Credit Framework for the Bachelor of Computer Applications -NEP-2020
School of Computer Applications, BBD University, Lucknow

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

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

SEMESTER I

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Total	
DSC	BCAN11101	Computer Fundamentals	3	1	0	40	60	100	4
DSC	BCAN11102	Web Designing	3	1	0	40	60	100	4
DSC	BCAN11103	Digital Electronics & Computer Organization	3	1	0	40	60	100	4
GE		Generic Elective-I	3	1	0	40	60	100	4
CC		Co-Curricular-I	2	1	0	40	60	100	3
DSC	BCAN11151	Computer Application Lab	0	0	4	40	60	100	2
DSC	BCAN11152	Web Designing Lab	0	0	4	40	60	100	2
VC		Vocational Course-I	2	0	0	40	60	100	2
	GPN1101	General Proficiency	0	0	0	100	0	100	1
Total			**16**	**5**	**8**	**420**	**480**	**900**	**26**

SEMESTER II

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Total	
DSC	BCAN12101	Programming in C	3	1	0	40	60	100	4
DSC	BCAN12102	Operating System	3	1	0	40	60	100	4
DSC	BCAN12103	Database Management System	3	1	0	40	60	100	4
GE		Generic Elective-II	3	1	0	40	60	100	4
CC		Co-Curricular-II	3	0	0	40	60	100	3
DSC	BCAN12151	Programming in C Lab	0	0	4	40	60	100	2
DSC	BCAN12152	Database Management System Lab	0	0	4	40	60	100	2
VC		Vocational Course-II	2	0	0	40	60	100	2
	GPN1201	General Proficiency	0	0	0	100	0	100	1
Total			**17**	**4**	**8**	**420**	**480**	**900**	**26**

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

SEMESTER III

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Total	
DSC	BCAN13201	Object Oriented Programming Using Java	3	1	0	40	60	100	4
DSC	BCAN13202	Data Structure Using C	3	1	0	40	60	100	4
DSC	BCAN13203	Data Communication and Network	3	1	0	40	60	100	4
DSC	BCAN13204	Numerical & Statistical Mathods	3	0	0	40	60	100	3
GE		Generic Elective-III	3	1	0	40	60	100	4
DSC	BCAN13251	Object Oriented Programming Using Java Lab	0	0	4	40	60	100	2
DSC	BCAN13252	Data Structure Using C Lab	0	0	4	40	60	100	2
VC		Vocational Course-III / SSMC	2	0	0	40	60	100	2
	GPN1301	General Proficiency	0	0	0	100	0	100	1
Total			**17**	**4**	**8**	**420**	**480**	**900**	**26**

SEMESTER IV

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Total	
DSC	BCAN14201	Python Programming	3	1	0	40	60	100	4
DSC	BCAN14202	.Net Framework & C#	3	1	0	40	60	100	4
DSC	BCAN14203	Design Analyis and Algorithm	3	0	0	40	60	100	3
GE		Generic Elective-IV	3	1	0	40	60	100	4
DSE		Discipline Specific Elective-I	3	1	0	40	60	100	4
DSC	BCAN14251	Python Programming Lab	0	0	4	40	60	100	2
DSC	BCAN14252	.Net Framework & C# Lab	0	0	4	40	60	100	2
VC		Vocational Course-IV / SSMC	2	0	0	40	60	100	2
	GPN1401	General Proficiency	0	0	0	100	0	100	1
Total			**17**	**4**	**8**	**420**	**480**	**900**	**26**

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

SEMESTER V

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Total	
DSC	BCAN15301	Mobile Application Development	3	1	0	40	60	100	4
DSC	BCAN15302	Server Side Programming Using PHP	3	1	0	40	60	100	4
DSC	BCAN15303	Software Engineering	3	1	0	40	60	100	4
DSE		Discipline Specific Elective-II	3	1	0	40	60	100	4
DSE		Discipline Specific Elective-III	3	1	0	40	60	100	4
DSC	BCAN15351	Mobile Application Development Lab	0	0	4	40	60	100	2
DSC	BCAN15352	Server Side Programming Using PHP Lab	0	0	4	40	60	100	2
	GPN1501	General Proficiency	0	0	0	40	60	100	1
Total			**15**	**5**	**8**	**320**	**480**	**800**	**25**

SEMESTER VI

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Total	
Theory									
DSC	BCAN16301	Advance Computer Technologies (Online)	3	1	0	40	60	100	4
DSC	BCAN16351	Industrial Training Cum-Project	0	0	0	200	400	600	20
	GPN1601	General Proficiency	0	0	0	100	0	100	1
Total			**3**	**1**	**0**	**340**	**460**	**800**	**25**

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

SEMESTER VII

Course Category	Course Code	Course Title	Period Per Week			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Total	
DSC	BCAN17401	Statistical & Optimization Techniques	3	1	0	40	60	100	4
DSC	BCAN17402	Research Methodology	3	1	0	40	60	100	4
DSE		Discipline Specific Elective-IV	3	1	0	40	60	100	4
DSE		Discipline Specific Elective-V	3	1	0	40	60	100	4
DSC	BCAN17451	Statistical Package for Social Sciences(SPSS) Lab	0	0	4	40	60	100	2
DSC	BCAN17452	Minor Dissertation	0	0	12	100	200	300	6
	GPN1701	General Proficiency	0	0	0	100	0	100	1
Total			**12**	**4**	**16**	**400**	**500**	**900**	**25**

SEMESTER VIII									
Course Category	**Course Code**	**Course Title**	**Period Per Week**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Total**	
DSC	BCAN18401	R Programming	3	1	0	40	60	100	4
DSC	BCAN18402	Intellectual Property Rights	3	1	0	40	60	100	4
DSC	BCAN18451	R Programming Lab	0	0	4	40	60	100	2
DSC	BCAN18452	Major Dissertation	0	0	28	200	300	500	14
	GPN1801	General Proficiency	0	0	0	100	0	100	1
Total			**6**	**2**	**32**	**420**	**480**	**900**	**25**
Award of Bachelor of Computer Applications With Research (After 4 Years: 204 Credits)									

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

Generic Elective-I		
1	BCAN11111	Office Automation
2	BCAN11112	Introduction to Multimedia
Generic Elective-II		
1	BCAN12111	Desktop Publishing (DTP)
2	BCAN12112	Animation & Design
Generic Elective-III		
1	BCAN13211	Artificial Intelligence
2	BCAN13212	Cloud Computing
Generic Elective-IV		
1	BCAN14211	Data Mining
2	BCAN14212	Internet of Things

Discipline Specific Elective-I		
1	BCAN14221	E-Commerce
2	BCAN14222	E-Goverance
3	BCAN14223	Enterprise Resource Planning (ERP)
Discipline Specific Elective-II		
1	BCAN15321	Biometric Security
2	BCAN15322	Blockchain Technology
3	BCAN15323	Storage Area Network
Discipline Specific Elective-III		
1	BCAN15324	Machine Learning
2	BCAN15325	Neural Network
3	BCAN15326	Data Analytics
Discipline Specific Elective-IV		
1	BCAN17421	Fundamentals of Data Privacy
2	BCAN17422	Soft Computing
3	BCAN17423	Deep Learning
Discipline Specific Elective-V		
1	BCAN17424	Computer Vision
2	BCAN17425	Natural Language Processing
3	BCAN17426	Human Computer Interaction

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

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

Bachelor of Computer Applications

FIRST SEMESTER

Program	Bachelor of Computer Applications				
Year	I	**Semester**	I		
Course Name	Computer Fundamentals				
Code	BCAN11101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The Subject provides the fundamental concepts of Computer, its functional and hardware components, Computer Networks, Operating System, and Modern Technologies.				
Course Outcomes					
CO1	To Understand the Functional Components of Computers, History of Computers, Hardware, and Software Components of Computer.				
CO2	To Understand the Concept of Operating Systems, Computer Security Systems, Computer Viruses.				
CO3	Understand the Concept of Computer Networking and How to Use Internet Technology and Their Various Applications.				
CO4	Understanding about the Modern Technologies.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Computers:** Introduction to Computer; Basics of Computers and its Operation; History of Computer; Generations of Computer; Capabilities and limitations of Computers; Types of Computers; Hardware: CPU (Architecture & Related Technology) and introduction to Microprocessors; Storage Devices: Primary & Secondary; Auxiliary Storage Devices; Cache Memory; Memory Hierarchy; Buffering and Spooling; Types of Software: System Software, Application Software; Input Devices; Output Devices; Booting and POST.	15	CO1
2	**Operating System:** Types of Operating System; MS-DOS: Internal and External Commands; MS-Windows; Functions of Operating System: Process Management (Job Scheduling), Memory Management, File Management, I/O Management, Security; Introduction to Programming Languages, Language Processing: Translator, Assembler, Compiler, Interpreter, Cross Compiler; Security threats: Virus & Anti-Virus and worms.	15	CO2
3	**Computer Networks & Internet:** Data Communication: Signaling & Transmission; Network Devices: HUB, Switch, Router, Gateways, etc.; Types of Networks: LAN, MAN, WAN, PAN; Topology: Types of Topologies; Transmission Mode & Media; Switching Techniques; Internet and Protocol, Internet Services, OSI Reference Model; TCP/IP Reference Model.	15	CO3
4	**Introduction to Modern Technologies:** Open Source Software: benefits, comparison between OSS and license software; Mobile Application Development: android , emulator; Data Science & Analysis: need of Data Science, components; Artificial Intelligence: application, types, goals; Soft Computing: need, elements, difference between hard and soft computing; Cloud Computing: types, advantages and disadvantages, applications; IOT: features, advantages and disadvantages; Digital Marketing: components; Blockchain:	15	CO4

	areas of blockchain, concept of bitcoin; Edge Computing: applications, challenges; Extended Reality (XR): applications, AR, VR, MR.		

Suggested Readings

1. E. Balagurusamy, "Fundamentals of Computers", Tata McGraw Hill Education, 2nd Edition, 2010.
2. Peter Norton's., "Introduction to Computers", McGraw Hill Education, 7th Edition, 2017.
3. Raja Raman,V. "Fundamentals of Computers", PHI Publications, 6th Edition, 2014.
4. A. K. Sharma, "Computer Fundamentals & Programming in C". The Orient Blackswan; Second Edition, 2018.

