, Switches, Hubs, Gateways; **Core Protocols and Their Roles**: IP, TCP, UDP, ICMP, ARP, Application Layer Protocols: HTTP, FTP, SMTP, DNS, DHCP; **Basics of Network Security**: CIA Triad: Confidentiality, Integrity, Availability, Authentication, Authorization, and Accounting (AAA); **Threats and Vulnerabilities**: Malware Types, Social Engineering, Types of Attacks: DoS, Man-in-the-Middle, Spoofing, Phishing; **Security Policy and Risk Management**: Risk Assessment, Security Controls, Principles of Least Privilege and Defense in Depth.	15	CO1
2	**Protocol Analysis and Threat Identification:** **Protocol Behavior and Analysis**: Understanding Protocol Headers and Structures, Packet Lifecycle and Flow Analysis **Analyzing Network Traffic**: Header Fields and Payload Inspection, Protocol Anomalies and Abnormal Behaviors; **Common Protocol Vulnerabilities**: ARP Poisoning, DNS Spoofing, TCP Session Hijacking, Insecure Protocols: FTP, Telnet, SNMP v1/v2; **Reconnaissance and Scanning Techniques**: Foot printing, Port Scanning, Banner Grabbing, Tools Overview: Nmap, Netcat (conceptual use); **Intrusion Detection Concepts**: Signature-based vs Anomaly-based Detection, Role of IDS/IPS in Protocol Analysis.	15	CO2

3	**Network Security Architectures and Defense Mechanisms Firewall Technologies**: Packet-Filtering and Stateful Firewalls, Application Firewalls and NGFW Concepts; **Virtual Private Networks (VPNs)**: IPsec and SSL VPN Fundamentals, Tunneling Protocols and Encryption Standards; **Secure Protocols and Communication**: HTTPS, SSH, SFTP, SNMPv3, SCP, SSL/TLS Handshake, Certificates and PKI; **Authentication Protocols and Services**: RADIUS, TACACS+, Kerberos, LDAP, Multi-Factor Authentication (MFA); **Wireless and Endpoint Security**: Wireless Security Standards: WPA2, WPA3, Endpoint Protection Strategies and BYOD Risks, 802.1X Authentication Flaws; **Application Layer Protocol Analysis**: HTTP/HTTPS: Header Manipulation, HSTS, DNS Security (DNSSEC, DoT/DoH), Email Protocols (SPF, DKIM, DMARC).	15	CO3
4	**Advanced Topics in Security and Protocol Advanced Persistent Threats (APT) and Evasion Techniques**: Malware Persistence, Stealth Attacks, Traffic Encryption and Obfuscation Techniques**; Zero Trust and Modern Network Security Models**: Principles of Zero Trust Architecture, Micro-Segmentation and Network Isolation; **Security Protocol Design and Evaluation**: Principles of Secure Protocol Design, Common Design Flaws and Pitfalls; **Incident Response and Forensic Protocol Analysis**: Network Forensics Overview, Steps in Incident Detection and Containment; **Case Studies and Real-World Attacks**: Analysis of Attacks like Stuxnet, Solar Winds, Target Data Breach, Lessons Learned from Protocol Exploitation; **Emerging Trends in Network Security**: AI/ML in Security Monitoring, Software-Defined Networking (SDN) Security, Cloud Network Security Practices.	15	CO4

Suggested Readings

1. William Stallings, *Network Security Essentials: Applications and Standards*, Pearson.
2. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw-Hill.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, *Network Security: Private Communication in a Public World*, Prentice Hall.
4. Richard Bejtlich, *The Practice of Network Security Monitoring*, No Starch Press.
5. Chris Sanders, *Practical Packet Analysis*, No Starch Press.

Online Resources

1. Wireshark Official Documentation
2. Cisco Networking Academy
3. OWASP - Open Web Application Security Project
4. MIT OpenCourseWare - Computer and Network Security
5. Cybrary - Network Security Courses.

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	2	1
CO2	2	2		1	2	1	2		2	2	1	3	2	2
CO3	2	2		2	2	2	3		3	3	2	3	3	3
CO4	2	2		3	2	2	3		3	3	3	3	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	I	Semester	II		
Course Name	Blockchain Fundamentals				
Code	BCACSN22102				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		2	0	0	2
Course Objectives	This course introduces students to blockchain technology, covering its architecture, protocols, and real-world applications, build basic blockchain structures, work with key components like hash and Merkle trees, and develop blockchain-based applications using web technologies and IBM Blockchain Platform. The course provides hands-on experience in smart contract development and deployment.				
Course Outcomes					
CO1	Students will learn fundamental concepts of Blockchain and Distributed Ledger Technology, use of hashing, nonce, and Merkle trees in block validation				
CO2	To acquire insights into Blockchain functionality, Blockchain implementation through Bitcoin and Merkle Root etc..				

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. **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 attacks, Finality, Limitation of proof-of-work, Alternatives to Proof of Work.	15	CO1
2	**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. **Distributed Ledger Technology in Alternative Blockchain:** Blockchain Governance Challenges: Bitcoin Block size 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, design a new blockchain, Potential for disruption, Design a distributed application.	15	CO2

Suggested Readings

1. Iyer, Kedar, et al., “Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions”, 2018, 1st edition, McGraw-Hill Education, United Kingdom.
2. Wattenhofer, R., “Distributed Ledger Technology: The Science of the Blockchain”, 2017, 1st edition.
3. Mark Gates, “Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money”, Wise Fox Publishing and Mark Gates 2017.
4. Bahga, Vijay Madisetti, “Block chain Applications: A Hands-On Approach”, Arshdeep Bahga, Vijay Madisetti publishers 2017.

Online Resources

1. Blockchain for Beginners: Getting Started Guide - 101 Blockchains.
2. NPTEL & MOOC courses titled blockchain technology: blockgeeks.comguide/what-is-block-chain-technology
3. https://nptel.ac.in/courses/106105184/

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	2	1
CO2	2	2	1	1	2	1	2		2	2	1	3	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**		II	
Course Name	Data Structure Using C				
Code	BCACSN22103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	1	0	3
Course Objectives	The objective of this course is to make the student learn fundamental data structures algorithms. This course describes and implements algorithms such as stacks, queues, linked lists, trees, searching techniques, sorting techniques, hashing techniques and graphs.				
Course Outcomes					
CO1	Apply advance C programming techniques such as pointers, dynamic memory allocation, structures to developing solutions for particular problems.				
CO2	To design and implement abstract data types such as stack, queue by using C as the programming language using static or dynamic implementations.				
CO3	To design and implement abstract data types such as linked list, using C as the programming language using static or dynamic implementations.				
CO4	To understand and implement the concept of trees and graphs.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Data Structures**: Classification of Data Structure, Operations on Data Structure, Arrays: Address Calculation, Application of arrays, Limitation of Array, Array as Parameters, Introduction to Dynamic Memory Allocation (Malloc, Calloc, Realloc, Free); Sparse Matrices.	09	CO1
2	**Continuous Implementation (Stack)**: Array Representation, Operations on Stacks: Push & Pop, Applications of stack, Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. **Recursion**: Recursive Definition and Processes, Principles of Recursion, Tower of Hanoi Problem, Recursion Vs. Iteration, **Continuous Implementation (Queue)**: Array representation and implementation of Queues, Operations on Queue: Create, Add, Delete, Full and Empty Queue, Circular Queue, Dequeue and Priority Queue.	12	CO2
3	**Non-Continuous Implementation (Link Lists)**: Linear List concept, List v/s Array, Linked List Terminology, Representation of Linked List in Memory, Types of Linked List, Single Linked List, Doubly Linked List, Single Circular Linked list, Circular Doubly Linked List, **Operations on Link List**: Create List, insert node (empty list, beginning, middle, end), Delete node (first, general case), Traversing node, Searching node, Print list, Count Nodes, Sort Lists.	12	CO3
4	**Trees**: Introduction to Tree & its Terminology, Binary trees, Types of Binary trees, Representation of Binary Tree, Traversals (In-order, Preorder, Post-order), Tree Expression, Binary Search Tree, Insertion and Deletion in BST, Graph Terminology, **Sorting & Searching Techniques**: Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Merge Sort, Sequential Search, Binary Search.	12	CO4

Suggested Readings

1. Y. Langsam, M. Augenstin and A. Tannenbaum, “Data Structures using C and C++”, Pearson Education.
2. Ellis Horowitz, S. Sahni, D. Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publication.
3. S. Lipschutz, “Data structures”, Mc-Graw-Hill.
4. Jean-Paul Tremblay, Paul. G. Soresan, “An Introduction to Data Structures with Applications”, Tata Mc-Graw-Hill.

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106127/2.

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

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	II		
Course Name	Web Designing				
Code	BCACSN22104				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	1	0	3
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; Image, Anchor Tag; **Links to External Documents:** Inter-page and Intra-page linking.	10	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.	12	CO2
3	**Introduction to JavaScript:** Advantages and disadvantages of JavaScript, Type of JavaScript, Data Types, Creating Variables and JavaScript Array; **Operators and Expressions:** Arithmetic , Logical, Comparison, String and Conditional Operators; J**avaScript 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.	12	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 new window; JavaScript in URLs, JavaScript security, Timers, Browser location and history.	11	CO4

Suggested Readings:

1. Xavier, C, “Web Technology and Design”, New Age International Publications.
2. Bayross Ivan,” HTML, DHTML. JavaScript, and PHP”, BPB Publications.
3. Steven M. Schafer, “HTML, XHTML, and CSS Bible, 5ed”, Wiley India.
4. Ramesh Bangia, “Internet and Web Design”, New Age International.

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	1	1		1	2	1	2		3	1	2	2	2	2
CO2	2	1		1	2	3	3		1			2	2	2
CO3	1	2		2	2	2	2		2	1	1	1	2	2
CO4	2	3		2	1	3	2		2		2	1	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	II		
Course Name	Digital Security & Evidence				
Code	BCACSN22111				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	This course introduces fundamental concepts and practical techniques related to securing digital information and handling digital evidence. Students will learn about cryptographic principles, digital forensics, security policies, incident response, and legal aspects related to digital evidence.				
Course Outcomes					
CO1	To understand the fundamental principles of digital security, including cryptography, authentication, and network protection techniques.				
CO2	To learn the processes and tools involved in identifying, preserving, and analyzing digital evidence for forensic investigations.				
CO3	To develop skills to design security policies, manage risks, and effectively respond to cyber security incidents while understanding legal and ethical considerations.				
CO4	To apply digital security and forensic concepts through real-world case studies, hands-on investigations, and emerging technology trends.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Foundations of Digital Security:** Introduction, Core Concepts, Key Concepts, Importance and Scope, Threats, Vulnerabilities, Risks, Cryptography Basics, Symmetric and Asymmetric Encryption, Hash Functions, Message Authentication, Digital Signatures and Certificates, Authentication, Access Control, Passwords; Biometrics, Multi-factor Authentication, Access Control Models; (DAC, MAC, RBAC), Network Security Fundamentals; Introduction, Core Concepts, Key Aspects, Firewalls, VPNs.	11	CO1
2	**Digital Evidence and Forensics:** Overview, Core Concepts, Key Aspects, Goal, Need, Types, Forensic Process; Identification, Preservation, Collection, Analysis, and Presentation, Chain of Custody, Tools and Techniques, Imaging and Cloning, File System Analysis, Memory Forensics, Forensic Software and Hardware Tools; Open-source and Commercial- Overview	11	CO2
3	**Security Policies, Incident Response, and Risk Management:** Security Policies and Standards, Designing and Implementing Security Policies, Compliance and Regulatory Frameworks, GDPR, HIPAA, Incident Response and Handling, Incident Detection, Containment, Eradication, Recovery, Incident Response Team; Roles, Responsibilities, **Risk Management:** Risk Assessment Methodologies, Vulnerability Assessment, Penetration Testing, Ethical and Legal Issues, Privacy Concerns and Ethical Hacking.	12	CO3
4	**Case Studies and Practical Applications:** Introduction, Case Studies in Cybers Security Breaches, Analysis of Real-world Cyber-attacks, Lessons Learned and Mitigation Strategies, Practical Forensic Investigations, Writing Forensic Reports, Emerging Trends and Technologies, Cloud Security and Forensic Challenges, Artificial Intelligence in Security and Forensics.	11	CO4

Suggested Readings

1. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms, and Source Code in C", Wiley
2. Eoghan Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", Academic Press.

3. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", Cengage Learning.
4. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Charles River Media.

Online Resources

1. https://www.sans.org/digital-forensics-incident-response/
2. https://www.open.edu/openlearn/science-maths-technology/digital-forensics/content-section-0

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

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	II		
Course Name	Machine Learning in Cyber Security				
Code	BCACSN22112				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	This course introduces the application of machine learning techniques in cyber security. Students will learn to detect, analyze, and respond to cyber threats using ML models. Emphasis is placed on practical solutions for intrusion detection, malware analysis, and threat prediction.				
Course Outcomes					
CO1	To understand Introduce foundational concepts of machine learning and cyber security, and explore how ML supports cyber threat analysis.				
CO2	To understand supervised and unsupervised learning techniques to detect intrusions, malware, and phishing attacks.				
CO3	To understand deep learning and advanced ML techniques for network analysis and robust cyber threat detection.				
CO4	To understand Implement real-world ML-based security solutions using tools, frameworks, and case studies.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Foundations of Machine Learning and Cyber Security:** Introduction to Machine Learning; Types: Supervised, Unsupervised, Reinforcement Learning, Key algorithms: Decision Trees, SVM, k-NN, Naive Bayes, Clustering; Basics of Cyber Security: Threats, Vulnerabilities, Attacks, and Defenses, CIA Triad: Confidentiality, Integrity, Availability; Role of ML in Cyber Security: Benefits and Limitations, Real-world applications overview; **Data Collection and Preprocessing:** Feature extraction from logs, packets, emails, Handling imbalanced and noisy data.	10	CO1
2	**Supervised and Unsupervised Learning for Threat Detection:** Intrusion Detection Systems, Signature-based vs. Anomaly-based detection, Dataset: KDD Cup, NSL-KDD, CICIDS; Malware Detection and Classification: Static and Dynamic features of malware, ML models for malware detection, Phishing Website and Email Detection, Feature engineering from URLs, HTML, headers, Logistic Regression, Clustering for Anomaly Detection.	12	CO2
3	**Deep Learning and Advanced ML Techniques in Cyber Security:** Introduction to Deep Learning, Neural Networks, CNNs, RNNs, Auto encoders, Feature learning from raw data; Network Traffic Analysis using DL: Packet payload analysis, Real-time detection challenges; Adversarial Machine Learning: Attacks on ML models (evasion, poisoning), Defense mechanisms and robustness; Feature Selection and Dimensionality Reduction: PCA, LDA, Feature importance metrics, Applications in log and binary analysis.	12	CO3
4	**Real-World Applications, Tools, and Case Studies:** Security Information and Event Management (SIEM) with ML, Log correlation and ML-based alerting; Threat Intelligence and ML: Data sources: STIX, TAXII, VirusTotal, Predictive models for threat forecasting; Tools and Frameworks: Scikit-learn, TensorFlow, PyTorch in cyber security workflows, Integration with Wireshark, Snort, ELK Stack; Case Studies, Analysis of real-world cyber attacks	11	CO4

Suggested Readings

1. Tom M. Mitchell, "Machine Learning", Tata McGraw-Hill Education.
2. Jiawei Han, Micheline Kamber, Jian Pie, “Data Ming Concept and Techniques”, Morgan Kaufmann.

3. Fengxiang He and Dacheng Tau, “Machine Learning Foundation, Methodologies and Application”, Springer
4. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, O'Reilly.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105152/
2. https://nptel.ac.in/courses/108103192

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

Program	Bachelor of Computer Applications (CS&F)				
Year	I	**Semester**		II	
Course Name	Data Structure Using C Lab				
Code	BCACSN22151				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To understand the various concepts of Data Structures, their usage and implement them using 'C' programming language.				
Course Outcomes					
CO1	Understand and implement 'C' program with data types, control loop, array, functions, structures, stack, string, queue, circular queue, linked list.				
CO2	Understand and implement 'C' program for implementing Linear Search, binary search, bubble sort, selection sort, insertion sort, merge sort, quick sort, binary tree				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Implementation of Arrays (Single & Double Dimension). 2. Array implementation of Stack. 3. Array implementation of Queue. 4. Array implementation of Circular Queue. 5. Array implementation of Linked List. 6. Adding a node in to linked list. 7. Deleting a node from linked list. 8. Insertion of a node in middle of linked list. 9. Insertion of a node at the end of linked list. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO1
2	1. Implementation of Binary tree. 2. Implementation of Linear Search. 3. Implementation of Binary Search. 4. Implementation of Bubble sort. 5. Implementation of Merge sort. 6. Implementation of Insertion sort 7. Implementation of Selection sort. 8. Implementation of Quick sort. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO2

Suggested Readings:

1. Y. Langsam ,M. Augenstin and A. Tannenbaum, "Data Structures using C and C++",Pearson Education Asia, 2nd Edition, 2002.
2. Ellis Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi.
3. S.Lipschutz,"Datastructures",Mc-Graw-HillInternationalEditions,1986.

Online Resources:

1. https://www.youtube.com/watch?v=Db9ZYbJONHc
2. https://www.mygreatlearning.com/blog/data-structures-using-c/
3. http://cse01-iiith.vlabs.ac.in/

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

Program	Bachelor of Computer Applications (CS & F)				
Year	I	**Semester**	II		
Course Name	Web Designing Lab				
Code	BCACSN22152				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To understand the various concepts of HTML, DHTML, JavaScript and their usage and implementation.				
Course Outcomes					
CO1	Understand and implement concept of HTML and DHTML, concepts.				
CO2	Understand and implement concept of JavaScript to develop Web Applications.				

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 Frameset Tag in HTML. 4. Implementation of different Form Tags in HTML. 5. Implementation of Cascading Style Sheet in Web Pages. 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. **Note: -** Students will also perform all other exercises provided by course instructor.	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. Implementing JavaScript to manipulate the specified attributes of window object in the given manner. **Note: -** Students will also perform all other exercises provided by course instructor.	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.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105191/

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

THIRD SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	III		
Course Name	Malware Analysis and Reverse Engineering				
Code	BCACSN23201				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Operating Systems and Programming	3	1	0	4
Course Objectives	To introduce students to the fundamental concepts, tools, and techniques involved in malware analysis and reverse engineering. The course will develop the ability to identify, dissect, and analyze malware behavior through both static and dynamic analysis methods and use reverse engineering techniques to understand malware functionality.				
Course Outcomes					
CO1	Understand fundamental concepts of malware, types, and infection techniques.				
CO2	Learn and apply static and dynamic malware analysis techniques.				
CO3	Use reverse engineering tools and techniques to analyze executable binaries.				
CO4	Develop skills in mitigating malware threats and writing basic detection signatures.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Malware and Its Ecosystem: Definition and History of Malware, Evolution of Malware, Types of Malware: Viruses, Worms, Trojans, Rootkits, Ransomware, Adware, Spyware, Bots and Botnets. Anatomy of a Malware: Infection Vectors, Persistence Mechanisms, Command and Control Infrastructure. Malware Behavior and Objectives: Data Exfiltration, Credential Theft, System Corruption, Lateral Movement. **Malware Development Environments:** Overview of environments/tools used by attackers, including crypters, packers, and obfuscators. Techniques of Anti-Analysis: Code Obfuscation, Packing, Encryption, Polymorphism and Metamorphism. Techniques of Malware Evasion: Sandbox Evasion, Virtual Machine Detection, Anti-Debugging, API Hooking. **Malware Categories in the Wild:** Targeted Attacks, Financial Malware, State-sponsored Malware, Advanced Persistent Threats (APTs), Mobile Malware, IoT Malware. Role of Malware Analysis in Incident Response, Threat Intelligence, and Digital Forensics. **Introduction to Malware Analysis Process:** Goals and Requirements, Legal and Ethical Considerations, Setting up a Safe Malware Analysis Lab using Virtual Machines and Network Simulators.	15	CO1

2	Static Malware Analysis: Concepts and Importance. File Types and Headers: PE (Portable Executable) format on Windows, ELF (Executable and Linkable Format) on Linux. Analyzing File Headers using Tools (PEview, Exeinfo PE). Hashing Techniques: MD5, SHA1, and their role in malware detection. Identifying Strings in Binaries: Use of tools like strings, FLOSS. File Metadata Analysis: Using tools like ExifTool. **Disassembly and Code Inspection:** Introduction to Disassemblers like IDA Pro, Ghidra, Radare2. Understanding **Assembly Language Basics**: Registers, Flags, Stack Operations, Jumps and Loops, Function Calls. Identifying Key Behavior: System Calls, API Calls, DLL Imports and Exports. Recognizing Common Obfuscation and Packing Techniques in Static Code. Extracting Embedded Resources and Configuration Files. Analysis of Malicious Documents: Macros in Word/Excel, Embedded Scripts in PDFs. **YARA Rules Introduction:** Writing simple YARA rules to detect malware patterns based on byte sequences, strings, and file properties.	15	CO2
3	**Dynamic Malware Analysis:** Sandboxing and Behavioral Analysis. Introduction to Sandboxes: Cuckoo Sandbox, Any.Run, Joe Sandbox. Setting up isolated environments for execution and monitoring. Tools and Techniques for Runtime Analysis: Process Monitor, Process Explorer, RegShot, Wireshark, TCPView. **Observing File System Modifications:** Creation, deletion, and alteration of files. Monitoring Registry Changes. Tracking Network Activity: IP Connections, DNS Requests, HTTP/HTTPS Traffic. Use of Fake Services to Capture Malware Communications. **Debugging Malware:** Introduction to Debuggers like x64dbg, WinDbg, OllyDbg. Techniques of Breakpointing, Stepping through Code, Watching Registers and Memory. Identifying and Bypassing Anti-Debugging Techniques. **Memory Analysis:** Concepts and Tools (Volatility, Rekall). Dumping and Analyzing Process Memory. Extracting Artifacts from RAM. Detecting Process Injection and Code Injection Techniques. **Dynamic Decryption of Obfuscated Malware:** Unpacking executables at runtime, dumping decrypted binaries.	15	CO3

4	**Dynamic Malware Analysis:** Sandboxing and Behavioral Analysis. Introduction to Sandboxes: Cuckoo Sandbox, Any.Run, Joe Sandbox. Setting up isolated environments for execution and monitoring. Tools and Techniques for Runtime Analysis: Process Monitor, Process Explorer, RegShot, Wireshark, TCPView. **Observing File System Modifications:** Creation, deletion, and alteration of files. Monitoring Registry Changes. Tracking Network Activity: IP Connections, DNS Requests, HTTP/HTTPS Traffic. Use of Fake Services to Capture Malware Communications. **Debugging Malware:** Introduction to Debuggers like x64dbg, WinDbg, OllyDbg. Techniques of Breakpointing, Stepping through Code, Watching Registers and Memory. Identifying and Bypassing Anti-Debugging Techniques. Memory Analysis: Concepts and Tools (Volatility, Rekall). Dumping and Analyzing Process Memory. Extracting Artifacts from RAM. Detecting Process Injection and Code Injection Techniques. **Dynamic Decryption of Obfuscated Malware:** Unpacking executables at runtime, dumping decrypted binaries.	15	CO4

Suggested Readings:

1. Michael Sikorski and Andrew Honig, "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software", No Starch Press.
2. Alexey Kleymenov, "Mastering Malware Analysis", Packt Publishing.
3. Dang, Gazet, Bachaalany, "Practical Reverse Engineering", Wiley.
4. Bruce Dang et al., "The Art of Memory Forensics", Wiley.
5. National Security Agency (NSA) Reverse Engineering Tools (Ghidra).