Online Resources

1. https://nptel.ac.in/courses/106106092
2. http://www.iitk.ac.in/esc101/current/lectures.html

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	I		
Course Name	Web Designing				
Code	BCAN11102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To focus on the process of Web Designing and build sound concepts of different languages like HTML, CSS, and JavaScript and tools used in Web Designing. Also, to create a static and dynamic, interactive web pages quickly, confidently, and successfully. This course gives you the basic knowledge of Dreamweaver and its applications.				
Course Outcomes					
CO1	Understand the basic concept of HTML and application in web designing.				
CO2	Students develop static and dynamic website using HTML and CSS.				
CO3	Understanding the basic concept of Java Script and its application.				
CO4	Student able to develop personal and professional websites.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basics of Web Designing:** Introduction to Web (www), Uniform Resource Locator (URL), Hypertext Transfer Protocol (HTTP), Introduction to Internet, Web Browsers, Web Clients, Web Servers , Introduction to HTML: HTML tags and its attributes; Text Formatting tags; Various types of Lists: Ordered, Unordered, Definition lists ;Table tags: Methods to Create Tables, Attributes of table tag, Col span and Row span; Frame tags and its Attributes; Form tag: Creation of Forms, Textbox, Radio Button, Hidden etc; Image, Anchor Tag ; Links to External Documents: Inter-page and Intra-page linking.	15	CO1
2	**DHTML and CSS:** Introduction to DHTML: Uses of DHTML, Features of DHTML, Components of Dynamic HTML, Advantages and disadvantage of DHTML; CSS (Cascading Style Sheet): Font Attributes, Color and Background Attributes Text Attributes, Border, Margin related Attributes, List Attributes; Types of Style Sheet-Inline, External and Embedded; CSSP (Cascading Style Sheet Positioning); Document Object Model; JSSS (JavaScript assisted Style Sheet); Browser objects; DHTML Events.	15	CO2
3	**JavaScript:** Introduction to JavaScript: Basic Programming Techniques: Data Types, Creating Variables and JavaScript Array; Operators and Expressions in JavaScript: Arithmetic, Logical, Comparison, String and Conditional Operators; JavaScript Programming Constructs: Conditional checking, Loops; Functions in JavaScript: Built in Functions and User Defined Functions; Dialog Boxes: Alert, Confirm and Prompt Dialog Box.	15	CO3
4	**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, Regular Expression, Cookies, Page Redirect, Session Storage, Error Handling and Debugging.	15	CO4

Suggested Readings

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

Online Resources

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

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2		2	1	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				
Year	I	**Semester**	I		
Course Name	Digital Electronics & Computer Organization				
Code	BCAN11103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Develop a comprehensive understanding of Digital Electronics and Computer Organization, focusing on the design and implementation aspects. Enable students to effectively analyze and communicate design challenges in developing processors or other components that meet specific design requirements.				
Course Outcomes					
CO1	Acquire a strong foundation in the vocabulary and fundamental principles of Digital Electronics.				
CO2	Develop a solid understanding of the terminology and fundamental principles of Computer Processors.				
CO3	Gain a comprehensive understanding of the principles governing communication between Input/Output (I/O) devices and Processors.				
CO4	Demonstrate a thorough understanding of the concepts related to storing and retrieving data from memory.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Digital Electronics:** Number System, Boolean Algebra**,** Minimization of Boolean Expressions using K-Map; Logic Gates, Implementations of Logic Functions using Gates; **Combinational Circuits:** Introduction to combinational circuits, Adders & Subtractors; Multiplexer & De-Multiplexer; Decoder; **Sequential Circuit:** Introduction to Flip Flops, Types of Flip flop, Excitation table of Flip flop, Introduction of Registers; Classification of Registers, Introduction of Counter; Synchronous and Asynchronous counter.	15	CO1
2	**Register Transfer and Micro-operation:** Register Transfer Language: Bus and Memory Transfer; Micro operations: Arithmetic, Logical, shift micro- operations; Arithmetic logic shift unit; Timing and control; Instruction codes; Computer instructions, Instructions Format., Instruction Cycle; **Central Processing Unit:** Accumulator based organization; General register organization; Stack organization; Addressing Modes, RISC vs. CISC, Hard wired & micro programmed control Unit.	15	CO2
3	**I/O Organizations:** Introduction to system buses; Input/ output interface; Interrupt and Types of Interrupts, Serial Vs Parallel communications; I/O Processor; Synchronous Data Transfer; Asynchronous Data Transfer methods: Strobe Control, handshaking; Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O. DMA: DMA Controller, DMA Transfer	15	CO2 & CO3
4	**Memory organizations**: Memory hierarchy; Main Memory: RAM Chips, ROM Chips; Concept of address space & Memory Space; Address Mapping; Auxiliary Memory; Cache memory: Mapping Techniques: Direct mapping, Associative mapping, Set associative mapping; Associative memory	15	CO4

Suggested Readings

1. M. Morris Mano “Digital Logic and Computer Design”, 2nd Edition, PHI.
2. P. Raja, “Switching Theory”, Fourth Edition, Umesh Publication.

3. M. Morris Mano, “Computer System Architecture”, PHI
4. William Stalling, “Computer Organization & Architecture”, Pearson Education Asia.

Online Resources

1. https://www.youtube.com/watch?v=TH9nd-KdVHs
2. https://archive.nptel.ac.in/courses/117/106/117106086/
3. https://archive.nptel.ac.in/courses/106/105/106105163/

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	I		
Course Name	Office Automation				
Code	BCAN11111				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course objective of Microsoft Office is to provide users with a comprehensive understanding of the various tools and features available in the word processing software, spreadsheet software, presentation software and database management software.				
Course Outcomes					
CO1	Understand the concepts of Word documentation.				
CO2	Understand the mathematical and functional concepts of Excel.				
CO3	Student learns presentation design skill.				
CO4	Student able to create and manage the database.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to MS Word**: MS Word - Working with Documents -Opening & Saving files, Editing text documents, Inserting, Deleting, Cut, Copy, Paste, Undo, Redo, Find, Search, Replace, Formatting page & setting Margins, Converting files to different formats, Importing & Exporting documents, Sending files to others, Using Tool bars, Ruler, Using Icons, using help, Formatting Documents - Setting Font styles, Font selection- style, size, color etc., Type face - Bold, Italic, Underline, Case settings, Highlighting, Special symbols, Setting Paragraph style, Alignments, Indents, Line Space, Margins, Bullets & Numbering. Setting Page style - Formatting Page, Page tab, Margins, Layout settings, Paper tray, Border & Shading, Columns, Header & footer, Setting Footnotes & end notes – Shortcut Keys; Inserting manual page break, Column break and line break, creating sections & frames, Anchoring & Wrapping, Setting Document styles, Table of Contents, Index, Page Numbering, date & Time, Author etc., Creating Master Documents, Web page. Creating Tables- Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula, Drawing - Inserting Clip Arts, Pictures/Files etc., Tools – Word Completion, Spell Checks, Mail merge, Templates, creating contents for books, Creating Letter/Faxes, Creating Web pages, Using Wizards, Tracking Changes, Security, Digital Signature. Printing Documents – Shortcut keys.	15	CO1

2	**Introduction to MS Excel**: MS Excel: Spread Sheet & its Applications, Opening Spreadsheet, Menus - main menu, Formula Editing, Formatting, Toolbars, Using Icons, Using help, Shortcuts, Spreadsheet types. Working with Spreadsheets- opening, saving files, setting Margins, converting files to different formats (importing, exporting, sending files to others), Spread sheet addressing - Rows, Columns & Cells, Referring Cells & Selecting Cells – Shortcut Keys. Entering & Deleting Data- Entering data, Cut, Copy, Paste, Undo, Redo, Filling Continuous rows, columns, Highlighting values, Find, Search & replace, Inserting Data, Insert Cells, Column, rows & sheets, Symbols, Data from external files, Frames, Clipart, Pictures, Files etc, Inserting Functions, Manual breaks, Setting Formula - finding total in a column or row, Mathematical operations (Addition, Subtraction, Multiplication, Division, Exponentiation), Using other Formulae. Formatting Spreadsheets- Labelling columns & rows, Formatting- Cell, row, column & Sheet, Category - Alignment, Font, Border & Shading, Hiding/ Locking Cells, Anchoring objects, Formatting layout for Graphics, Clipart etc., Worksheet Row & Column Headers, Sheet Name, Row height & Column width, Visibility - Row, Column, Sheet, Security, Sheet Formatting & style, Sheet background, Color etc., Borders & Shading – Shortcut keys. Working with sheets – Sorting, Filtering, Validation, Consolidation, and Subtotal. Creating Charts - Drawing. Printing. Using Tools – Error checking, Spell Checks, Formula Auditing, Creating & Using Templates, Pivot Tables, Tracking Changes, Security, Customization.	15	CO2
3	**Introduction MS Power Point:** MS Power point: Introduction to presentation – Opening new presentation, Different presentation templates, setting backgrounds, Selecting presentation layouts. Creating a presentation - Setting Presentation style, Adding text to the Presentation. Formatting a Presentation - Adding style, Color, gradient fills, arranging objects, Adding Header & Footer, Slide Background, Slide layout. Adding Graphics to the Presentation- Inserting pictures, movies, tables etc. into presentation, Drawing Pictures using Draw. Adding Effects to the Presentation- Setting Animation & transition effect. Printing Handouts, Generating Standalone Presentation viewer.	15	CO3
4	**MS Access:** Introduction, planning a Database, Starting Access, Access Screen, creating a New Database, Creating Tables, Working with Forms, creating queries, Finding Information in Databases, Creating Reports, Types of Reports,	15	CO4

	Printing & Print Preview – Importing data from other databases viz. MS Excel etc.		

Suggested Readings

1. McFedries, P. "Automating Microsoft Office 2019 Work with VBA", Wiley, 2019.
2. Walkenbach, J., "Excel VBA Programming for Dummies", Dummies, 2020.
3. Machado, M., "PowerShell for Office 365", Apress, 2019.

Online Resources

1. https://nios.ac.in/online-course-material/sr-secondary-courses/word-processing-(327).aspx
2. https://ncert.nic.in/textbook/pdf/kect103.pdf
3. https://nios.ac.in/media/documents/vocational/basiccomp/l12.pdf
4. https://support.microsoft.com/en-us/office/basic-tasks-for-creating-a-powerpoint-presentation-efbbc1cd-c5f1-4264-b48e-c8a7b0334e36
5. https://cag.gov.in/uploads/course_material/CourseMaterial-05ef48abca632f4-86870602.pdf

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	I		
Course Name	Introduction to Multimedia				
Code	BCAN11112				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The subject focuses on the basic concepts of Multimedia, its elements and making of Multimedia Projects.				

Course Outcomes	
CO1	Understand the basic concepts of Multimedia and its applications.
CO2	Understand the elements of Multimedia applications.
CO3	Understand the making of Multimedia Project.
CO4	Understand the Multimedia Tools and Virtual Reality.

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introductory Concepts:** Definition of Hypertext, Hypermedia and Multimedia, Categories of Multimedia, Multimedia Highway, Content Distribution System (CD/DVD, Internet, Television, Flash Drive), Skills and Training Opportunities in Multimedia, Motivation for Multimedia Usage, Multimedia Operating System, Multimedia Communication System, Multimedia Entertainment, Multimedia Business, Multimedia in Education and Training, Smart-classroom, Multimedia Advertisement, Multimedia Web, Multimedia in Banking and Finance, Multimedia in E-Commerce & M-Commerce, Multimedia in E-Governance, Multimedia at Home, Multimedia in Public Places.	15	CO1
2	**Elements of Multimedia:** Graphics, Types of Graphic Images, Graphic Files Compression Formats, Uses for GIF and JPEG Files, Image Resolution &Color; Audio &Video: Sound and Audio, Analog Sound Vs Digital Sound, Audio File Formats, Image Capture Formats, Digital Video, Need for Video Compression, Video File Formats, Uses of MPEG, MP4, AVI and .VOB files, Multimedia Text, Multimedia Standards.	15	CO2
3	**Making a Multimedia:** The Stages of Multimedia Project, Multimedia Hardware: Input Device and Output Devices; Multimedia Software: Device Drivers, Media Players, OCR Software; Multimedia Project Team: Project Manager, Multimedia Designer, Video Specialist, Audio Specialist, Multimedia Programmer; Process of Making Multimedia Applications.	15	CO3
4	**Multimedia Tools:** Basic Tools, Types of Basic Tools, Authoring Tools, Types of Authoring Tools, Multimedia Editing Tools, Media Conversion Tools, Text Editing and Word Processing Tools, Painting and Drawing Tools; **Introduction to VRML:** Virtual Reality & Augmented Reality, Applications of virtual & Augmented Reality, Introduction to MIME and its Types.	15	CO4

Suggested Readings

1. Tay Vaughan, “Multimedia, Making IT Work”, Tata McGraw Hill, 1993.
2. Buford, “Multimedia Systems”, Addison Wesley, 1994.
3. Sleinreitz, “Multimedia System”, Addison Wesley, 1995.

4. David Hillman, “Multimedia technology and Applications”, Galgotia Publications, 1997.

Online Resources

1. https://egyankosh.ac.in/handle/123456789/10499
2. https://www.tutorialspoint.com/multimedia/multimedia_introduction.htm

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	I		
Course Name	Computer Application Lab				
Code	BCAN11151				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The course objective of Microsoft Office is to provide users with a comprehensive understanding of the various tools and features available in the word processing software, spreadsheet software, presentation software and database management software.				
Course Outcomes					
CO1	Create, edit, save, and print documents. Include lists and tables in it. Format text and to use styles, add a graphic to a document, manipulate documents using functions such as find and replace; cut, copy, replace.				
CO2	Create, edit, save, and print, format presentations. Add a graphic to a presentation. Create and manipulate simple slide shows with outlines and notes. Use design layouts and templates for presentations.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Microsoft Word: a. Creating and formatting a professional-looking resume. b. Designing a newsletter with multiple columns, images, and hyperlinks. c. Creating a table of contents and incorporating footnotes in a research paper. 2. Microsoft Excel: a. Creating a budget spreadsheet with formulas for calculating expenses, income, and savings. b. Analyzing sales data using charts and graphs to identify trends and patterns. c. Building a loan amortization schedule to understand repayment plans.	15	CO1
2	3. Microsoft PowerPoint: a. Designing an engaging presentation on a historical event or a scientific concept. b. Creating an interactive slideshow with hyperlinks and custom animations. c. Using advanced features like slide transitions, embedded videos, and audio narration. 4. Microsoft Access: a. Creating a database to manage inventory for a small business. b. Designing a student database system to track grades, attendance, and courses. c. Building a customer relationship management (CRM) database to store and analyze customer data.	15	CO2

Suggested Readings

1. McFedries, P. “Automating Microsoft Office 2019 Work with VBA”, Wiley, 2019.
2. Walkenbach, J., “Excel VBA Programming for Dummies”, Dummies, 2020.
3. Machado, M., “PowerShell for Office 365”, Apress, 2019.

Online Resources

1. https://nptel.ac.in/courses/106106092

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	I		
Course Name	Web Designing Lab				
Code	BCAN11152				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To provide practical implementation on the process of Web Designing and build sound concepts of different languages and tools used in Web Designing using Dreamweaver framework.				
Course Outcomes					
CO1	Visualize and recognize the basic concept of HTML, DHTML and CSS in web designing.				
CO2	Understanding the basic concept of Java Script to create personal and/or business websites following current professional and/or industry standards.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Write an HTML program to create a webpage about the different art forms of India, with appropriate title on the title bar. Use different heading tags for the headings, and list them using ordered list. 2. Write an HTML program to create sections in the document using appropriate tags and apply different color as background to them. Use internal hyperlinks to move to different points within the page. 3. Write an HTML program to insert a picture on the webpage, giving description for the picture in a paragraph. Use properties of height, width, hspace, vspace and align, with different values. 4. Write an HTML Program, to create a profile of 2 pages, the First page containing the applicant's picture with personal details using unordered lists, and the second containing educational details using tables. Use hyperlinks to move to the next page. 5. Using Frames create an Indian Flag and insert the image of chakra in the center. 6. Create a frame like structure based on the given diagram, such that When the first link is clicked, the contents of the first frame is filled with the corresponding information and when the second link is clicked the second frame is filled. 7. Write a program in HTML to demonstrate the concept of Image map, for India map. Map for areas rectangle, Circle, and polygon.	15	CO1
2	1. Write a program using JavaScript to do the multiplication table for a number entered by the user in the textbox. 2. Create a sparse array using the values entered by the user in the five textboxes, and use Array methods such as sort(), pop(), push(), reverse() and join(). 3. Create a Math object and use methods ceil(), floor(), round() for rounding off the number, also use methods such as cos(), sin(),sqrt(). 4. Write a Program using JavaScript to print a bill for 5 items purchased by the user.	15	CO2

	5. Write a program Using Date object, to display appropriate greeting message “Good Morning” or “Good Afternoon” or “Good Night”, in an alert box with the user’s name, after receiving the same in the prompt box. 6. To demonstrate the concept of styles, write a program applying internal style for paragraph tag, and override the same by applying inline style. Also create an external CSS file applying styles for the headings. 7. Create a registration form for creating an email account, having the input type elements like checkbox, radio button, select option, text area and submit button, and validate the textboxes for verifying the password. 8. Create a web page using two image files, which switch between one another as the mouse pointer moves over the image. Use onMouseOut and onMouseOver event handlers. 9. Using filters apply opacity feature to blur the image and using Transition apply hover feature, so the image will be transparent again when the mouse pointer is placed on the image.		

Suggested Readings

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

Online Resources

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

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

SECOND SEMESTER

Program	Bachelor of Computer Applications				
Year	I	Semester		II	
Course Name	Programming in C				
Code	BCAN12101				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To provide the fundamental knowledge about various concepts of programming and clear understanding of the basic terminology required for programming.				
Course Outcomes					
CO1	Understand the basic concepts of programming and various constructs of the C Language with proper syntax.				
CO2	Use and Implement programs on arrays and their operations.				
CO3	Understand and Develop programs on functions, pointers, structure, union, and enumeration.				
CO4	Understand the concept of file handling and various header Files.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Evolution of Programming Languages; Programming Approaches: Top-down Approach, Bottom-up Approach; Algorithm; Flowchart; Source Code; Object Code; Executable File. **Introduction to C:** Basic Structure of C Programming, Data Types: Primitive Data types, Derived Data types, User-Defined Data Types; **Operators:** Different Types of Operators, Precedence of Operators, Expression and Statements; **Token:** Variables, Constants, Literals, Identifiers, Keyword, Escape Sequence; **Types of Conversion:** Typecasting, Type Conversion; **Decision Control Statements:** IF, IF-ELSE, Nested IF, IF-ELSE ladder, Switch-case; **Iterative statements:** FOR loop, WHILE loop, DO-WHILE loop; **Jump Statements:** Break, Continue, goto.	15	CO1
2	**Array:** Declaration and Initialization of Array, Types of Arrays: Single Dimension Array, Two-Dimensional Array; Address Calculation of an Element in Array; Insertion and Deletion in an Array; **Searching**: Linear Search, Binary Search. **Sorting**: Bubble Sort, Selection Sort, Insertion Sort; **Character Array and Strings:** Reading, writing, String Handling Functions: strcat(), strcmp(), strcpy(), strlen().	15	CO2
3	**Functions:** User-Defined Functions; Function Declaration; Types of Arguments: Actual Arguments, Formal Arguments; Function Definition; Methods to Call a Function: Call by Value, Call by Reference; Passing Arrays as Parameters; Storage Classes. **Pointers:** Declaration of Pointer Variables; Pointer Arithmetic; Pointers and Arrays, Pointer and Character Strings, Array of Pointers, Pointers as Function Arguments; Structures; Unions; Array of Structures; Array of Union; Pointers and Structures; Enumerations.	15	CO3
4	**File Handling:** Opening a File, closing a File, File-Opening Modes, reading from and Writing to a File, Copying Content of an Existing File to another, File Handling Library Functions; Command Line Arguments; Pre-processor Directives. **Header Files:** stdio.h, conio.h, math.h, stdlib.h, setjmp.h, signal.h, time.h, stdarg.h, graphics.h.	15	CO4

Suggested Readings

1. E. Balagurusamy, “Programming in ANSI C”, TMH Publications.
2. Reema Thareja, “Programming in C”, OXFORD University Press.
3. Peter Norton’s, “Introduction to Computers”, TMH Publications.
4. Kernighan, Ritchie, “The C Programming Language”, PHI Publications.
5. Yashwant Kanitakar, “Let us C”, BPB Publications.

Online Resources

1. https://www.youtube.com/playlist?list=PLJ5C_6qdAvBFzL9su5J-FX8x80BMhkPy1
2. https://www.coursera.org/specializations/c-programming

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	II		
Course Name	Operating System				
Code	BCAN12102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To provide a good understanding of the underlying concepts of operating systems.				
Course Outcomes					
CO1	Understand the principles and techniques used to implement processes and threads as well as the different algorithms for process scheduling.				
CO2	Understand the mechanisms used for process synchronization & handling deadlock.				
CO3	Understand the concept of memory management and virtual memory.				
CO4	Understand the file system structure and storage management.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction and Process Management:** Operating System: System Components, System Calls and its types, System Programs; Types of Operating System; Operating System Structure: Simple Structure, Layered Approach, Microkernels, Exokernels; Virtual machine; Introduction to Process: Process States, Process Control Block; Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Scheduling Objectives, Scheduling Criteria; Scheduling Algorithms: First Come First Serve, Shortest Job First, Round Robin, Priority; Multiple-Processor Scheduling; Real-Time Scheduling; Multilevel Feedback Queue Scheduling; Threads.	15	CO1
2	**Process Synchronization and Deadlocks**: Critical- Section Problem; Peterson's Solution; Semaphore: Usage of Semaphore; Classical Problems of Synchronization: Producer Consumer, Readers-Writer, Dining Philosophers; Deadlock System Model; Deadlock Characterization: Necessary Condition, Resource- Allocation graph; Deadlock Handling Methods: Deadlock Prevention, Deadlock Avoidance Mechanisms: Resource Allocation graph Algorithm, Banker's Algorithm, Deadlock Detection and Recovery.	15	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.	15	CO2 & CO4
4	**Storage Management:** File Concept: File Attribute, File Operations, File Types**,** File Structure; File Access Method: Sequential Method, Direct Access Method; Directory	15	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				
Year	I	**Semester**	II		
Course Name	Database Management System				
Code	BCAN12103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective of this course is to introduce the fundamental concepts of DBMS, terminologies of database management system, E-R Modelling, PL/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: Sequential file organization, Heap file organization, Hash file organization, B+ file organization, Indexed sequential access method (ISAM),Cluster 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:1-Tier Architecture,2-Tier Architecture and 3-Tier Architecture. Capabilities of good DBMS, Database Schemas and Instances, Classification of Database Management Systems, Database Languages. **Introduction of Data Models**: Network Data Model, Hierarchical Data Model, Relational Data Model, Entity Relationship Data Model, Object Based Data Model, Semi-Structure Data Model.	15	CO1
2	**Relational Database Management System & Data Modelling**: 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:	15	CO1 & CO2