Online Resources:

1. https://www.malwareunicorn.org/
2. https://cuckoosandbox.org/
3. https://ghidra-sre.org/
4. https://www.malware-traffic-analysis.net/
5. https://www.reversinglabs.com/

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	2	1
CO2	2	2	1	1	2	1	2		2	2	1	3	2	2
CO3	2	2	2	2	2	2	3		3	3	2	3	3	3
CO4	2	2	3	3	2	2	3		3	3	3	3	3	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	III		
Course Name	Digital Security & Forensic Fundamentals				
Code	BCACSN23202				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
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**: Core Concepts, Key Aspects of Digital Security, Threat; Overview, Types, Attack; Introduction, Categories; Active and Passive, Types, Principles of Information Security, CIA Traid, Operational Security (OPSEC), People's Role in Information Security, Access Control; Overview, Types; RBAC, DAC, ABAC, Intrusion Detection System and Intrusion Prevention System, Authentication; Introduction, Types; 1FA, 2FA, MFA, Physical Security, Cryptography and Steganography; Overview, Core Concepts and Types, Encryption, Digital Signatures, Covert Channels.	11	CO1
2	**Network and Web Application Security:** Network Security Fundamentals; Key Aspect, IPSEC, IP Level Security, Application Layer Security; Overview, Core Concept, Pretty Good Privacy, **Firewall;** Introduction, Types, Web Security; Core Concept, Key Aspects, Virtual Private Network, Overview, Types; Remote Access VPN, Site to Site VPN, Benefits and Challenges: Web Browser Security; Introduction, Key Aspects, E- Commerce Security**;** Importance, Need, Issue and Challenges**,** E mail Security**;** Overview, Core Concept , Phases, Policies, Best practices.	12	CO2
3	**Digital Forensics:** Fundamentals, Core Concepts, Key Aspects, Phases; Identification, Collection, Analysis, Documentation and Presentation of Digital Evidence, Incident Response, Chain of Custody; overview, Key Aspects, Importance, Issues and Challenges, Data Acquisition; Overview, Importance, Components, Methods, Applications, Types.	11	CO3
4	**Digital Forensics Tools and Techniques**: Overview, Key Aspects, Software; Autopsy; Key Features and Functionalities, Benefits, Wireshark; Introduction and Kay Features, The Sleuth Kit; Key Features and Functionalities, Benefits, Forensic Imaging; Overview and Importance, Digital Forensics Framework (DFF), Memory Forensics; Introduction, Key Concepts, Importance and Challenges, Legal and Ethical Considerations in Digital Forensics.	11	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

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

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	III		
Course Name	Database Management System				
Code	BCACSN23203				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	1	0	3
Course Objectives	The objective of this course is to introduce the fundamental concepts of DBMS, terminologies of database management system, E-R Modelling, SQL concept, database transactions and concurrency control techniques.				
Course Outcomes					
CO1	Understand the basic concepts of the database and data models.				
CO2	Understand the fundamental concepts ER diagrams and map ER diagrams into Relations.				
CO3	Evaluate the alternative database designs to determine which one is better according to selected criteria.				
CO4	Understand the basic concepts/features of database transactions and concurrency control techniques.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction:** Data and information, Concepts of persistent data, File and File management system., Basic File Operations, File Structure and Organization, Types of File Organization. **Database Management System:** Introduction of DBMS, Evolution of DB & DBMS, Characteristics of the Database Approach, Components of Database System, Database Management System vs. File Management System, Advantages and Disadvantages of DBMS, DBMS Users, DBMS Architecture, Capabilities of good DBMS, Database Schemas and Instances, Classification of Database Management Systems, Database Languages. **Data Models:** Introduction of Data Models: Relational Data Model, Entity Relationship Data Model, Object Based Data Model, Semi-Structure Data Model, Network Data Model, Hierarchical Data Model.	10 Hrs.	CO1
2	**Relational Database Management System:** Introduction to Relational database, Structure of Relational Database, Relational Data Model, Relational model terminology: Relations , Domains, Attributes, Tuples, Relational Constraints, Codd Rule, Entity- Relationship Model: Entity Sets, Entity Types, Attributes, Attributes Types, Relationships, Relationship Types, Keys, Constraints, Entity-Relationship Model: E-R Model Concepts, Notation for E-R Diagram, Mapping Constraints, Extended E-R Features, Reduction of E-R Diagram to Relation. **Relational Algebra:** Concepts of Relational Algebra, Fundamentals Operations: Select, Project, Rename, Union, Set difference, division, Cartesian Product, Additional Relational-Algebra Operations: Set Intersection, Natural Join And Outer Join.	12 Hrs.	CO1 & CO2
	Structured Query Language (SQL): Introduction on SQL: Characteristics of SQL, Advantage of SQL, SQL Data Type and Literals, Types of SQL Commands, SQL Operators and their		

3	Procedure, Queries and Sub Queries, Aggregate Functions, Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, View, Cursors and Triggers. **Functional Dependencies and Normalization:** Informal Design Guidelines for Relation Schemas, Database Anomalies, Functional Dependencies, Armstrong's axioms, Closure of Attribute sets, Normal Forms, First Normal Form, Second Normal Form, Third Normal Forms and Boyce-Codd Normal Forms.	12 Hrs.	CO3
4	**Transaction Processing & Concurrency Control:** Introduction to Transaction ACID Properties, Transaction State. Transaction logs, Importance of Backups. Database recovery. Causes of failures. Recovery concepts and terminology. **Concurrency Control:** Definition of concurrency, lost update, dirty read, and incorrect summary problems due to concurrency.	11 Hrs.	CO3 & CO4

Suggested Readings

1. Korth, Silbertz, Sudarshan, Database Concepts, McGraw Hill.
2. Elmasri, Navathe, Fundamentals of Database Systems, Addison Wesley.
3. Date C J, An Introduction to Database Systems, Addison Wesley
4. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications
5. Ramakrishnan, Gehrke, Database Management System, McGraw Hill
6. Ivan Bayross -- SQL, PL/SQL: The Programming Language of Oracle, BPP Publication.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://nptel.ac.in/courses/106104135

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	2	1
CO2	1	2	3	1	3	2	1		3	2	2	2	2	2
CO3	1	1	2	3	2	2	2		3	2	2	2	2	3
CO4	2	2	1	2		2	1		1	1		2	1	2

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	III		
Course Name	Object Oriented Programming Using Java				
Code	BCACSN23204				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	1	0	3
Course Objectives	The main objective of this subject is to introduce the fundamental concepts of object-oriented Programming, show competence in the use of the Java programming language in the development of small to medium-sized application programs that demonstrate professionally acceptable coding and performance standard.				
Course Outcomes					
CO1	To understand the concept of object-oriented programming and implement it in Java.				
CO2	To understand building blocks of OOPs language, class, objects and method etc.				
CO3	Able to understand inheritance, package and interfaces concepts.				
CO4	To implement multithreading in object-oriented programs and designing GUI using AWT Control and event handling.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of OOPs:** Basic Concept of OOP, features of OOP, Benefits & Applications of OOPs; **Introduction to Java:** Evolution of Java, Features of Java, Byte Code and Java virtual machine, JDK, Structure of Simple Java Program, Compiling and Interpreting Applications; Java Tokens: Java Character set, Keyword and Identifiers; Data Types, Operators and Expression; Control Statements, Looping; **Array and String:** Single and Multidimensional Arrays, String Class, StringBuffer Class, Operations on String, Command Line Argument, and Use of Wrapper Class.	10	CO1
2	**Classes, Objects & Methods:** Class, Object, Object Reference, Methods in Java, Method Overloading, Constructor, Constructor Overloading, Passing and Returning Object from method; new Operator; this & Static Keyword; finalize() method; Visibility modifiers; Nested Class; Inner class.	11	CO2
3	**Inheritance and Polymorphism:** Inheritance in Java, Types of Inheritance, Member Access Rule, Use of this and Super Keyword, Abstract class, Dynamic Method Dispatch, Use of final Keyword; **Package & Interface:** Defining and Importing Packages, Defining and Implementing Interfaces, Extending Interfaces; **I/O STREAM:** Concept of Streams, Streams Classes: Byte and Character Stream, Reading Console input & Writing Console output.	12	CO3
4	**Exception Handling:** Exception Type, Usage of try, catch, throw, throws and finally Keywords, Creating Own Exception Classes; **Multi-Threading:** Concept of Thread, Thread Life Cycle, Creating Thread Using Thread Class and Runnable Interface, Thread Priority; **AWT Control:** The AWT Class Hierarchy, User Interface Components: Labels, Button, Text Components, Check Box, Check Box group, Choice, List Box, Panels, Working with Frame Class, Fonts and Layout Manager; **Event Handling:** Events, Event Sources, Event Listeners, EDM, Handling Mouse and Keyboard Events.	12	CO4

Suggested Readings:

1. Herbert Schild, “The Complete Reference, Java 2”, TMH.
2. R. Krishnamoorthy & S. Prabhu, “Internet and Java Programming”, New Age International Publishers.
3. E. Balaguruswamy, “Programming with Java A Primer”, TMH.
4. Udit Agrawal, “Internet and Java Programming”, Dhanpat Rai & Co.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105191/

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	2		3	1	2	2	2	2
CO2	2	1		1	2	3	3		1			2	2	2
CO3	1	2		2	2	2	2		2	1	1	1	2	2
CO4	2	3		2	1	3	2		2		2	1	2	2

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	III		
Course Name	Operating System				
Code	BCACSN23205				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
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 to Operating System:** 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 Management**: 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.	11	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.	11	CO1 & 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.	12	CO2 & CO4
4	**Storage Management:** File Concept: File Attribute, File Operations, File Types**,** File Structure; File Access Method: Sequential Method, Direct Access Method; Directory	11	CO3 & CO4

	Structure; File System Implementation: File System Structure, Allocation Methods**,** Free space Management; Secondary Storage Structure: Disk Structure**,** Disk Scheduling Algorithms**,** Disk Management.		