	Select, Project, Rename, Union, Set difference, division, Cartesian Product, Additional Relational-Algebra Operations: Set Intersection, Natural Join And Outer join.		
3	**SQL and Database Design Theory**: Introduction on SQL: Characteristics of SQL, Advantage of SQL, SQL Data Type and Literals, Types of SQL Commands, SQL Operators and their Procedure, Queries and Sub Queries, Aggregate Functions, Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, View, Basic concept of Cursors and Triggers. **Functional Dependencies and Normalization:** Informal Design Guidelines for Relation Schemas, Database Anomalies, Functional Dependencies, Armstrong's axioms, Closure of Attribute sets, Normalization: Need of Normalization, Normal Forms, First Normal Form, Second Normal Form, Third Normal Forms and Boyce-Codd Normal Forms.	15	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.	15	CO3 & CO4

Suggested Readings

1. Korth, Silbertz, Sudarshan, Database Concepts, McGraw Hill, Seventh Edition-2019
2. Elmasri, Navathe, Fundamentals of Database Systems, Addison Wesley, Seventh Edition-2017
3. Date C J, An Introduction to Database Systems, Addison Wesley, Eight Edition-2017
4. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications, Sixth Edition-2013
5. Ramkrishnan, Gehrke, Database Management System, McGraw Hill, Third Edition-2002
6. Ivan Bayross -- SQL, PL/SQL: The Programming Language of Oracle, BPP Publication, Fourth Edition-2010
7. R. S. Deshpandey --SQL/PL SQL for Oracle,2011

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				
Year	I	**Semester**	II		
Course Name	Desktop Publishing (DTP)				
Code	BCAN12111				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To impart basic level knowledge of DTP software such as InDesign, Photoshop, and CorelDraw				
Course Outcomes					
CO1	Students can create Documents and Templates; add text into documents using InDesign. They can create multipage Layout Design.				
CO2	Students shall be able to use Photoshop as a premier graphic design and image editing tool, and gain entry level position in graphic design and animation.				
CO3	Students can conceptualize and create Logos, Pamphlets, posters, banners etc. using CorelDraw.				
CO4	Understand various software used for Desktop Publishing and would be able to create and design documents with text and graphics like newspaper ad, wedding cards, visiting cards, greeting card etc.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Desktop Publishing:** Introduction to DTP, Merits & Demerits of Desktop Publishing, Design Principles of Desktop Publishing, Comparative Analysis between DTP and Traditional Composing Process, General Text Organization, Publications. **Familiarize with the Networking concept:** Practice web browsing, create email id, and sending-receiving mails with attachment. Perform text chat and video chat using social network sites. Identify different cables and connectors used in networking.	15	CO1
2	**InDesign:** Introduction to InDesign, The Application Bar, The Menu Bar, Control Panel, Tools Panel, Working with Custom Workspace, Working with Documents, Creating a Master Page, Working with Text, Working with Objects, Working with Layers, Creating Text Frames, Changing fonts and paragraph alignment Formatting the Text, Basic Formatting Tasks, Editing the Text, Working with Tables, Creating a Table, Embedding a Table within a Table, Modifying a Table, Formatting a Table.	15	CO2
3	**Photoshop:** Introduction to Photoshop, Features in Photoshop, Basic Image Manipulation, Color Basics, Painting Tools, Brush Settings, Making Selections, Filling and stroking, Layers, Advanced Layers, Text, Drawing, Using Channels and Masking , Manipulating images, Getting to know the work area, Basic Photo Corrections, Retouching and Repairing, Working with selections, Layer Basics, Masks and channels, Correcting and enhancing digital photographs, Vector drawing techniques, Advanced Layer techniques, Vector Composting, Creating Links within an image, Creating rollover web visuals, Animating GIF images for the web, Producing and printing consistent color.	15	CO3
4	**CorelDraw:** Introduction to Corel Draw, Features of Corel	15	CO4

	Draw, Corel Draw Interface, Tool Box, Common Tasks; Drawing and Coloring, Selecting Objects, Creating Basic Shapes, Reshaping Objects, Organizing objects, Applying color fills and Outlines; Mastering with Text, Text Tool Artistic and paragraph text, Formatting Text, Embedding Objects into text, Wrapping Text around Object, Linking Text to Objects; Applying Effects, Envelopes, Lens effects, Transparency, Creating Depth Effects, Power Clips; Working with Bitmap Commands, Working with Bitmaps, Editing Bitmaps, Applying effects on Bitmaps, Printing; Corel Draw- Web resources, Internet Tool bar, Setting your webpage, Exporting files,		

Suggested Readings

1. Bill Grout and Osborne, “Desktop Publishing from A to Z”, McGraw Hill,
2. Adobe creative team, “Adobe Photoshop CC Classroom in a Book “Adobe press
3. Gary David Bouton, “CorelDraw X8: The official guide”
4. M.C Sharma, “DESKTOP PUBLISHING ON PC “, BPB Publications.

Online Resources

1. http://www.nptelvideos.com/adobe/adobe_photoshop_tutorials.php
2. http://www.udemy.com/course/desktop-publishing-for-you/

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	II		
Course Name	Animation & Design				
Code	BCAN12112				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The subject focuses on the advanced concepts of multimedia, basic concepts of animations and its application.				
Course Outcomes					
CO1	Understand the basic concepts of internet &multimedia content delivery.				
CO2	Understand the basics of traditional and computer animation.				
CO3	Understand the elements of animation & simulating accelerations.				
CO4	Understand the process of making computer animation.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Internet and Multimedia:** Multimedia on the Web: Tools for WWW, Web Servers, Web Browsers, Search Engines, Web Page Makers and Site Builders, Plug-ins and Delivery Vehicles, Beyond HTML; **Multimedia Elements for WWW**: Developing for the Web, Text for the Web, Images for the Web, Sound for the Web, Animation for the Web, Video for the Web; **Multimedia Contents Delivery:** Testing: Alpha Testing, Beta Testing; Preparing for Delivery: file archive; Delivering on CDROM, Delivering on DVD, Wrapping it up, Delivering on World Wide Web; Video Conferencing and Virtual Reality, Electronic Encyclopedia.	15	CO1
2	**Basic of Animation:** Definition of Animation, Traditional and Historical Methods for Production of Animation, Traditional Animation Techniques, Types of Animation Systems: Key Frame Systems, Scripting System, Parameterized System, Types of Animation, Applications of Animation**; Computer Animation:** Definition of Computer Animation, Types of Computer Animation, Application of Computer Animation in Different Fields, Difference Between Traditional and Computer Animation.	15	CO2
3	**Elements of Animation:** Key frame, In-between Frame, ANIMOB, Storyboard; Computer Animation Tools: Hardware: SGI, PCs, Amiga, Macintosh; 2D Animation Software: Adobe Flash; 3D Animation Software: 3D Studio MAX; **Simulating Acceleration:** Zero Acceleration, Positive Accelerations Negative Accelerations, Combination of Positive and Negative accelerations.	15	CO3
4	**Making Computer Animation:** Sequencing of Animation Design, Required Key Frame for a Film, General Computer Animation Functions, Raster Animation, Computer Animation Languages, Key-Frame Systems, Morphing; Motion Specification: Direct Motion Specifications, Goal Directed System, Kinematics and Dynamics.	15	CO4

Suggested Readings

1. Tay Vaughan, “Multimedia, Making IT Work”, Tata McGraw Hill, 1993
2. Donald Hearn & M Pauline Baker, “Computer Graphics C Version, Prentice Hall of India, 1986.
3. Alberto Menache& John Lumsden, “Computer Animation Complete”, Morgan Kaufmann, 2009.

Online Resources

1. https://egyankosh.ac.in/bitstream/123456789/10497/1/
2. https://www.tutorialspoint.com/computer_graphics/computer_animation.htm.

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	II		
Course Name	Programming in 'C' Lab				
Code	BCAN12151				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To make the student learn a programming language, problem solving techniques and to teach the student to write programs in C and to solve the problems.				
Course Outcomes					
CO1	Understand and Implement programs with data types, operators, conditional statement, looping and arrays.				
CO2	Understand and Implement programs on functions, pointers, file, command line arguments and header files.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Implementation of Fundamental Data Types. 2. Implementation of Fundamental Operators. 3. Implementation of Conditional Program such as if, switch etc. 4. Implementation of Basic Control Constructs such as for loop, while loop, do while loop. 5. Implementation of Advance Control Constructs such as Arrays	15	CO1
2	1. Implementation of Structures, Union, and enumeration etc. 2. Implementation of Functions. 3. Implementation of Pointers. 4. Implementation of Pointers as Function Arguments. 5. Implementation of File. 6. Implementation of Command Line arguments. 7. Implementation of various header files.	15	CO2

Suggested Readings

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

Online Resources

1. https://www.youtube.com/playlist?list=PLJ5C_6qdAvBFzL9su5J-FX8x80BMhkPy1
2. https://cse02-iiith.vlabs.ac.in/

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

Program	Bachelor of Computer Applications				
Year	I	**Semester**	II		
Course Name	Database Management System Lab				
Code	BCAN12152				
Course Type	DSC-Lab	**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	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	15	CO1 & CO2

Suggested Readings

1. Korth, Silbertz, Sudarshan, “Database Concepts”, McGraw Hill,Seventh Edition-2019
2. Elmasri, Navathe, “Fundamentals of Database Systems”, Addison Wesley,Seventh Edition-2017
3. Date C J, “An Introduction to Database Systems”, Addison Wesley,Eight Edition-2017
4. Ivan Bayross, “SQL, PL/SQL: The Programming Language of Oracle”, BPP Publication,Fourth Edition-2010
5. R. S. Desphpandey,” SQL/PL SQL for Oracle” ,2011

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://nptel.ac.in/courses/106104135
3. https://www.youtube.com/watch?v=TB5T2O8Hwm8.

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		2		1	2	1	1

THIRD SEMESTER

Program	Bachelor of Computer Applications				
Year	II	**Semester**	III		
Course Name	Object Oriented Programming Using Java				
Code	BCAN13201				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
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 andperformance 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	**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, CommandLine Argument, and Use of Wrapper Class.	15	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.	15	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.	15	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.	15	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	2	1	2	1	2		3	1	2	2	2	2
CO2	2	1	1	1	2	3	3		1			2	2	2
CO3	1	2	2	2	2	2	2		2	1	1	1	2	2
CO4	2	3	1	2	1	3	2		2		2	1	2	2

Program	Bachelor of Computer Applications				
Year	II	Semester	III		
Course Name	Data Structure Using C				
Code	BCAN13202				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
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, Dynamic Memory Allocation, Arrays: Address Calculation, Application of arrays, Limitation of Array, Application of Arrays, Array as Parameters, Sparse Matrices	15	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.	15	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	15	CO3
4	**Trees**: Introduction to Tree & its Terminology, Binary trees, Types of Binary trees, Representation of Binary Tree, Traversals (Inorder, Preorder, Postorder), 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	15	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	3	2	2	3	1		2	2	1	2	2	3
CO2	1	1	3	2	2	3	1		2	2	1	2	2	3
CO3	1	1	3	2	2	3	1		2	2	1	2	2	3
CO4	1	1	3	2	2	3	1		2	2	1	2	2	3

Program	Bachelor of Computer Applications				
Year	II	**Semester**	III		
Course Name	Data Communication and Network				
Code	BCAN13203				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To introduce basic elements of communication system. To understand channels, techniques and devices used to transmit data between distant locations through different devices. To introduce the functions of different layers of reference model. Understand different protocols and network components.				
Course Outcomes					
CO1	To describe and analyze the hardware, software, and various components of a communication network.				
CO2	Able to explain networking protocols models and devices with their hierarchical relationship. Compare reference models and select appropriate protocols for a particular design.				
CO3	Able to classify networks, transferring of data, address of data packets, analyzing performance, and understanding concepts of data connection and transfer.				
CO4	Able to Identify infrastructure components and their roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Data Communications:** Basic Data Communication System: Data, Signaling and Transmission System; Synchronous and Asynchronous Transmission; Transmission modes: Serial and Parallel; Simplex, Half Duplex and Full Duplex Transmission; Transmission media: Guided and Unguided. **Introduction to Computer Network:** Definition; Goals and Application of Computer Network; Types of Networks: Point to point, Multipoint, Types of Topologies (PAN, LAN, MAN, WAN), Centralized, Distributed and Collaborative; Type of Data Communication System: Wired and Wireless communication.	15	CO1
2	**Introduction to Network Connections:** Introduction to Internet, Intranet, Extranet, VPNS; Bandwidth, Band and Channel Capacity: Nyquist Capacity and Shannon Capacity Formula. **Network Architecture:** Monolithic v/s Layered Approach; Design Issues of Layered approach; Services, Interfaces, Standards and Protocols; ISO- OSI Reference Model and TCP/IP Model; Multiplexing: SDM, FDM, TDM, WDM; Switching: Circuit, Message, Packet; PSTN & ISDN: Narrowband and Broadband. **Subnet Communication:** Concept of Subnet & Host-to-Host Communication; Intermediate Devices: Repeaters and Regenerators, Hub, Switch, Router, Gateway. **Physical Layer:** Design Issues, Services, Protocols.	15	CO2

3	**Data Link Layer:** Framing, Error Control-VRC, LRC, CRC, Checksum, Flow Control- Hamming Code; LLC and MAC Sub-layer; DLL Protocols: Stop-and-wait Protocol, Sliding Window Protocols, Go-Back-N protocol; LAN Protocols: IEEE protocol; Frame Relay; Cell Relay and ATM. **Network Layer:** Routing, Congestion Control, QoS, Internetworking; Routing Algorithms: Distance Vector Routing, Link State; IP Addressing: IPV4 & IPV6, Firewalls, Frame Relay; Cell Relay and ATM. **Transport Layer:** Connection Management, Multiplexing, Segmentation and Reassembly Host- to-Host Flow Control, Acknowledge and Error Control; Transport Protocol: Connection-oriented TCP and Connection-less UDP.	15	CO3
4	**Session Layer** Logical Session Management, QoS, Token Management; Synchronization; Event Management; Exception Handling. **Presentation Layer:** Data Presentation, Compression and Encryption; Data Compression: Text, Image, Audio and Video; Cryptography; Symmetric and Asymmetric Encryption; Private Key and Public Key Encryption. **Application Layer:** HTTP, HTTPS, Internet Browser, FTP, Telnet, DNS, Email System.	15	CO4

Suggested Readings

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

Online Resources

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

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

Program	Bachelor of Computer Applications				
Year	II	Semester		III	
Course Name	Numerical & Statistical Methods				
Code	BCAN13204				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	0	0	3
Course Objectives	The main objective of this course is to understand the various concepts of numerical analysis and statistics , Analysis of Statistical Data: Frequency distribution; Frequency curve and histogram.				
Course Outcomes					
CO1	Compute the error estimates for the numerical methods. Apply numerical methods to find the solution of equations using different methods.				
CO2	To understand various interpolation methods and finite difference concepts.				
CO3	Able to understand numerical differentiation and integration whenever applicable and differential equations using an appropriate numerical method.				
CO4	To Understand the basic knowledge on data collection and various statistical elementary tools.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Errors and Floating Point Numbers: Errors in numerical computation:** Sources of Errors, Types of Errors; Representation of Floating point numbers: Arithmetic operations on Floating Point numbers, Normalization of Floating Point numbers, Pitfalls of Floating Point representation. **Solution of Non Linear equations:** Zero's of Single transcendental equations and zero's of polynomial: Bisection Method, Iteration or Successive Approximation Method, Regula-Falsi or False Position Method, Newton Rapson Method; Rate of Convergence of iterative Methods.	12	CO1
2	**Solutions of Simultaneous Linear equations: Solution of System of Linear equation using Direct Method and pivoting:** Gauss Elimination Method, Gauss Jordan Method, Matrix Invasion Method, ILL Conditioned System of Equations; **Solution of System of Linear equation using Iterative Method:** Gauss Jacobi iterative method, Gauss Seidel iterative method. **Interpolation and Approximations:** Finite Difference; Difference Tables; **Polynomial Interpolation for equal intervals:** Newton's Forward and Backward, **Central Difference Formulas:** Gauss Forward and Backward Formulas, Sterling's and Bessel's Formula; **Polynomial Interpolation for Unequal intervals:** Lagrange's Interpolation Formula, Newton divided difference Formula.	12	CO2
3	**Numerical Differentiation and Integration: Numerical Differentiation of Polynomial Interpolation:** Newton's Formulae, Central Difference Formulae; **Numerical Integration:** Trapezoidal Rule, Simpson's Rule. **Solution of Ordinary Differential Equation: Introduction and Methods of Ordinary Differential Equation:** Picard's Method, Euler's Method, Runge-kutta Method.	12	CO3
4	**Curve Fitting:** Curve Fitting using Method of Least Squares: Fitting of Straight Line, Fitting of Polynomial, Fitting of Exponential Curves etc. **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.	12	CO4

Suggested Readings

1. S.S. Shastri., “Numerical Analysis”, PHI.
2. E -Balaguruswami, “Numerical Methods”, TMH Publications.
3. S. P. Gupta, “Statistical Methods”, Sultan and Sons.
4. V. Rajaraman, “Computer Oriented Numerical Methods”, PHI.
5. P. Kandasamy, “Numerical Methods”, S. Chand Publications. Online Resources

Online Resources

1. https://archive.nptel.ac.in/courses/111/107/111107105/
2. http://digimat.in/nptel/courses/video/111105038/L01.html

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

Program	Bachelor of Computer Applications				
Year	II	**Semester**	III		
Course Name	Artificial intelligence				
Code	BCAN13211				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre - Requisite		3	1	0	4
Course Objectives	To introduce the fundamental concepts of artificial intelligence and to equip students with the knowledge and skills in logic. Also to explore the different paradigms in knowledge representation and reasoning and to evaluate the effectiveness of hybridization of different artificial intelligence techniques.				
Course Outcomes					
CO1	To understand the history, development and various applications of artificial intelligence.				
CO2	To understand the concept of searching and different searching techniques in AI.				
CO3	Learn the knowledge representation and reasoning techniques familiarize with propositional and predicate logic and their roles in logic and handling inconsistency.				
CO4	To understand different learning concepts in AI.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to AI**: Definition, Scope of AI, General Issues and Overview of AI, AI Techniques, AI Problems; **Intelligent Agents**: Definition, Types of agents: Rational, Simple Reflex based, Model-Based, Goal-Based and Utility Based Agent;, **Agent's Environment:** Types of Environment, Overview of **Problem Solving Techniques;** Defining the problem as a State Space Search(in detail), Issues in defining problems solving rules**, Production System**: Components of Production System, Search Space Control Strategies	15	CO1
2	**Search Algorithms:** introduction, Role of search algorithms in A; **Types of Search Algorithm: Uninformed Search**: Breadth-first search (steps with example), Depth-First Search (steps with example); **Informed /Heuristic Search:** Hill Climbing Search and its variations, Best-First Search, A* Search, AO* Search, Branch and Bound, Problem Reduction, Constraint Satisfaction.	15	CO2
3	**Knowledge Representation**: Predicate Logic: Unification, Modus Ponens, Declarative and Procedural Representation, Rule Based Systems, Structured Knowledge Representation: Semantic Nets, Slots, Exceptions and Default Frames, Conceptual Dependency, Handling **Inconsistent and Incomplete Knowledge:** Truth Maintenance Systems, Reasoning Techniques, Concept of Uncertainty, Bayes' Theorem	15	CO3
4	**Learning:** Forms of learning: Learning from observations, Inductive learning, Learning decision trees, Ensemble learning; **Knowledge in learning** – Logical formulation of learning – Explanation based learning – Learning using relevant information – Inductive logic programming, Statistical learning methods, Learning with complete data, Learning with hidden variable, Instance based learning**.**	15	CO4

Suggested Readings:

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach” (2nd ed.), Pearson Education.
2. Elaine Rich and Kelvin Knight, “Artificial Intelligence”, Tata McGraw Hill.
3. Eugene Charniak and Drew McDermott, “Introduction to Artificial Intelligence”, Pearson Education.
4. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Prentice Hall of India.

Online Resources

1. https://nptel.ac.in/courses/106105077
2. http://www.digimat.in/nptel/courses/video/106106126/L01.html

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

Program	Bachelor of Computer Applications				
Year	II	**Semester**	III		
Course Name	CLOUD COMPUTING				
Code	BCAN13212				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of this subject is to introduce the basic concept, types and characteristics of cloud computing with architecture and service models, familiarize the concepts Virtualization and its types in cloud computing and learn fundamental concepts and architecture of cloud computing security.				
Course Outcomes					
CO1	To understand basic concepts, principles and paradigm of Cloud Computing.				
CO2	To interpret various Cloud computing models and services.				
CO3	To identify the significance of implementing virtualization techniques.				
CO4	To understand the need of security in Cloud computing.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Cloud Computing Basics:** History of Cloud Computing, Need for Cloud computing, Advantages and Possible Disadvantages of cloud computing; **Cloud Characteristics:** On-demand service, pay as per usage pricing, elasticity, resource pooling, scalability Grid vs Parallel Computing, Challenges of Cloud Computing, Impact of cloud computing: Business perspective.	15	CO1
2	**Cloud Deployment Models:** Public, Private, Hybrid, Community, Other deployment Models; **Cloud Architecture:** Layered, NIST Cloud Computing Reference architecture**; Cloud Services:** Types of Cloud services: Software as a Service-Platform as a Service –Infrastructure as a Service, Hypervisor, Type 1 and Type 2.	15	CO2
3	**Virtualization for Cloud:** Need for Virtualization – Pros and cons of Virtualization, Software Virtualization, Memory Virtualization, Storage Virtualization, Server Virtualization and Network Virtualization; **Types of Hardware Virtualization:** Full, Partial and Para, Virtualization. **Cloud Service Providers:** Google Cloud, Microsoft Azure, and Amazon Web Services (AWS).	15	CO3
4	**Overview of Cloud Security:** Introduction to Cloud Security, **Cloud Security Fundamentals:** Confidentiality, Integrity, Authenticity, Availability, Threat, Vulnerability, Risk, Cloud Security Threats. Security Governance, Security Standards, Introduction to Green Cloud; **Securing Data:** Encryption, Hashing, Digital Signature, Identity and Access Control.	15	CO4