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	II	Semester		III	
Course Name	End to End Security				
Code	BCACSN23211				
Course Type	GE	L	T	P	Credit
Pre-Requisite		3	0	0	3
Course Objectives	To provide a comprehensive understanding of end-to-end security concepts, network and wireless security controls, firewall and intrusion systems, endpoint protection technologies, and key Windows security practices.				
Course Outcomes					
CO1	To understand fundamental principles of end-to-end security and network access control mechanisms.				
CO2	To understand firewalls, IDS/IPS, and the key differences between EPP and EDR in endpoint security.				
CO3	To understand wireless network security principles and techniques for protecting and monitoring wireless environments.				
CO4	To learn key Windows security tools and techniques for system hardening and user management.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to End-to-End Security:** Overview, Importance, Objective and Scope, Key Components; **Network Security Control:** Definition and Purpose, Network Security Protocol, Access Control System: Overview, Principles, Components, Administrative Access Control, Physical Access Controls, Technical Access Controls, Merits and Limitations.	11	CO1
2	**Concept of Firewall:** Definition and Purpose, Types of Firewalls: Packet Filter, Stateful Inspection Firewall, Next-generation Firewall; Intrusion Detection System (IDS) and Intrusion Prevention System (IPS), **Endpoint Protection Platforms (EPP):** Overview, Purpose, Key Features and Capabilities, Benefits; **Endpoint Detection & Response (EDR):** Overview, Purpose, Key Features and Capabilities, Impact on Incident Response, Benefits; Difference between EPP and EDR.	12	CO2
3	**Wireless Network Security:** Overview, Importance, Objective and Scope, Disable SSID Broadcasting, Monitoring Wireless Network Traffic, Defending Against WPA Cracking: Passphrases, Client Settings, Passphrase Complexity, Detecting Rogue Access Points, **Wireless Scanning:** Wired Network Scanning, SNMP Polling.	11	CO3
4	**Windows Security:** Microsoft Baseline Security Analyzer (MBSA), Setting up BIOS Password, Auditing Windows Registry, User and Password Management, Disabling Unnecessary User Accounts, configuring user authentication, Configuring Windows Firewall.	11	CO4

Suggested Readings

1. William Stallings and Lawrie Brown “Computer Security: Principles and Practice”. Pearson Publications.
2. Randall K. Nichols and Panos C. Lekkas “Wireless Security: Models, Threats, and Solutions”. McGraw-Hill Professional Publications.
3. Mark Minasi “Practical Windows Security". Pearson Publications.

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106234/
2. https://youtu.be/6LLVhrhAdtA?si=24p1JhMgEnoY_w8v

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	II	Semester	III		
Course Name	Big Data Security				
Code	BCACSN23212				
Course Type	GE	L	T	P	Credit
Pre-Requisite		3	0	0	3
Course Objectives	To acquire the fundamental knowledge of Big Data security.				
Course Outcomes					
CO1	To understand the security challenges associated with big data.				
CO2	To understand techniques and technologies used to secure big data environments.				
CO3	To understand risk management strategies and privacy-preserving frameworks.				
CO4	To understand access control and encryption methods in distributed systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Big Data Fundamentals and Security:** Introduction to Big Data and Its Ecosystem, Characteristics of Big Data: Volume, Velocity, Variety, Veracity, and Value, Types of big data (structured, semi-structured, unstructured), Real-world sources: sensors, IoT, social media, transactions, Big Data Architecture Overview, Hadoop Distributed File System (HDFS), YARN, MapReduce, Apache Spark framework basics, Data flow and system components, Fundamentals of Data Security, Understanding Confidentiality, Integrity, and Availability (CIA Triad), Importance of security in large-scale systems, Threat Landscape in Big Data Environments, Common threats: data breaches, denial of service, injection attacks, insider threats, Security vulnerabilities in distributed processing and storage systems, Case Studies: Security Breaches in Big Data Systems.	12	CO1
2	**Security Technologies and Frameworks for Big Data:** Security Architecture in Hadoop and Spark: Overview of Hadoop security features, Kerberos authentication integration, Hadoop ecosystem tools: Apache Ranger, Sentry, Knox, Secure Communication and Data Transfer, Use of SSL/TLS in distributed environments, Encryption in motion vs. encryption at rest, Cloud Security for Big Data Platforms, Security features in AWS, Azure, and GCP for big data workloads.	10	CO2
3	**Privacy, Compliance, and Risk Management:** Data Privacy Fundamentals, Privacy threats in big data analytics, De-identification, anonymization, and re-identification risks; Differential Privacy and Noise Injection Techniques: Mathematical guarantees of privacy, Real-world applications: Apple, Google data collection practices, Privacy-Preserving Data Mining (PPDM): Techniques to mine data without compromising user privacy, Cryptographic and non-cryptographic methods; Privacy by Design: Embedding privacy from the design phase, Data minimization and user consent principles.	12	CO3
4	**Cryptography and Access Control in Big Data Systems:** Advanced Cryptographic Techniques: Homomorphic encryption: computing on encrypted data, Searchable encryption: querying encrypted datasets; Access Control Mechanisms: Role-Based Access Control (RBAC) and limitations, Attribute-Based Access Control (ABAC) for dynamic big data environments; Identity and Access Management (IAM): IAM frameworks in cloud platforms, Multi-factor authentication and identity federation, Key Management in Distributed Systems: Key distribution strategies, Hardware	11	CO4

	security modules (HSMs) and vault services; Emerging Trends: Federated Learning and Secure Multi-Party Computation (SMPC): Collaborative analytics without sharing raw data, Applications in healthcare, finance, and cross-organization data analysis.		

Suggested Readings

1. "Big Data Security", Nasir Memon, Springer.
2. "Security, Privacy, and Forensics Issues in Big Data", Sharvari Tamane, Springer.
3. "Security and Privacy in the Era of Smart Devices and Social Networking", Natarajan Meghanathan, Springer.

Online Resources

1. https://archive.nptel.ac.in/courses/106/104/106104189/

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

Program	Bachelor of Computer Applications (CS&F)				
Year	II	Semester	III		
Course Name	Database Management System Lab				
Code	BCACSN23251				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		0	0	4	2
Course Objectives	The main objective is students gain knowledge about databases for storing the data and to share the data among different kinds of users for their business operations.				
Course Outcomes					
CO1	Develop database modelling for a problem.				
CO2	Design a database using normalization.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Creating and Managing Tables a. Creating and Managing Tables b. Including Constraints 2. Manipulating Data a. Using INSERT statement. b. Using DELETE statement. c. Using UPDATE statement. 3. SQL Statements – 1 a. Writing Basic SQL SELECT Statements b. Restricting and Sorting Data c. Single-Row Functions 4. SQL Statements – 2 a. Displaying Data from Multiple Tables b. Aggregating Data Using Group Functions c. Subqueries **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO1& CO2
2	1. Using SET operators, Date/Time Functions, GROUP BY clause (advanced features) and advanced subqueries a. Using SET Operators b. Datetime Functions c. Enhancements to the GROUP BY Clause d. Advanced Subqueries 2. Creating and Managing other database objects a. Creating Views b. Other Database Objects c. Controlling User Access 3. Using DCL commands a. creating users b. Authenticating users c. Roll back command **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO1 & CO2

Suggested Readings

1. Ivan Bayross, "SQL, PL/SQL: The Programming Language of Oracle", BPP Publication.
2. Connolly & Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Pearson Education.
3. R. S. Despandey, "SQL/PL SQL for Oracle", Dreamtech.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://nptel.ac.in/courses/106104135

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	
CO2	1	1	1	1	2	2	2		3		1	2	1	1

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	III		
Course Name	Object Oriented Programming Using Java Lab				
Code	BCACSN23252				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To implement the basic concepts of object-oriented using classes and objects, inheritance, interface, packages, exception handling techniques and multithreading and to design streams and efficient user interface design techniques using GUI.				

Course Outcomes	
CO1	Able to use the syntax and semantics of java programming language and basic concepts of OOP using the concepts of inheritance, polymorphism, interfaces and packages.
CO2	Able to apply the concepts of Multithreading and Exception handling to develop efficient and error free codes and to design event driven GUI and web related applications which mimic the real word scenarios.

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Writing simple Java Program, Interpreting & Compiling. 2. Developing programs based on decision making & Looping statements. 3. Developing program based on Single and Multidimensional Array. 4. Developing program based on String class and String Operations. 5. Developing program based on class and object. 6. Developing program based on method in Java. 7. Implementation of Constructor overloading. 8. Developing program based on access modifiers, static and this keyword. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO1
2	1. Implementation of Inheritance in Java 2. Developing program based on super and final keyword. 3. Writing program based on abstract class. 4. Developing and testing program based on importing built-in and user defined packages. 5. Defining and Implementing Interface concept. 6. Working with I/O stream and Exception Handling 7. Handling of Multiple Threads. 8. Working with AWT Control & Event Handling. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO2

Suggested Readings:

1. Herbert Schild, "The Complete Reference, Java 2", TMH.
2. R Krishnamoorthy & S. Prabhu, "Internet and Java Programming", New Age International Publishers.
3. E. Balaguruswamy, "Programming with Java A Primer", TMH.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105191/

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	2	1
CO2	2	2		1	2	1	2		2	2	1	3	2	2

FOURTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	IV		
Course Name	Security Intelligence				
Code	BCACSN24201				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	● Gain comprehensive knowledge of Cybersecurity Incident Management and Security Information and Event Management (SIEM) principles. ● Understand the architecture and deployment models of IBM Security QRadar SIEM, including on-premises, cloud-based, and hybrid deployments. ● Develop proficiency in investigating security offenses, utilizing rules, network hierarchy, and index management techniques. ● Learn to effectively operate a Security Operations Centre (SOC) and monitor security events using SIEM tools.				
Course Outcomes					
CO1	Understand the current trends and challenges in IT security and the importance of Cybersecurity Incident Management.				
CO2	Describe the architecture and components of IBM Security QRadar SIEM and its deployment models.				
CO3	Analyze and investigate security offenses using SIEM tools, rules, network hierarchy, and index management techniques.				
CO4	Operate effectively within a Security Operations Centre (SOC) and manage security events through the SOC Incident Lifecycle.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Cybersecurity Incident Management and SIEM** Status quo of IT Security, Trends in Cybersecurity Landscape, Security technologies implemented in the IT Industry, Problems of traditional security mechanisms, Introduction to Cybersecurity Incident Management, Log Management, Introduction to SIEM, SIEM Evolution, Benefits of SIEM, Introduction to IBM Security QRadar SIEM, SOAR, XDR.	15	CO1
2	**QRadar Architecture:** QRadar Deployment Architecture – On-Premises, QRadar on Cloud (QRadar as a Service), QRadar Hybrid Deployment, Introduction to QRadar Licensing Model, QRadar Licensing Metrics, FPM and EPS Burst Handling, QRadar High-Level Component Architecture, Flow Collector Architecture, Event Collector Architecture, Event/Flow Processor Architecture, Console Architecture.	15	CO2
3	**Security Operations Centre and Monitoring:** Log vs Event vs Incident, Threat Intelligence, Awareness of Assets, Aggregation and Correlation, Alerts, Defense and Compliance, Introduction to Security Operations Centre, SOC Operations Team, SOC Incident Lifecycle.	15	CO3
4	**Offense Investigation, Rule Management, and Reporting:** Real-World Attack Scenarios, Investigating Offenses based on Events, Investigating Offenses based on Flows, SIEM Detection Mechanisms, Rules and Building Blocks, Identification of Rules and Tests that Triggered from Offenses, Anomaly Detection Rules, Network Hierarchy, QRadar Index Management, SIEM Dashboards and Tabs, SIEM Integrations, SIEM Reporting, Finding and Managing Reports, Applying Filters.	15	CO4

Suggested Readings:

1. “Security Information and Event Management (SIEM) Implementation" – David Miller et al.
   Covers SIEM architecture, implementation strategies, and real-world case studies.
2. "IBM QRadar SIEM: Quickstart Guide" – Shilpa Radhakrishna, IBM Redbooks
   Focuses on IBM QRadar’s deployment models, configuration, and operational features.
3. IBM Security QRadar Documentation (Official)
   Crucial for module-specific details like licensing models, flow/event processing, rule creation, and integrations.