Suggested Readings

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

Online Resources

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

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

Program	Bachelor of Computer Applications				
Year	II	**Semester**	III		
Course Name	Programming with java Lab				
Code	BCAN13251				
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. Implementation of a simple Java Program, Interpreting & Compiling. 2. Implementation of control, such as Loops etc. 3. Implementation of Single and Multidimensional Array. 4. Implementation of String class and String Operations. 5. Implementation of Classes and Objects. 6. Implementation of Method in Java. 7. Implementation of Constructor overloading. 8. Implementation of Access Modifier. 9. Implementation of static and this keyword. Note: - Students will also perform all other exercises provided by course instructor.	30	CO1
2	1. Implementation of Inheritance in Java 2. Implementation of Super Keyword. 3. Implementation of Abstract class and final Keyword. 4. Defining and Importing Packages. 5. Defining and Implementing Interface. 6. Implementation of I/O Stream. 7. Implementation of Exception Handling 8. Handling of Multiple Threads. 9. Implementation of AWT Control. 10. Implementation of Event Handling. Note: - Students will also perform all other exercises provided by course instructor.	30	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	1	2	1	2		2	2	1	3	2	2

Program	Bachelor of Computer Applications				
Year	II	**Semester**	III		
Course Name	Data Structure Using C Lab				
Code	BCAN13252				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
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	Ability to implement linear and non-linear data structure operations using C programs				
CO2	Ability to implement sorting and searching algorithms using relevant data structures				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Array implementation of Stack. 2. Array implementation of Queue. 3. Array implementation of Circular Queue. 4. Array implementation of Linked List. 5. Implementation of Stack using dynamic memory allocation. 6. Implementation of Queue using dynamic memory allocation. 7. Implementation of Circular Queue using dynamic memory allocation. 8. Implementation of Linked List using dynamic memory allocation. **Note:** Students will also perform all other exercises provided by course instructor	30	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	30	CO2

Suggested Readings

1. Y. Langsam, M. Augenstin and A. Tannenbaum, “Data Structures using C and C++”, Pearson Education Asia, 2nd Edition.
2. Ellis Horowitz, S. Sahni, D. Mehta, “Fundamentals of Data Structures in C++”, Galgotia Book Source, New Delhi.
3. S. Lipschutz, “Data structures”, Mc-Graw-Hill International Editions.

Online Resources

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

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

FOURTH SEMESTER

Program	Bachelor of Computer Applications				
Year	II	**Semester**	IV		
Course Name	Python Programming				
Code	BCAN14201				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This subject provides in-depth knowledge of developing and debugging Python Programs using core data structures like Lists, Dictionaries, Tuples, and Strings as well as understand the concept of functions, modules and NumPy Library.				
Course Outcomes					
CO1	To Acquire programming skills in core Python using various programming constructs				
CO2	To Implement Python programs using functions and strings.				
CO3	To Implement methods to create and manipulate lists, tuples, and dictionaries.				
CO4	For Implementation of Python Library: NumPy.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Overview of programming**: structure of a python program, elements of python; **Introduction to python**: python interpreter, using python as calculator, python shell, indentation. Atoms, identifiers and keywords, Comments, literals, strings, operators, Creating python programs: input and output statements; control statements (branching, looping, conditional statement, exit function, difference between break, continue and pass); errors and exceptions; Iteration and recursion: conditional execution, alternative execution, nested conditionals, the return statement.	15	CO1
2	**Conditional and Looping Construct, Functions**: if - else statement and nested if – else while, for, use of range function in for, Nested loops, break, continue, pass statement, Use of compound expression in conditional constructs; Module(Importing entire module or selected objects using from statement), Functions from math, random, time & date module, Defining and invoking functions: Built-In Function, user defined function, default arguments, passing parameters (default parameter values, keyword arguments); Scope of variables, void functions and functions returning values.	15	CO2

3	**Strings**: Introduction to String, working with Text, Creating Strings of Characters, Using Special Characters in Strings, creating a Multiline String, String functions concepts & their use; String operators: +, *, in, not in, range, indexing, slicing; String built-in functions & methods: len, capitalize, find, isalnum, isalpha, isdigit, lower, islower, isupper, upper, lstrip, rstrip, isspace, istitle, partition, replace, join, split, count, decode, encode, swap case, Strings constants; **Lists, Tuples**: Concept of mutable lists, creating, initializing and accessing the elements of list, List operations (Concatenation, Repetition, Membership, slicing); List comprehensions, List functions & methods: len, insert, append, extend, sort, remove, reverse, pop, Immutable concept, creating, initializing and accessing the elements in a tuple; Tuple functions.	15	CO3
4	**Sets and Dictionaries**: Concept of Sets, creating, initializing and accessing the elements of sets, Concept of key-value pair, creating, initializing and accessing the elements in a dictionary, Traversing, appending, updating and deleting elements;**Introduction of NumPy**: Installing NumPy, Array creation and printing Array ndim, shape, size, dtype, itemsize and data.	15	CO4

Suggested Readings

1. Kenneth A. Lambert, the Fundamentals of Python: First Programs, Cengage Learning, ISBN: 978-1111822705.
2. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
3. NumPy for Beginners: first Step to Learn to Data Science – Preeti Saraswat.
4. David Beazley, Brian K. Jones "Python Cookbook". O'Reilly Publications.

Online Resources

1. https://nptel.ac.in/courses/106106145

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				
Year	II	**Semester**	IV		
Course Name	.Net Framework & C#				
Code	BCAN14202				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The Subject provides the Fundamental Concepts of Windows Desktop Application and Website Development with machine learning and data science through .Net framework and C#.				
Course Outcomes					
CO1	To develop an understanding of .Net technology using C# and Asp.net.				
CO2	To understand the Database Connectivity.				
CO3	To develop an understanding of Static and Dynamic web pages.				
CO4	To understanding API, REST, SOAP and AJAX				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**.Net Framework:** Introduction and Origin of .Net technology; Framework Components, Common Language Runtime (CLR) and FCL; Managed and Unmanaged Code; Common Type System (CTS) & Common Language Specification (CLS); Microsoft Intermediate Language (MSIL) and Metadata; Just-In-Time Compilation (JIT); Garbage Collection; Base Classes andMs.Net Namespaces. **Object and Classes:** Properties (Read, Write), Indexers, Inheritance (Multilevel and Hierarchical), Constructor Polymorphism (Runtime, Compile Time), Operator Overloading, Interfaces, Delegates and Events, Boxing and Un-boxing.	15	CO1
2	**C# Basics: Introduction and Evolution of C#,** Types, Identifiers, Tokens, Literals, Type Conversion and Casting, Operators, Data Structures in C#: Enum, Arrays, ArrayList, Strings; Control Statements and Looping: If Statement, Switch Statement, For Loop, While Loop, Do While Loop, For each Loop; **C# Libraries and Assemblies:** Input-output (Streams Classes); Multithreading; Networking and Sockets; Managing Console I/O Operations; .NET Assemblies: Type of Assemblies, GAC(Global Assembly Cache), Concept of Strong Names.	15	CO2
3	**Windows and Website Development:** Windows Forms (A Skeletal Form Based Windows Program, Remoting: Server Activated Object, Client Activated Object; Marshalling: Marshal by value, Marshal by reference; Debugging, Exceptions and Error Handling; ASP.NET Web Form Controls: User controls and Server Controls; Web Services: UDDI, DISCO, WSDL; ADO.NET: Architecture, Difference between Dataset and data Reader, Connection and Command Object; Distributed applications; Reflection; Globalization and Localization; Authentication and Authorizations; XML in .NET.	15	CO3
4	**Advanced Concepts:** REST AND SOAP: Rest, Restful, Soap, WCF, **WPF**, Implementation of Rest and Soap, Restful Vs Soap. Web server: web server, types, web server used in .net; **Ajax Controls**: AJAX and need for AJAX, Implement with JavaScript, ASP.NET AJAX – Update Panel, Update Progress etc., ASP.NET Ajax Control toolkit, Client-side Template Rendering–Data View control.	15	CO4

Suggested Readings

1. Balagurusamy," Programming. with C#", Tata McGraw Hill Publication.
2. Stephen C. Perry, Atul Kahae, Stephen Walther, Joseph Mayo," Essential of .NET and Related Technologies with a focus on C#, XML, ASP.net and ADO.net", Pearson.
3. Joseph Albahari, "C# 8.0 Pocket Reference", O'Reilly.

Online Resources

1. https://archive.nptel.ac.in/courses/605/607/608/609
2. https://archive.nptel.ac.in/courses/703/704/705/706

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

Program	Bachelor of Computer Applications				
Year	II	Semester		IV	
Course Name	Basics of Design & Analysis of Algorithms				
Code	BCAN14203				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	0	0	3
Course Objectives	To know the importance of studying the complexity of a given algorithm and various design techniques. Utilizing data structures and/or algorithmic design techniques in solving new problems. Understanding basic computability concepts and the complexity.				
Course Outcomes					
CO1	Able to Argue the correctness of algorithms using inductive proofs and analyze worst-case running times of algorithms using asymptotic analysis.				
CO2	Able to explain important algorithmic design paradigms (divide-and-conquer, greedy method) and apply when an algorithmic design situation calls for it.				
CO3	Able to explain important algorithmic design paradigms (dynamic-programming and Backtracking) and apply when an algorithmic design situation calls for it.				
CO4	Able to Explain the major graph algorithms and Employ graphs to model engineering problems, when appropriate.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basic Concepts of Algorithms**: Definition of algorithm; Characteristic of algorithm; Pseudo Codes & Time Complexity of Basic Control Structures; Time and Space Complexity of Insertion Sort; Selection Sort; Heap Sort; Bubble Sort; Asymptotic Notations (Growth of Functions).	12	CO1
2	**Divide and conquer**: Binary Search, Maximum & Minimum, Merge Sort, Quick Sort, Strassen's matrix multiplication; **Greedy Method**: General method, Knapsack Problem, Travelling Salesman problem, Job Sequencing with deadline, Optimal Storage on tapes, Huffman Codes, An Activity Selection Problem.	12	CO2
3	**Dynamic Programming**: Assembly Line Scheduling, Matrix Chain Multiplications, Longest Common Subsequence; **Backtracking**: General method, N Queens Problem, Sum of subsets, Hamiltonian Circuit Problem.	12	CO3
4	**Branch & Bound**: Introduction, Live Node, Dead Node and Bounding Functions, Knapsack Problem, Assignment Problem; **Analysis of Graph Algorithms**: Elementary Graph Algorithms, Multistage Graphs, Minimum Spanning Trees: Kruskal's & Prim's Algorithm, Single Source Shortest Path: Dijkstra's & Bellman Ford.	12	CO4

Suggested Readings

1. Thomas H. Coremen, "Introduction to Algorithms", MIT Press.
2. Horowitz & Sahani, "Fundamentals of Algorithms", Galgotia Publications.
3. Aho, Ullman, "Design & Analysis of Computer Algorithms", Pearson.
4. Johnsonbaugh, "Algorithms", Pearson.
5. Bressard, "Fundamentals of Algorithms", PHI.