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

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	IV		
Course Name	Operating System Security				
Code	BCACSN24202				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	Understand core security principles and their application within the Linux environment.				
Course Outcomes					
CO1	Understand the basic security concepts of Linux operating system including security models and file system.				
CO2	Effectively manage user access and implement file system security measures;				
CO3	Secure network services and implement basic firewall configurations on Linux systems.				
CO4	Monitor system activity, identify potential security issues, and understand basic hardening techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Operating System Security:** Basics of Operating Systems and Security Concepts; Need for OS Security; **Classic Security Models:** Bell-LaPadula, Biba, Clarke Wilson Security Model; **Introduction to Linux Operating System:** Introduction: History, Basic features, architecture, distributions. Installing Linux, Logging in / Logging out; **Linux File System:** Hierarchical File Structure, Types of file System(ext3,ext4,XFS)Linux Block Structure – boot block, super block, inode block (Indirection Policies), data block.	11	CO1
2	**Linux Security Model:** Overview of users, groups, permissions, and the root user; **User and Group Management:** User/group creation, modification, deletion (useradd, usermod, userdel, groupadd); Understanding /etc/passwd, /etc/shadow, /etc/group; Password policies (passwd, chage); **File System Security and Permissions:** File ownership and permissions (rwx), chmod, chown, chgrp; Special permissions (SUID, SGID, Sticky Bit) **Authentication and Authorization:** Traditional Linux authentication; Pluggable Authentication Modules (PAM) basics; Implementing SSH key-based authentication.	12	CO2
3	**File system interface:** File Concept, Access Methods, Pipes and filters: Connecting processes with pipes, redirecting input and output, Filters: sort, grep, uniq, more,cat, cut, paste, tr; **Networking Tools:** Communication oriented commands- ping, nslookup, telnet, arp, netstat, route, ftp, ifconfig, nslookup, host, hostname finger,; **Firewalls in Linux** – firewalld, rules of Firewall, Types of Linux Firewalls, Types of Tables- Security, Mangle, Nat, Raw, Filter; Types of Chains- Input, Output, Forward; Configuring a firewall on Linux- iptables.	11	CO3

4	**System Monitoring and Logging:** Importance of monitoring, Basic monitoring tools (top, htop,iotop)**; Logging:** viewing and monitoring log files, Type of logs, Log file analysis for basic security events; **Security Auditing Basics:** Introduction to the Linux audit subsystem (auditd); Basic audit rule creation and log analysis; **Advanced Linux Security Tools and Practices:** Malware detection and rootkit scanners (chkrootkit, rkhunter); Log analysis and intrusion detection (fail2ban, logwatch); File integrity monitoring (AIDE); Security updates and patch management (apt, yum, dnf).	11	CO4

Suggested Readings

6. Christopher Negus, “Linux Bible”, Wiley India Pvt. Ltd.
7. Kyle Rankin, “Linux Hardening in Hostile Networks”, Addison-Wesley Professional
8. William Stallings, “Operating Systems: Internal and Design Principles”, PHI.
9. Sumitabha Das, "Your Unix/Linux - The Ultimate Guide," McGraw Hill.

Online Resources

3. https://youtu.be/i_7ofp7fK_E?t=16
4. https://youtu.be/dyQhaku2qQc?t=5

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

Program	Bachelor of Computer Applications (CS & F)				
Year	II	Semester	IV		
Course Name	Mobile Application Development				
Code	BCACSN24203				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		2	1	0	3
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.	10	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, Activity Life Cycle and its methods, Logcat, Components of an Android App: Activity, Service, Broadcast Receiver, Content Provider.	12	CO2
3	**Layout**: Constraint 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.	11	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 persistence using SQLite. Internal and External Storage.	11	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/

Course Articulation Matrix														
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

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	IV		
Course Name	Mobile Forensics				
Code	BCACSN24211				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	In this course, students will develop an understanding of the importance of mobile forensics, including evidence extraction, preservation techniques, mobile operating systems, and forensic tools used in mobile investigations.				
Course Outcomes					
CO1	To understand the basics and important technology of the mobile devices.				
CO2	To understand the various types of acquisition methods on various platforms.				
CO3	To provide an in-depth understanding of the android architecture relevant to mobile forensics.				
CO4	To gain knowledge on mobile forensic data extraction process.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Mobile Device Fundamentals:** Overview, Key Elements of Mobile Devices in relevance to Forensics, Associated Crimes; Phone Cloning, SMS Spoofing, Mobile Malware Distribution, SIM Swap Fraud, SIM Cloning**, Mobile Forensics:** Introduction, Core Concepts, Issues & Challenges; **Mobile Security and SIM Security:** Application Sandboxing, Permission Models, Secure Boot, Root/Jailbreak Detection, SIM Data Protection, SIM Security (PIN/PUK Protection, SIM Locking, SIM Authentication).	11	CO1
2	**Mobile Forensics Procedures:** Introduction, Rules of Evidence; Admissible, Authentic, Complete, Reliable, and Believable, Good Forensic Practices; Securing, Preserving, and Documenting the Evidence, Data Acquisition Methods: Live Acquisition, Dead Acquisition, Remote Acquisition, Memory Forensics, Hybrid Acquisition**;** Examination and Analysis of Evidence Stored on Mobile Phones.	10	CO2
3	**Android Architecture and Security**: Introduction, Core Concept, Android Architecture Layers; Applications, Application Framework, Android Runtime, Platform Libraries, Linux Kernel **Android Security:** Introduction, Security checklists Encryption Methods, Full Disk Encryption: (FDE process, Key derivation, Limitations), **File-Based Encryption** (Credential Encrypted data, Device Encrypted data, Per-user keys, Scoped storage impact), Trusted Execution Environment (ARM TrustZone, Secure key handling, Biometric protection), Application Sandboxing, Permission Model(Normal permissions, Dangerous permissions, Runtime requests, Scoped Storage, Auto-reset), Application Signing, Secure Inter-Process Communication(Intents, Binder, Content Providers, AIDL, IPC vulnerabilities), Android File System, File Hierarchy, File System Analysis(Static analysis, Dynamic monitoring, SQLite & XML artifacts).	12	CO3

4	**Android Forensics and Application Analysis:** Android Forensic Setup and Pre-Data Extraction Techniques, Screen Lock Bypassing Techniques, Gaining Root Access, Android Data Extraction Techniques; Introduction, Core Concepts, Types- Logical, File System, Physical and Cloud; **Android Data Analysis And Recovery** : Manifest, Java classes, Resources, Storage locations: shared preferences, SQLite databases, Internal vs external storage, Log analysis, Behavior analysis, Reverse: (Decompiling APKs, Code injection, Detecting tampering or malware behavior), Extracting an Apk File From An Android Device, Android Malware Analysis, Case Study On Android Forensics: Use of mobile evidence, Extraction techniques used in investigation, Role of call logs/SMS/app usage, Challenges in digital forensics, Lessons for forensic analysis, **Case Study:** The Aarushi Talwar Murder Case.	12	CO4

Suggested Readings

1. Bommisetty, Satish, Rohit Tamma, and Heather Mahalik. Practical mobile forensics. Packt Publishing Ltd, 2014.
2. Tamma, Rohit, and Donnie Tindall. Learning android forensics. Packt Publishing Ltd, 2015.
3. Angus M.Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008.

Online Resources

1. https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
2. https://source.android.com/docs/setup/start

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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	II	**Semester**	IV		
Course Name	IOT & Security				
Code	BCACSN24212				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	To study fundamental concepts of IoT, roles of sensors and hardware in IoT. To learn different Wireless Technologies, protocols for IoT and 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.	11	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.	12	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, MQTT.	12	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.	10	CO4

Suggested Readings

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy “Introduction to IoT” Cambridge University Press; First Edition.
2. Arsheep Bahga, Vijay Madisetti,” Internet of Things: A Hands-On Approach”, Orient Blackswan Private Limited - New Delhi; First Edition.
3. Raj Kamal, Internet of Things Architecture and Design Principles, McGraw Hill; Standard Edition.
4. Vibha Soni, “IoT for Beginners: Explore IoT Architecture, Working Principles, IoT Devices, and Various Real IoT Projects”, BPB Publications.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105166/
2. https://kp.kiit.ac.in/pdf_files/06/SM_6th-Sem_Cse_Internet-of-Things.pdf

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			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	1	1	1	1	1	3	1	3	2	1	2

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	IV		
Course Name	Introduction to System Security				
Code	BCACSN24221				
Course Type	DSE	**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, Core Concepts, Aspects of System Security, Need for Security, Goals of System Security, Features of a Good Security Policy, Security Services; Introduction, Core Concepts, Mechanisms; Overview, Key Aspects, Types, Assumptions and Trust, Operational Issues, Human Issues.	10	CO1
2	**Security Attacks**: Introduction, Core Concepts, Key Aspects, Classification, Phishing, Password Cracking, Key-loggers, Virus, Worms, DoS and DDoS, SQL Injection, Buffer Overflow, Spyware, Adware and Ransomware; **Malicious Logic and Countermeasures**: Introduction, Core Concepts, Antivirus and other Security Measures, Intrusion Detection System: IDS Core Concepts, Key Aspects, Types, Intrusion Prevention System; Introduction, Core Concepts and Key Aspects.	12	CO2
3	**Concepts of Security**: Introduction, Core Concepts, Key Aspects, Steganography; Overview, Core Concepts, Types, Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Block Cipher Principles; Overview and Key Concepts, Block Cipher Modes of Operation; Overview, Core Concepts, Encryption and Decryption; Overview and Types, Conventional Encryption Model.	12	CO3
4	**Security Policies:** Introduction, Core Concepts, Key Aspects, Need, Types, **Passwords; Attacks;** Introduction, Core Concepts, Key Aspects, Types, **Countering Password;** Introduction, Key Aspects, Password Policies, Password Screening, Authentication**;** Basics of Authentication, Key Aspects, Types, Biometrics; Fingerprints, Faces, Voices, Eyes & Combinations, Layered Defense.	11	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
CO2	1	2		1	1	1	1		1			1	1	2
CO3		1		2		1	1		1	1	1	1		1
CO4	2	2		2	2	2	1		3	2	2	2	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II	Semester	IV		
Course Name	Identity Access Management				
Code	BCACSN24222				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	0	0	3
Course Objectives	The objectives of this course are to understand and apply key concepts, technologies, and architectures of Identity Access Management for securing digital identities and access in enterprise and cloud environments.				
Course Outcomes					
CO1	Understand and explain core IAM principles, models, and components.				
CO2	Analyze and apply identity lifecycle and governance practices.				
CO3	Design secure, scalable IAM architectures and evaluate emerging trends.				
CO4	Implement authentication, authorization, and access control using modern IAM tools and protocols.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of IAM:** Definition, Purpose, and Importance; **Core Functions of IAM:** Identification, Authentication, Authorization, and Accountability; **Access Control Models:** Discretionary Access Control (DAC), Mandatory Access Control (MAC), Role-Based Access Control (RBAC), Attribute-Based Access Control (ABAC); **IAM Use Cases:** Business to Business (B2B), Business to Consumer (B2C), Business to Employee (B2E), Government to Citizen (G2C).	11	CO1
2	**IAM Governance Framework:** IAM Policies, Standards, and Compliance Needs, Roles and Responsibilities in IAM Governance; **Identity Lifecycle:** Identity Onboarding and Creation, Access Provisioning and Role Assignment, Modification, Suspension and termination of Identities; **Monitoring and Compliance:** Audit Trails and Logging, IAM and Compliance Standards: General Data Protection Regulation (GDPR), Health Insurance Portability and Accountability Act (HIPAA), International Organization for Standardization/ International Electrotechnical Commission (ISO/IEC 27001).	11	CO2
3	**IAM Architecture:** Introduction, Core Components, Types of IAM Architecture; Centralized, Federated, and Distributed, **IAM Security & Risk Management:** Credential Theft, Insider Threats, Privilege Escalation, Identify Spoofing and Social Engineering; Privileged Access Management (PAM), Context-Aware Access Control; **Authentication Mechanism:** Password-based, OTP, Single Sign-On (SSO), Multifactor Authentication.	12	CO3
4	**Directory Services:** Introduction to Lightweight Directory Access Protocol (LDAP), and Active Directory (AD), **IAM Protocols and Standards:** OAuth 2.0; OpenID Connect, Security Assertion Markup Language; **Cloud IAM Concepts:** Amazon Web Services; Introduction, and Core Concept,	11	CO4

	Microsoft Azure; Key Features, Azure Storage Services, Google Cloud; Introduction, Core Concept, and Architecture.		