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106131/.
2. ttps://onlinecourses.nptel.ac.in/noc19_cs47/preview

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

Program	Bachelor of Computer Applications				
Year	II	Semester	IV		
Course Name	Data Mining				
Code	BCAN14211				
Course Type	GE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	This course provides an in-depth exploration of data mining and data warehousing techniques, methodologies, and applications. Students will learn how to extract valuable insights from large datasets, design and implement data warehouses, and apply data mining algorithms for knowledge discovery.				
Course Outcomes					
CO1	To understand the basic concept Data Warehousing and Data Mining				
CO2	To understand the concept of preprocessing, OLAP and Frequent pattern Mining				
CO3	To understand the concept of Classification				
CO4	To understand the concept of Clustering				

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

Suggested Readings

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

Online Resources

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

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

Program	Bachelor of Computer Applications				
Year	II	**Semester**	IV		
Course Name	IOT & Technology				
Code	BCAN14212				
Course Type	GE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
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.	15	CO1
2	**Hardware for IoT:** Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology; **Embedded Platforms for IoT:** Embedded computing basics, Overview of IoT supported Hardware platforms such as Arduino, Net Arduino, and Raspberry pi.	15	CO2
3	**Wireless Technologies for IoT:** IEEE 802.15.4, Bluetooth, Wi-Fi, Zigbee, RFID, HART, LoRaWAN, NFCZ-Wave, Z-Wave; **IP Based Protocols for IoT:** IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.	15	CO3
4	**Overview of IoT Security:** Introduction Securing the Internet of Things, Architecture, Requirements, Security Protocols for IoT Access Networks, Attack, Defense, and Network Robustness of Internet of Things; **Case Studies/Industrial Applications:** Home Automation, Smart Cities, Smart Parking, Agriculture and Health Sector, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	15	CO4

Suggested Readings

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy “Introduction to IoT” Cambridge University Press; 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				
Year	II	Semester		IV	
CourseName	E Commerce				
Code	BCAN14221				
CourseType	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To provide students with an overview and understanding of E-Commerce with a specific emphasis on Internet Marketing and explore the major issues associated with E-Commerce, security, privacy, intellectual property rights, authentication, encryption, acceptable use policies, and legal liabilities. The evolving role of new highly portable, place-aware, always-with-your personal devices in E-Commerce.				

Course Outcomes	
CO1	To Understand the nature and trends in E-Commerce and Mobile commerce
CO2	To Recognize the business impact and potential of E-Commerce
CO3	To Explain the technologies required to make E-Commerce viable
CO4	To Obtain thorough understanding about the security issues, threats and challenges of E-Commerce

Module	CourseContents	Contact Hrs.	Mapped CO
1	**Introduction of E-Commerce:** Introduction to Electronic Commerce: E-commerce, Traditional Commerce vs. Ecommerce, Advantages and Disadvantages of E-commerce, Impact of E-commerce, Classification of E-commerce, Applications of E- commerce, Limitations of E-commerce, Emerging Trends in E-commerce, Electronic Commerce Business Models: Native Content based Model, Transplanted Content Model, Native Transaction Model, Transplanted Transaction Models.	15	CO1
2	**E-Commerce Framework and Business Security:** Architectural Framework of Electronic Commerce, Network Infrastructure, Information Distribution Technology, Networked Multimedia Content Publishing Technology, Security and Encryption, Payment Services, Business Service Infrastructure, Public Policy and Legal Infrastructure, Vulnerability of Information on Internet: Security Policy, Procedures and Practices, Site Security, Protecting the Network, Firewalls.	15	CO2
3	**Electronic Commerce Network Security & Payment System**: Transaction Security, Cryptology, Digital Signatures, Electronic Mail Security, and Security Protocols for Web Commerce, Electronic Payment System. Introduction to Payment Systems: Online Payment Systems, Pre-Paid Electronic Payment Systems, Postpaid, E-Security: Information system Security, Security on the Internet, E-Business Risk Management Issues Information Security Environment in India. Legal and Ethical Issues :Cyber talking-Privacy is at Risk in the Internet Age, Phishing, Application Fraud , Skimming , Copyright-Internet Gambling , Threats to Children.	15	CO3
4	**Mobile Commerce:** Introduction and Applications, Mobile Commerce, Benefits of Mobile Commerce, Impediments in Mobile Commerce, Mobile Commerce Payment Systems, Mobile Commerce Applications, Case Study: Future of E-commerce in India, Flipkart: Journey of E- Commerce Start-Up.	15	CO4

Suggested Reading

1. Bharat Bhaskar, “Electronic Commerce: Framework, Technologies & Applications”, TMH
2. David Whiteley, “E-Commerce Strategy, Technologies and Applications”, Tata McGraw Hill
3. Ravi Kalakota, Andrew Winston, “Frontiers of Electronic Commerce”, AddisonWesley
4. Bajaj and Nag, “E-Commerce: The Cutting Edge of Business”, Tata McGraw Hill
5. P. T. Joseph, “E-Commerce: An Indian Perspective”, PHI Learning Pvt. Ltd.

Online Resources:

1. https://onlinecourses.swayam2.ac.in/cec19_cm01/preview
2. https://onlinecourses.swayam2.ac.in/nou21_cm14/preview

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

Program	Bachelor of Computer Applications				
Year	II	**Semester**	IV		
Course Name	E-Governance				
Code	BCAN14222				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		**3**	**1**	**0**	**4**
Course Objectives	The course aims to provide students with the comprehensive understanding of the concept of E-Governance and to know different e-governance models and infrastructure development. The use data warehousing and mining in e-governance and to understand the role of E Governance in various sectors.				
Course Outcomes					
CO1	To understand the principles of E-Governance and its model.				
CO2	To develop skills to critically evaluate E-readiness and strategies				
CO3	To understand the applications in Data Mining.				
CO4	To educate E-Governance with its use cases in various sectors.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Overview of E-Governance and its Models:** Introduction to E-Governance, Needs of E-Governance, Issues in E-Governance Applications and Digital Divide; Evolution of E-Governance, its scope and content; Present global trends of growth in E-Governance; **Evolution in E-Governance and Maturity Levels**: Five Maturity Levels; Characteristics of Maturity Levels; Key areas.	**15**	**CO1**
2	**E-Governance Infrastructure, Strategies:** E-Government Models; E-readiness; Digital System Infrastructure, Legal Infrastructural Preparedness, Institutional Infrastructural Preparedness, Human Infrastructural Preparedness, Technological Infrastructural Preparedness; Evolutionary Stagesin E-Governance.	**15**	**CO2**
3	**Data Warehousing and Data Mining in Government:** Features of Data Warehouse and data Mining; **Significance of Data Warehouse:** Census Data, Prices of Essential Commodities; **Other areas for Data Warehousing and Data Mining:** Agriculture, Rural Development, Health, Planning, Education, Commerce and Trade, Other Sectors.	**15**	**CO3**

4	**Case Studies of E-Governance in Indian perspective NICNET:** Role of Nationwide Networking in E-Governance, Smart Nagarpalika-Computerization of Urban Local Bodies (Municipalities, EkalSeva Kendra, Aadhar,E-Suvidha, Bhulekh).	**15**	**CO4**

Suggested Readings

1. C.S.R. Prabhu, "E-Governance: Concepts and Case Studies", Prentice-Hall of India Private Limited.
2. N. Gopalsamy, "Information Technology & e-Governance", New Age Publication, First Edition.
3. Backus, Michael, "e-Governance in Developing Countries", IICD Research Brief.
4. SubhashBhatnagar, "Unlocking E-Government Potential: Concepts, Cases and Practice, SAGE Publications India Pvt Ltd.

OnlineResources

1. https://nptel.ac.in/courses/129106001
2. http://acl.digimat.in/nptel/courses/video/106106093/L32.html

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		1			2	1	1
CO2	1	1	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				
Year	II	**Semester**		IV	
CourseName	Enterprise Resource Planning				
Code	BCAN14223				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To present the fundamental concepts of ERP. To provide a contemporary approach towards ERP systems and integrating business process across functional areas. To make the students aware regarding the need and importance of ERP in today's scenario. To train the students to develop the basic understanding of how ERP enriches the business organizations in achieving a multidimensional growth. To develop understandings about the concept like e-ERP, e-CRM, e-SCM.				
Course Outcomes					
CO1	Able to Introduce ERP system, its structural representation, evolution along with MRP, MIS, EIS, DSS, DWDM.				
CO2	Able to classify ERP business models, their working and Introduction to BPR, SCM and CRM**.**				
CO3	Able to identify various ERP modules and Implementation of different phases, life cycle, methodologies of ERP.				
CO4	To understand Interdependence of ERP and E-Commerce. Concept of ERP markets, role of vendors and Consultants in ERP Implementation.				

Module	**CourseContents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction:** Basic Concept of ERP System; Enterprise – An overview, Need of ERP; Structure of ERP; Common Misconception about ERP; Benefits & Risk of ERP. **Evolution of ERP:** Concept of Material Requirement Planning (MRP), Manufacturing Resource Planning (MRP II); Related Technologies: MIS (Management Information System), EIS (Executive Information System), DSS (Decision Support System), Role and Importance of Data Warehouse and Data Mining in ERP.	15	CO1
2	**ERP Business Modelling:** Building the Business Model, Role of Consultants, Vendors and Users – Customization – Precautions – ERP: Post-implementation Options – ERP Implementation Methodology – Guidelines for ERP Implementation. **Introduction to BPR, SCM and CRM Energy:** Business Process Reengineering: ERP and BPR, Supply Chain Management (SCM): Evolution, Components, and Characteristics of SCM, ERP and SCM; Role and Need of CRM, Integration of ERP, SCM and CRM.	15	CO2
3	**ERP Modules:** Introduction, Finance, Production, Marketing, Quality Management, Logistics, Material Management, Integration of ERP, Supply chain and Customer Relationship Application.**ERP Implementation:** Implementation challenges, ERP implementation, Strategies**,** ERP Implementation Lifecycle, Implementation Methodologies, ERP project teams, vendors, consultants, Dealing with employee resistance, training and education, data migration, Project monitoring and management,	15	CO3

	Post implementation activities.		
4	**ERP Market:** ERP market place, Market Place Dynamics, SAP, BANN, JD Edwards, PeopleSoft, Oracle, Just in Time, Make-To-Order, Make- To-Stock.**Future Directions Different Roles in ERP Implementation:** Role, Need, Evaluation Criteria for Vendors, Role and Need of ERP Consultants, Role of End Users, ERP and E-commerce, Future Directions in ERP, Concept of e-ERP, e-CRM, e-SCM	15	CO4

Suggested Readings-

1. Alexis Leon, "Enterprise Resource Planning Demystified", Tata McGraw-Hill Publishing Company Ltd.
2. Vinod Kumar Garg and N.K. Venkitakrishnan, "Enterprise Resource Planning– Concepts and Practice", Prentice Hall of India.
3. Rahul V. Altekar, "Enterprisewide Resource Planning", Tata McGraw Hill.
4. Mary Summer, "Enterprise Resource Planning", Pearson Education

Online Resource-

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

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

Program	Bachelor of Computer Applications				
Year	II	**Semester**	IV		
Course Name	Python Programming Lab				
Code	BCAN14251				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	It provides the practical implementation of developing and debugging Python Programs using core data structures like Lists, Dictionaries, Tuples, and Strings as well as understand the concept of functions, modules and NumPy Library.				
Course Outcomes					
CO1	Acquire programming skills in core Python using various programming constructs, functions, and strings.				
CO2	Implement methods to create and manipulate lists, tuples and dictionaries and basic introduction of NumPy.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Installing and configuring Python on windows, Linux. 2. Introduction to Variables, keywords, basics operation in python, Taking input in console. 3. Taking multiple inputs from user in Python operators' implementation 4. Displaying Output using print () function, using end parameter in print (), 5. Practical implementation of the constructs like if, else, elseif ladder. 6. Implementation of range function in for loop. 7. Implementation of Special keyword - in and is. 8. Implementation of looping constructs using for loop, range() function and examples use of enumerate, zip() function. 9. Implementation of strings in python, single quoted/double quoted/triple quoted Strings, string functions - split, trim, join, format, replace, count, find, index, rjust, ljust, center, upper, lower. Note: - Students will also perform all other exercises provided by course instructor.	30	CO1
2	1. Practical implementation of list, creation and traversal, list functions - append, insert, extend, remove, pop, clear, sort, count, index, copy. 2. Practical implementation of tuples, creation, and traversal. 3. Practical implementation of Set, creation, and traversal, set functions - add, update, remove, clear, pop, union, intersection, difference, disjoint, subset, superset. 4. Practical implementation of Dictionary, creation and traversal. 5. Practical implementation of dictionary function - get, update, keys, items, values. 6. Making module for functions and importing them different types of imports in python.	30	CO2

	7. Practical implementation of 1d array and its attributes. 8. Practical implementation of 2d array and its attributes. Note: - Students will also perform all other exercises provided by course instructor.		