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**
CO1	1				2	2	1		1		1	3
CO2		1	3	3	2		2		2			
CO3	2			1	3	2				2		3
CO4	1	3	3		3	3	1		3	3	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**		IV	
Course	Operating System Security Lab				
Code	BCACSN24251				
Course	DSC	**L**	**T**	**P**	**Credit**
Pre-		0	0	4	2
Course Objectives	The objective of a Linux Security Lab course is to provide hands-on experience in securing Linux systems by exploring key concepts such as user authentication, file permissions, network security, firewalls, and intrusion detection.				
Course Outcomes					
C	To demonstrate the basic knowledge of Linux commands and user related security commands.				
C O	To introduce network security, operating system security tools and basic security audit files in Linux Environment.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Linux Operating System Installation. 2.Use of Basic LINUX Commands: PATH, man, echo,who passwd, uname, date, stty, pwd, cd,mkdir, rmdir, cat,ls, cp, mv, rm, more, wc; 3.User and Group Management a. Listing existing users and groups (/etc/passwd, /etc/group). b. Adding new user accounts (useradd or adduser). c. Setting and changing user passwords (passwd). d. Modifying user account properties (usermod). e. Deleting user accounts (userdel). f. Adding and managing groups (groupadd, groupmod, groupdel). g. Adding users to groups (usermod, gpasswd). 4. Special Permission commands (SUID, SGID, Sticky Bit); 5. Commands related to Security by file permissions: chmod, umask, stickybit. 6.Commands related to disk utilities-du, df. **Note:** Students will also perform all other exercises provided by course instructor.	15	CO1
	1. **Network Security:** Introduction to firewalls (iptables, ufw) and Basic network monitoring commands (netstat, ss, tcpdump) 2. **Security Auditing Basics:** Check if auditd is running, create a basic audit rule to monitor access to a sensitive file (/etc/shadow), attempt to access the monitored file and then analyze the auditd logs (/var/log/audit/audit.log). 3. **Implementation of Filters and Pipes:** a. Use cat to display file content. b. Combine ls -l | grep ".txt" to find all text files. c. Use sort and uniq on a file containing unsorted, duplicate lines. 4. **Security Updates and Patch Management:** Regularly updating the system using package managers like apt, yum, or dnf. 5. **Log Analysis:** a. Locate common log files in /var/log (e.g., auth.log, syslog, kern.log). b. Use tail -f /var/log/auth.log to monitor authentication attempts in real-time. 6. **System Monitoring:** a. Use top and htop to monitor CPU, memory, and process activity. Identify processes consuming high resources. b. Use iotop to monitor disk I/O usage. **Note:** Students will also perform all other exercises provided by course instructor	15	CO2

Suggested Readings

1. Duncan A Buell, “Data Structures Using Java”, Jones & Bartlett Learning, January 2012.
2. Narasimha Karumanchi “Data Structures and Algorithms Made Easy in Java”; Fifth Edition 2022.
3. Robert Lafore, “Data Structures and Algorithms in Java”, Second Edition, SAMS, Second Edition, 2003.
4. Goodrich, “Data Structures & Algorithms in Java”, Sixth Edition, (January 2014).

Online Resources

1. 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	1	1	2	1		1	1		3	1	1	2	2	3
CO2	2	2	2	3	2	3	2		3	2	2	3	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	II	**Semester**	IV		
Course Name	Mobile Application Development Lab				
Code	BCACSN24252				
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. Demonstrate the installation of Android Studio, including setting up the Android SDK, SDK Manager, and AVD (Android Virtual Device). Provide screenshots of each step. 2. Install additional SDK packages using SDK Manager. Set up and configure a new Android Virtual Device (AVD) with custom specifications. Launch and test it. 3. Create a basic "Hello Android" app using Android Studio. Deploy the app on both an emulator and a USB-connected Android device. 4. Edit the AndroidManifest.xml file to include necessary permissions and activity declarations. Explain how changes in the manifest affect the application. 5. Create an Android app that logs each lifecycle method (e.g., onCreate(), onStart(), onResume(), etc.) using Logcat. 6. Creating an application that displays message based on the screen orientation. Note: Students will also perform all other exercises provided by course instructor	15	CO1
2	1. Create an Android app using at least three different layouts: ConstraintLayout, LinearLayout (vertical and horizontal), and RelativeLayout. Show how each layout affects component positioning with screenshots. 2. Develop a form with multiple fields and buttons using a Vertical ScrollView and place a Horizontal ScrollView inside it. Demonstrate the scrolling behavior and explain its use cases 3. Design a UI that uses the following views: TextView, EditText, Button, CheckBox, RadioButton, ImageView and SeekBar. Capture and display the user input on a button click. 4. Create an app that uses a VideoView to play a video from local storage or a URL and a WebView to load a webpage. 5. Develop an application that makes use of Notification Manager. 6. Build an app that stores and retrieves student information (e.g., name, roll number, grade) using SQLite. Implement	15	CO2

	insert, update, delete, and fetch operations using UI controls. 7. 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" 8. Create an app to write and read text files using internal and external storage. 9. Develop a Mobile application for simple needs (Mini Project) Note: Students will also perform all other exercises provided by course instructor.		

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/

Course Articulation Matrix														
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

FIFTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**	V		
Course Name	Deployment of Private Cloud				
Code	BCACSN25301				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Prerequisite		3	1	0	4
Course Objectives	1. To explore the considerations of designing and planning of deployment of a private cloud. 2. To understand the principles and best practices for designing the scalable and resilient private cloud infrastructure. 3. To evaluate the different management tools and platforms of private cloud environment. 4. To understand the compliance requirements and frameworks relevant for private cloud deployment.				
Course Outcomes					
CO1	Understand the principles of Cybersecurity Incident Management and the evolving trends in IT security.				
CO2	Explain the architecture and deployment models of IBM QRadar SIEM including on-premises, cloud, and hybrid environments.				
CO3	Analyze security offenses using SIEM tools, rules, network hierarchy, and index management techniques.				
CO4	Operate within a Security Operations Centre (SOC), managing the SOC Incident Lifecycle effectively.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cloud Computing and IBM Cloud Offerings:** Introduction to Cloud Computing, Advantages and Disadvantages of Cloud Computing, Key Components of Cloud Computing, Core Reference Model or Architecture of Cloud Computing, Introduction to IBM Cloud, IBM Cloud Offerings.	15	CO1
2	**Private Cloud Infrastructure and Deployment Models:** Different Cloud Deployment Models, Concepts of Private Cloud Deployment Models, Advantages and Disadvantages of Private Cloud, Deployment Models, Factors for Choosing Appropriate Deployment Models, Comparative Analysis of Deployment Models, Private Cloud Infrastructure, Hardware and Software for Private Cloud Infrastructure.	15	CO2
3	**Private Cloud Management and Service Models:** Private Cloud Deployment Models and their Pros and Cons, **Overview of Other Service Models:** NaaS, DEaaS, STaaS, DaaS, Virtualization Techniques in Private Cloud Deployment, Monitoring Performance of Private Cloud, Managing Private Cloud Performance.	15	CO3
4	**Security, Compliance, and Cloud Migration:** Security Challenges in Private Cloud Deployment, Threats in Virtualized Environments, Techniques for Securing Virtualized Environments, Strategies for Implementing Security Controls, Governance Frameworks in Private Cloud, Operational Practices in Private Cloud Management, Optimization and Cost Management in Private Cloud, Planning and Executing Private Cloud Migration, Challenges in Application and Data Migration, Steps of Migration Modeling, Migration Risks and Mitigation, **Case Studies:** IBM Smart Cloud, Google App Engine, Microsoft Azure.	15	CO4

Suggested Readings

1. IBM Cloud Docs https://cloud.ibm.com/docs
2. Official documentation for IBM Cloud services, architecture, and offerings.
3. NIST Cloud Computing Reference Architecture
4. https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf
5. Authoritative source on cloud models, service models, and governance.
6. Microsoft Learn – Azure Fundamentals
7. https://learn.microsoft.com/en-us/training/paths/azure-fundamentals/Includes cloud deployment, migration, and cost optimization.

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

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**	V		
Course Name	Python Programming with Django				
Code	BCACSN25302				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	1	0	3
Course Objectives	The main objective of this subject is to introduce concepts of python programming and in addition to this Django framework which help in web application development using Python, show competence in the use of the Django framework and MySQL in the development of small to medium-sized web application programs that demonstrate professionally acceptable coding and performance standard.				
Course Outcomes					
CO1	To understand basic concepts of Python including control flow statements.				
CO2	To understand concept of functions, module, list, tuple and dictionary.				
CO3	To understand concept of OOP in python and working with MySQL				
CO4	To understand concept of Django Framework, Django Model and Django Form.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Python:** Indentation; Python character set; Tokens; Core Data Types**;** print(); Assigning values to variable; Multiple Assignments; input(); eval(); Formatting Number & String; Python inbuilt mathematical function; Operators & Expression; Decision Statement; Loop Control Statement; range(); Nested Loops, break, continue, pass.	11	CO1
2	**Functions:** Syntax; use of function; return statement; parameters & arguments; Scope of a variable; Recursive function; Lambda function; **Python Modules**: creating, importing; **Built-in Modules**: math, random, time & date module; **String:** Str class; index[] operator; String operators; String operations; Built-in method; **Python Data Structure**: List, Tuples, Dictionary, Sets.	11	CO2
3	**Object Oriented Concepts**: Defining Classes, Special Class, Attribute, Accessibility, constructor, destructor, Method Overloading, Inheritance, Method Overriding. **Introduction to MySQL:** Installation & working with MySQL, Basics of Database & Table, Data Types in MySQL, Creating Table in MySQL, select, insert, update and delete SQL queries in MySQL.	11	CO3
4	**Django Framework**: Introduction; Installation; Apps Life Cycle; Admin Interface; Creating Views; URL mapping; Template System; **Django Model**: Model Relationship, Querying Models & Connecting to MySQL database; **Django Forms:** Understand the process of building, Handling, Submitting & Validating HTML forms using Django; Web application using Django framework, deployment.	12	CO4

Suggested Readings:

1. Ashok N. Kamthane & Amit A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Educations.
2. Kenneth A. Lambert, The Fundamentals of Python: First Programs, Cengage Learning, ISBN: 978- 1111822705.
3. Samuel Dauzon, Aidas Bendoraitis, Arun Ravindran ,"Django: Web Development with Python", packt publications.

Online Resources:

1. https://www.youtube.com/watch?v=aFRA52st9to

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

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**		V	
Course Name	Web Application Security				
Code	BCACSN25303				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	To equip students with the knowledge and practical skills required to identify, analyze, and mitigate security vulnerabilities in web applications, using industry-standard tools and secure coding practices to build resilient and ethically sound web systems.				
Course Outcomes					
CO1	Understand the foundational concepts of web application security, including historical evolution, security threats, and mechanisms like authentication, authorization, SSL/TLS, and input validation.				
CO2	Apply secure development and deployment practices by using frameworks such as SDL, OWASP CLASP, and SAMM to plan, build, and maintain secure web applications.				
CO3	Conduct vulnerability assessments and penetration testing using open-source tools to identify, analyze, and report security flaws in web applications, networks, databases, and APIs.				
CO4	Demonstrate the ability to recognize and counteract common hacking techniques and attacks such as XSS, injection, CSRF, and misconfiguration using real-world tools like Burp Suite, Nikto, and OpenVAS.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Fundamentals of Web Application Security:** Introduction to Web Application Security; Web application Security Life Cycle, Secure SDLC (sSDLC) basics; HTTP v/s HTTPS; Common Web Threats (OWASP Top 10); Authentication & Authorization; Sessions and Cookies (Secure, HttpOnly flags); Security Headers (CSP, X-Frame-Options, etc.); Basic Cryptography (Hashing, Salting, SSL/TLS). Threat Modeling-STRIDE, Risk Assessment-DREAD.	11	CO1
2	**Common Vulnerabilities and Exploits:** Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), SQL Injection, Command Injection, Directory Traversal, File Upload Vulnerabilities, Security Misconfiguration; Scanning with WebGoat, DVWA, Juice Shop; **Penetration Testing:** Types of Penetration Testing, Penetration Testing Methodologies, Tools: Wireshark, Hashcat, John the Ripper, SQLMap, Dirb, Gobuster.	11	CO2
3	**Secure Coding and Testing:** Input Validation and Output Encoding, Secure Authentication and Password Storage, Role-Based Access Control (RBAC), Security Testing Techniques, Introduction to Vulnerability Scanning Tools (OWASP ZAP, Nikto); **API & Web Services Security:** Introduction to API Security, Authentication protocols (OAuth2, JWT, API Keys).	11	CO3
4	**Defence, Monitoring & Best Practices:** Web Application Firewalls (WAFs), Logging and Intrusion Detection, Session Management Practices, Phishing Awareness and Mitigation, Secure Deployment Practices, Regular Security Audits and Penetration Testing; **Social Engineering & User Security:** Types of social engineering attacks (pretexting, baiting, phishing), Real-world case studies (Equifax, Facebook breaches).	12	CO4

Suggested Readings:

1. Andrew Hoffman, “Web Application Security”,O’Reilly.
2. Ravidas and Grek Jhonson, “Testing and Securing Web Applications”, Auerbach pub.
3. Piyush Kumavat, “Web Application Security 101”, Self Published.
4. Shostack, Adam, “Threat modeling: Designing for security”, John Wiley & Sons, 2014.

Online Resources:

1. https://youtu.be/K1S3kOeRmLg?si=PoOHCbQCEL6m_lyu
2. https://youtu.be/Dp019cWu1cg

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	1	1	2
CO2	1	2		2	2	1		1		2		2	2	3
CO3	2	3		2	3	3			1	2			2	3
CO4	2	3		1	3	2	1		1	3	1	3	2	3

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**	V		
Course Name	Cryptography				
Code	BCACSN25321				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	This course aims to equip students with a solid foundation in the principles and practices of cryptography, focusing on securing data through encryption and authentication techniques. Students will explore both classical and modern cryptographic algorithms, including symmetric and asymmetric systems. The course emphasizes practical applications such as secure communication, digital signatures, and key management. By the end, learners will be able to analyze cryptographic protocols and design secure systems for real-world scenarios.				
Course Outcomes					
CO1	To understand the foundational concepts and objectives of cryptography, including confidentiality, integrity, authentication, and non-repudiation.				
CO2	To understand and compare classical and modern cryptographic algorithms, identifying their strengths and weaknesses.				
CO3	To understand and design secure communication systems using symmetric and asymmetric cryptographic techniques.				
CO4	To understand the cryptographic primitives like encryption, hashing, and digital signatures to real-world scenarios such as secure data storage, communication, and user authentication.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Fundamentals of Cryptography and Classical Techniques:** Introduction to Cryptography: History, Terminology, Types of cryptographic systems: Symmetric vs. Asymmetric, Classical Ciphers: Substitution Ciphers: Caesar, Monoalphabetic, Polyalphabetic (Vigenère), Transposition Ciphers, Playfair and Hill Ciphers; Cryptanalysis Techniques: Frequency Analysis, Known Plaintext and Ciphertext-only attacks, Introduction to Security Models and Cryptanalysis.	11	CO1
2	**Symmetric Key Cryptography and Block Cipher Design:** Overview of Symmetric Key Cryptography, Block vs. Stream Ciphers, Data Encryption Standard (DES): Structure, key schedule, weaknesses; Advanced Encryption Standard (AES): SubBytes, ShiftRows, MixColumns, Key Expansion; Modes of operation: Electronic Codebook (ECB), Cipher Block Chaining (CBC), Cipher Feedback (CFB), Output Feedback (OFB), Padding schemes and performance analysis.	11	CO2
3	**Public Key Cryptography and Key Exchange Mechanisms:** Need for Public Key Cryptography; RSA Algorithm: Key generation, Encryption, and Decryption, Security and Attacks; Diffie-Hellman Key Exchange, ElGamal Encryption System; Digital Signatures: RSA-based digital signatures, Digital Signature Algorithm (DSA), ECDSA.	11	CO3

4	**Cryptographic Hash Functions and Authentication:** Pre-image resistance, collision resistance, avalanche effect, MD5, SHA-1, SHA-2 family; Message Authentication: Message Authentication Codes (MACs), HMAC: Structure and applications; Digital Signatures (revisited): Creation and verification, Use in software authentication and legal documents; Key Management: Key distribution challenges, Public Key Infrastructure (PKI), Role of Certificate Authorities (CAs)	12	CO4

Suggested Readings

4. Andrew S Tanenbaum, David. J. Wetherall, “Computer Networks”, Pearson Education, 5th Edition,
5. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, Fourth Edition
6. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010
7. Dayanand Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, “Advance Computer Network”, Wiley India.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105031/

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

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**	V		
Course Name	Biometric Security				
Code	BCACSN25322				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre- Requisite		3	0	0	3
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	Explain the fundamental concepts and applications of biometric security.				
CO2	Describe different biometric modalities and their mechanisms.				
CO3	Evaluate the performance, security, and privacy issues in biometric systems.				
CO4	Analyze real-world applications and the future of biometrics in cybersecurity.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**INTRODUCTION TO BIOMETRIC SECURITY:** Definition, History, and Evolution of Biometrics, Characteristics of Biometric Traits (Universality, Uniqueness, etc.), Classification: Physiological vs Behavioral, Architecture of a Biometric System, Application Domains (Healthcare, Security, Banking, Law Enforcement), Social, Ethical, and Legal Implications of Biometric Systems.	11	CO1
2	**BIOMETRIC MODALITIES AND TECHNOLOGIES FINGERPRINT RECOGNITION:** Fingerprint Recognition: Minutiae-based Techniques, Facial Recognition: Feature-based vs Appearance-based, Iris Recognition: Iris Code, Texture Analysis, Voice and Signature Recognition, Gait and Palmprint Biometrics (Introduction only), Strengths and Limitations of Each Modality, Sensor Technologies and Acquisition Quality.	12	CO2
3	**SYSTEM PERFORMANCE AND SECURITY:** Performance Metrics: FAR, FRR, EER, ROC/DET Curves, Security Threats: Spoofing, Replay Attacks, Template Theft, Presentation Attack Detection and Liveness Detection, Biometric Template Protection: Cancelable Biometrics, Cryptographic Technique, Privacy Concerns and Regulatory Frameworks (GDPR, UIDAI).	11	CO3
4	**INDUSTRY PRACTICES AND INNOVATION TRENDS:** Biometric Standards: ISO/IEC 19794, ANSI/NIST-ITL, Multimodal Biometric Systems: Fusion Techniques and Applications, Aadhaar as a Case Study (India's National ID System), Cloud-based Biometrics and Mobile Biometrics, Future Directions and Research Opportunities in Biometric Security.	11	CO4

Suggested Readings:

1. *Wayman et al., "Biometric Systems: Technology, Design and Performance Evaluation",* Springer Open Access.
2. *Jain, Flynn, Ross, "Handbook of Biometrics",* Springer Open Access.
3. *Shimon Modi, "Biometrics in Identity Management: Concepts to Applications"*, Internet Archive Open Access.

Online Resources:

- UIDAI official resources: https://uidai.gov.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	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

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**	V		
Course Name	Cyber Law & IT Act 2000				
Code	BCACSN25323				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
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 cyber security 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.	11	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.	11	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.	12	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.	11	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. Nandan Kamath, "Law Relating to Computers Internet & E-commerce - A Guide to Cyber laws & the Information Technology", Universal Law Publishers.

.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	III	**Semester**	V		
Course Name	Physical Security				
Code	BCACSN25324				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	To understand the principles and applications of physical security technologies and access control systems for effectively protecting IT infrastructure and ensuring secure access to critical assets.				
Course Outcomes					
CO1	Introduce the fundamental principles and components of physical security in cyber forensic environments.				
CO2	Able to utilize existing risk exposure analysis in developing the physical 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 build awareness of physical security for IT assets, identify threats and vulnerabilities, conduct effective training, and manage its administrative aspects.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Physical Security:** Overview, Need, Scope, Principles, Role and Significance, Relationship Between Physical and Cyber Security, Role of Corporate Security, IT Security, and Network Security, Natural, Accidental and Intentional Threats, Internal vs. External Threats, Factors Affecting Physical Security, Major Sectors of Physical Security.	11	CO1
2	**Physical Security Plan:** Components, Planning Process, Developing the Physical Security Plan, Integrating Physical IT Security and Cyber Security Planning, Evaluating Regulatory Requirements, Steps to Improve Physical Security, **Designing Physical Security Procedures:** Designing Security for Data Centers, Wiring and Cabling, Desktops, Department-Based Servers, Telecom and Datacom Equipment, Surveillance and Alarm Systems.	11	CO2
3	**Auditing and Testing Procedures:** Develop Audit and Test for Data Centers, Wiring and Cabling, Desktops, Department Servers, Telecom and Datacom Equipment, Surveillance and Alarm Systems, **Role of the Incident Response Team:** Initial Incident Report & Confirmation Process, Mobilization of Response Team, Notifying Management, Alert System, Evidence Preservation and Law Enforcement Involvement, Returning to Normal Operations, Post-Incident Review and Lessons Learned, IRT Role during Disaster.	12	CO3

4	**Physical Security for IT Assets:** Testing and Evaluating the Module, 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.	11	CO4

Suggested Readings

1. Truett A. Ricks, Bobby E. Ricks, Jeffrey Dingle “Physical Security and Safety: A Field Guide for the Practitioner”. CRC Press.
2. Baker, P.R., & Benny, D.J. “The Complete Guide to Physical Security”. Auerbach Publications.
3. Lawrence J. Fennelly “Effective Physical Security". Butterworth-Heinemann.
4. Fares Khairallah “Physical Security Assessment Handbook". CRC Press.

Online Resources

5. https://archive.nptel.ac.in/courses/106/106/106106234/
6. https://youtu.be/dNrKk3pFhPY?si=Gb6ueS0pjHfY7Ovx/

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	Python Programming with Django Lab				
Code	BCACSN25351				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To provide students with comprehensive knowledge and practical skills in python programming and Django framework.				
Course Outcomes					
CO1	To know working knowledge of working with python programming syntax, decision making and looping statement, function, module and string.				
CO2	To have practical knowledge of OOP concepts in python, MySQL database handling, Django Framework and database handling using Django framework and MySQL.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Introduction to Variables, keywords, basics operation in python, taking input in console, displaying output using print () function, using end parameter in print (). 2. Practical implementation of the constructs like if, else, elseif ladder, for loop and while loop. 3. Practical implementation of module and functions in python. 4. Practical implementation of list, tuple, dictionary and sets. 5. 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. 6. Working with Recursive function and lambada function. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO1
2	1. Implementation of OOP concepts like class, object, constructor, destructor, accessing members of class using Object. 2. Implementation of inheritance, overloading, overriding concepts. 3. Installation, configuration of MySQL, database and table creation in MySQL. 4. Installation and configuration of Django Framework to develop web page. 5. Working with basic programming construct in Django. 6. Working with Django Model and Django Form. 7. Database Handling using Django and MySQL. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO2

Suggested Readings:

1. Ashok N. Kamthane & Amit A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Educations.
2. Kenneth A. Lambert, The Fundamentals of Python: First Programs, Cengage Learning, ISBN: 978-1111822705.
3. Samuel Dauzon, Aidas Bendoraitis, Arun Ravindran," Django: Web Development with Python", packt publications.

Online Resources:

1. https://www.youtube.com/watch?v=aFRA52st9to

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

Program	Bachelor of Computer Applications (CS & F)				
Year	III	**Semester**	V		
Course Name	Web Application Security Lab				
Code	BCACSN25352				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To provide students with comprehensive knowledge and practical skills in identifying, assessing, and mitigating web application vulnerabilities by applying secure development practices, utilizing open-source security tools, and understanding industry-standard frameworks and attack methodologies.				
Course Outcomes					
CO1	Understand the fundamental principles of web application security, including common attack vectors, authentication and authorization mechanisms, SSL/TLS protocols, session management, and input validation techniques and demonstrate proficiency in detecting and mitigating common web attacks such as SQL Injection, XSS, CSRF, and misconfiguration using ethical hacking tools and best security practices.				
CO2	Perform vulnerability assessments and penetration testing using various tools and techniques to identify, analyze, and report security weaknesses in web and network systems.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. HTTP & HTTPS: Use a tool like Wireshark or Chrome DevTools to capture HTTP and HTTPS requests. 2. Use browser DevTools to inspect cookie attributes (Secure, HttpOnly). 3. SQL Injection: Create a login page with input validation and test for SQL injection using invalid credentials. 4. XSS: Inject JavaScript into input fields in DVWA or OWASP Juice Shop. 5. CSRF: Create a simple HTML page to forge a request to change a user's password. 6. File Upload: Upload a .php or .exe disguised as an image and try to execute it. 7. Scan a vulnerable website (like DVWA or BWAPP) and analyze the reports. 8. OWASP Top 10: Analyze a sample application using OWASP Top 10 checklist and identify which vulnerabilities are present. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO1
2	8. Hashing: Implement password hashing using bcrypt or Argon2. 9. Authentication: Use Postman to test REST APIs with JWT or OAuth2 tokens and identify authentication flaws. 10. Pen Test: Conduct a penetration test on a test web application (e.g., DVWA or bwapp) and identify at least 3 vulnerabilities. 11. Tools: Use Burp Suite to detect and exploit XSS and CSRF vulnerabilities in a test web application, then explain how to mitigate them. 12. Build a small web app (login + input form) and run a complete vulnerability scan with OWASP ZAP or Wapiti. 13. RBAC: Set up user roles (admin/user) in a basic web app. 14. Perform vulnerability scanning using OpenVAS or Nikto and prepare a vulnerability assessment report. **Note: -** Students will also perform all other exercises provided by course instructor.	15	CO2

Suggested Readings:

5. Andrew Hoffman, “Web Application Security”,O’Reilly.
6. Ravidas and Grek Jhonson, “Testing and Securing Web Applications”, Auerbach pub.
7. Piyush Kumavat, “Web Application Security 101”, Self Published.
8. Dr. Rohit Gautam and Dr. Shifa Cyclewala, “Ultimate Pentesting for Web Applications: Unlock Advanced Web App Security Through Penetration Testing Using Burp Suite, Zap Proxy, Fiddler, Charles Proxy, and Python”.
9. Michael Cross, “Developer'S Guide To Web Application Security (Pb 2011) Paperback – 16 February 2007”. Syngress.

Online Resources:

3. https://youtu.be/K1S3kOeRmLg?si=PoOHCbQCEL6m_lyu
4. https://youtu.be/Dp019cWu1cg

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	1	1	2
CO2	1	2		2	2	1		1		2		2	2	3
CO3	2	3		2	3	3			1	2			2	3
CO4	2	3		1	3	2	1		1	3	1	3	2	3

SEVENTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	**Semester**		VII	
Course Name	Statistical & Optimization Techniques				
Code	BCACSN27401				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		2	1	0	3
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	Gain proficiency in basic statistical analysis and interpretation.				
CO2	Master problem-solving techniques for linear programming and optimization.				
CO3	Develop skills to solve transportation and assignment problems efficiently.				
CO4	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	11	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.	11	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.	11	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).	12	CO4

Suggested Readings

1. Gillet B.E., “Introduction to Operation Research, Computer Oriented Algorithmic approach”, Tata McGraw Hill Publising Co. Ltd. New Delhi.
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.D. Sharma, “Operations Research”, Kedar Nath Ram Nath, Meerut (UP).
5. S.S. Rao “Optimization Theory and Application”, Wesley Eastern.
6. Tata Hamdy, A “Operations Research - An Introduction”, Fifth Edition, Prentice, Hall of India Pvt. Ltd., New Delhi.

Online Resources

1. https://nptel.ac.in/courses/111105039
2. https://youtu.be/COI0BUmNHT8?si=Zkf3u_vzGl_rVoPG

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3	2		3	2	1			1	3	1	2	1	1
CO2	1	2	1	2	3	1	1		1	3	1	2	1	1
CO3		2	2	3	3	1	1		1	2	2	2	1	
CO4	2	2	3	2	2	1			1	2	2	2		1

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	Semester	VII		
Course Name	Research Methodology				
Code	BCACSN27402				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	0	0	3
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	11	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.	11	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	12	CO3
4	**Report/ Thesis writing:** Pre writing consideration, Formulation of research projects/ proposals; Format of Report, Presentation of Research report, Research / review articles, bibliography norm & plagiarism.	11	CO4

Suggested Readings

1. Cooper, Donald R and Schindler, Business Research Methods, 9th Edition, Tata McGraw Hill.
2. Chawla, Deepak & Sondhi, Neena, Research Methodology- Concepts and Cases, Vikas Publication House.
3. Kothari C R, Research Methodology Methods &Techniques, 2nd Edition, New Age International Publishers.
4. Naresh Malhotra, Market Research, Pearson Education.
5. Kumar, Ranjit, Methodology: A Step by Step guide for Beginners, Pearson Education

Online References:

1. https://study.sagepub.com/onlineresearchmethods2e
2. https://laverne.libguides.com/c.php?g=34939&p=5114220

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 Studies				
Code	BCACSN27403				
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	Soft Computing				
Code	BCACSN27421				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	0	0	3
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.	11	CO1
2	**Learning Rules and Various Activation Functions**, Basic Learning Mechanism, Types of Learning; Hebbian Learning Rule, Perception Learning Rule, Delta Learning Rule, Widrow-Hoff Learning Rule, Correlation Learning Rule, Competitive Learning, Winner-Take All Learning Rule, Associative Memories**.**	11	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: Mamdani and Sugeno, Fuzzy Rule Base, Fuzzy Knowledge Base, Fuzzification and Defuzzification**.**	11	CO3
4	**Type II Fuzzy Set:** Need of Type II Fuzzy Set, Type II Fuzzy Set, Generalized Type II Fuzzy Set, Intuitionistic 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, mutation and crossover, Genetic Algorithm Solved Example: Maximizing the function.	12	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	BCACSN27422				
Course Type	DSE	L	T	P	Credit
Pre-Requisite	Machine learning	3	0	0	3
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.	11	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, EfficientNet, DenseNet, Xception; 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 Brain Tumor from MRI using CNN or any other similar case Study.	11	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; Introduction to Neural Machine Translation (NMT) and Transformer Models (BERT, T5, GPT); **Case Study:** Sequence classification or any other similar case study.	12	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; case study: The addition of attention layer in Encoder/ Decoder.	11	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

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			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

EIGHTH SEMESTER

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	Semester	VIII		
Course Name	R Programming				
Code	BCACSN28401				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		2	1	0	3
Course Objectives	The objective is to provide students with a fundamental understanding of R Programming/RStudio, commands, data structures, conditional & iterative statements, matrix, lists, vector etc, It will dive deep in managing concepts and significance of Data Management and Data Frames in R Programming. By the last students must be able to understand needs and usages of graphical tools such as plots, boxplot etc and statistical functions, handling data through graphics, 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.	10	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.	11	CO2
3	**Matrices and Data Frames:** Creating matrices and Data frames, Matrices and data frame functions, slicing data frame, combining slicing with functions, data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings. Advanced Data frames manipulations, import of external data in various file formats.	12	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).	12	CO4

Suggested Readings

1. Christian Heumann, Michael Schomaker and Shalabh "Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R" Springer, 2016.
2. Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet "The R Software-Fundamentals of Programming and Statistical Analysis" Springer 2013.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters "A Beginner's Guide to R (Use R)" Springer 2009
4. Klarenberg "Introduction to Programming with R" last update: 06/29/2023 Summer B 202

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		1						
CO2	2	1				1		1		1				
CO3	2	2		1	1	2		2		1		1		
CO4	2	2		1	1	2		2		1		1	1	

1-Low Correlation; 2-Moderate Correlation; 3-Substantial Correlation

Program	Bachelor of Computer Applications (CS & F)				
Year	IV	Semester	VIII		
CourseName	Intellectual Property Right				
Code	BCACSN28402				
CourseType	DSC	L	T	P	Credit
Pre-Requisite		3	0	0	3
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.	11	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.	11	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.	11	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.	12	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.
3. Nityananda, K.V. , Intellectual Property Rights: Protection and Management. India, In: Cengage Learning India Private Limited.

Online Resources

1. https://www.uspto.gov/
2. http://cipam.gov.in/

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	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	BCACSN28451				
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 and basic commands, variables, data structures, conditional & iterative statements, matrix, lists and vector operations, this course will dive deep in managing the concept and significance of Data Management and Data Frames, and to understand need and usages of graphical tools such as plots, boxplot etc. and relevant statistical functions, handling data through graphics, 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
01	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.	15	CO1
	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		

02	6. Simulating and implementation Hypothesis Testing: Testing the Significance of the Difference Between Two Means 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	15	CO2

Suggested Readings

1. Christian Heumann, Michael Schomaker and Shalabh "Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R", Springer, 2016.
2. Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet "The R Software-Fundamentals of Programming and Statistical Analysis" Springer 2013.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters "A Beginner's Guide to R (Use R)" , Springer 2009
4. Klarenberg "Introduction to Programming with R (FOR 6934)" last update: 06/29/2023, Summer B 2023

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		1						
CO2	2	1				1		1		1				

1-Low Correlation; 2-Moderate Correlation; 3-Substantial Correlation