Suggested Readings

1. Kenneth A. Lambert, the Fundamentals of Python: First Programs, Cengage Learning.
2. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
3. NumPy for Beginners: first Step to Learn to Data Science – Preeti Saraswat .
4. David Beazley, Brian K. Jones "Python Cookbook", 3rd Edition. O'Reilly Publications.

Online Resources

1. https://nptel.ac.in/courses/106106145
2. https://www.python.org/

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

Program	Bachelor of Computer Applications				
Year	II	**Semester**	IV		
Course Name	.NET FRAMEWORK & C# LAB				
Code	BCAN14252				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To present the fundamental concepts of Windows Desktop and Website development through Microsoft Technologies. To impart a solid foundation and develop the skill of Web Development through C# Programming. To develop the concepts of static and dynamic Web Pages and make students familiar with Client servers to learn about technology, Distributed Applications and Web Services.				
Course Outcomes					
CO1	To work on the fundamental concepts of Windows Desktop and Website development through Microsoft Technologies.				
CO2	To become able to develop the skill of Web Development through C# Programming. And develop the concepts of static and dynamic Web Pages and make the students familiar with web services.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Implementation of Decision Making and Branching Statements on Console Applications. 2. Implementation of Iterative Statements on Console Applications. 3. Implementation of Arrays and Array List on Console Applications. 4. Implementation of Boxing and Unboxing on Console Applications. 5. Implementation of Strings on Console Applications. 6. Implementation of Inheritance and Polymorphism on Console Applications. 7. Implementation of Interfaces on Console Applications. 8. Implementation of Properties and Indexers on Console Applications. **Note:** Students will also perform all other exercises provided by course instructor.	30	CO1
2	1. Implementation of Multithreading in C# 2. Implementation of private assemblies in .NET Applications. 3. Implementation of shared assemblies in .NET Applications. 4. Implementation of Server-Side Controls in asp.net. 5. Implementation of Database Connectivity in asp.Net 6. Implementation of various Data Rendering Controls in asp.Net. 7. Implementation of Web Services in ASP.Net Applications. 8. Construct the C# console application to implement the Operator Overloading. **Note:** Students will also perform all other exercises provided by course instructor.	30	CO2

Suggested Readings

1. Balagurusamy, "Programming. with C#", Tata McGraw Hill Publication.
2. Stephen C. Perry, Atul Kahae, Stephen Walther, Joseph Mayo," Essential of .NET and Related Technologies with a focus on C#, XML, ASP.net and ADO.net", Pearson.
3. Jospeh Albahari, "C# 8.0 Pocket Reference", O'Reilly.

Online Resources

1. https://archive.nptel.ac.in/courses/201/202/203/
2. https://archive.nptel.ac.in/courses/306/309/310/

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				
Year	III	Semester		V	
Course Name	Mobile Application Development				
Code	BCAN15301				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The capabilities and limitations of mobile platforms that affect application development and deployment. The technology and business trends impacting mobile application development. The characterization and architecture of mobile applications. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability.				
Course Outcomes					
CO1	To understand the basic concepts of Mobile application development				
CO2	Able to design and develop user interfaces for the Android platforms.				
CO3	Able to design and develop mobile applications using Components.				
CO4	Able to design and develop mobile applications using a chosen application development framework.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** introduction to android, history and versions of android, android API, Various mobile platforms, android architecture, android runtime, Dalvik virtual machine, features of android, introduction and installation of eclipse and ADT plugin and/or introduction and installation of android studio, requirements and installation of android SDK, SDK manager, emulator, AVD, android virtual device manager, Google play account, installing android app from google play, APK file.	15	CO1
2	**Development Environment**: Setting up Development Environment, Installing Packages using SDK Manager, Android Project Structure, Creating Hello Android App, deploy it on USB-connected Android device, setting up an Emulator, Android Tool Repository, Manifest File, Installing and Running Android - Hello App, Activity Life Cycle and its methods, Logcat, Components of an Android App: Activity, Service, Broadcast Receiver, Content Provider.	15	CO2
3	**Layout**: Linear Layout, Relative Layout, Scroll View: Vertical, Horizontal Layout, Table Layout, Frame Layout, **Views**: Text view, Edit Text, Button, Check Box, Radio Button, Image View, Grid View, Web View, Video View, Toast, Rating Bar, Seek Bar, Date Picker.	15	CO3
4	**Intent**, Types of Intents**; Fragments**: Lifecycle, Methods **Service**: Features of Service, Android platform service, Defining new service, Service Lifecycle, Permission, example of service. **Android Menu:** Option, context, popup Menu; Data persistency using SQLite.	15	CO4

Suggested Readings

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

Online Resources

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

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				
Year	III	Semester	V		
Course Name	Server Side Scripting Using PHP				
Code	BCAN15302				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of this subject is to understand about server side scripting languages, applying PHP programming principles and techniques for effective web development, developing form handling, validation and creating databases using MySQL.				
Course Outcomes					
CO1	To use different data types to design programs involving control flow and looping statements.				
CO2	To understand the concept of Strings and arrays in PHP.				
CO3	To create functions in HTML forms and handling HTML forms using PHP.				
CO4	Able to understand MYSQL database and perform insert, update and delete operations and implementing and debugging programs in PHP and MYSQL for a specific application.				

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

Suggested Readings:

1. Robin Nixon," Learning PHP, MySQL & JavaScript_ with jQuery, CSS & HTML5", O' Reilly Media.
2. Larry Ullman, "Php for the Web Visual Quickstart Guide", Peachpit Press.
3. Vikram Vaswani, "PHP: A Beginner's Guide", McGraw-Hill.
4. Larry Ullman, "PHP 5 Advanced: Visual Quickpro Guide", Peachpit Press.

Online Resources:

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

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

Program	Bachelor of Computer Applications				
Year	III	**Semester**	V		
Course Name	Software Engineering				
Code	BCAN15303				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To present the fundamental concepts of Software Engineering and to make the students aware regarding the importance of various phases in Software Development and to understand Life Cycle Models, Software design approaches and importance of testing.				
Course Outcomes					
CO1	To understand the phases of Software Development Life Cycle.				
CO2	To Prepare SRS, High Level, Low Level Design and Test Cases.				
CO3	To know about the various types Software design approaches.				
CO4	To Know how to ensure quality during software development life cycle.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to Software Engineering; Introduction to Software; Types of software; Scope and necessity of Software Engineering; Software Components and Software Characteristics; Software Crisis, Software Development Life Cycle (SDLC), **Software Life Cycle Models:** Classical Water Fall Model, Iterative Water Fall Model, Prototype Model, Agile Model, Spiral Model; Comparison of different Life Cycle Models.	15	CO1
2	**Software Requirement Analysis and Project Planning**: Requirements Analysis; Feasibility Study, Types of Feasibility Study; Software Requirements Specification (SRS), Characteristics of SRS, Components of SRS; Project Planning; **Software Cost Estimation:** Basic COCOMO, Intermediate COCOMO, Complete COCOMO.	15	CO2
3	**Software Analysis & Design:** Characteristics of good software design; Cohesion and Coupling; **Software design approaches:** Function-Oriented Software design: Structured Analysis, Data Flow Diagrams, Structured Design; Object-Oriented Software design: Key concepts of Object-Oriented Software design, Object-Oriented Vs. Function-Oriented Software design, Graphical Representation of Object-Oriented design: Introduction to UML, Use Case Diagram.	15	CO3
4	**Coding, Testing and Maintenance:** Introduction to Software Coding: Coding Standards and Guidelines, Code Walkthrough, Code Inspections; **Software Testing:** Unit Testing; Black Box Testing; White Box Testing; Integration Testing; System Testing; User Acceptance Testing; **Software Maintenance:** Need for Maintenance; Types of Software Maintenance; Software Quality Assurance (SQA), Software Quality factor specification; Software Reliability & Reliability Models; Software RE-engineering, Reverse Engineering.	15	CO4

Suggested Readings

1. R. S. Pressman, “Software Engineering: A Practitioners Approach”, McGraw Hill.
2. Rajib Mall, “Fundamentals of Software Engineering”, PHI Publication.
3. Pankaj Jalote, “Software Engineering”, Wiley.
4. Ian Somerville, “Software Engineering”, Addison Wesley.

Online Resources

1. http://www.digimat.in/nptel/courses/video/106101061/L01.html

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

Program	Bachelor of Computer Applications				
Year	III	**Semester**	V		
Course Name	Biometric Security				
Code	BCAN15321				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Enrich the knowledge of students with the understanding of biometrics and standards applied to security. Help students understand various prevalent Biometric technologies and various feature extraction techniques for biometric systems. Also, help them to understand various biometric security issues.				
Course Outcomes:					
CO1	To understand the basic concepts of Biometrics and Biometric Standards				
CO2	To understand Physiological Biometric Technologies				
CO3	To understand Behavioral and Multimodal Biometric Technologies				
CO4	To understand to evaluate the performance of a Biometric System and Security issues				

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

Suggested Readings:

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

Online Resources:

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

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		1	2	2

Program	Bachelor of Computer Applications				
Year	III	**Semester**	V		
Course Name	Blockchain Technology				
Code	BCAN15322				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To Gain a comprehensive understanding of Blockchain and Distributed Ledger Technologies, covering fundamental concepts and functionalities. Delve into Alternative Blockchains to grasp the workings of Distributed Ledger Technology beyond conventional paradigms				
Course Outcomes					
CO1	Students will learn fundamental concepts of Blockchain and Distributed Ledger Technologies				
CO2	To acquire the insights into Blockchain functionality.				
CO3	To explore Blockchain implementation through Bitcoin and Merkle Root etc.				
CO4	To get knowledge about Distributed Ledger Technology in Alternative Blockchains.				

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

Suggested Readings

1. Iyer, Kedar, et al., "Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions", McGraw-Hill Education.
2. Wattenhofer, R., "Distributed Ledger Technology: The Science of the Blockchain, Create Space Independent Publishing Platform.
3. Mark Gates, "Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money, CreateSpace Independent Publishing Platform,
4. Bahga, Vijay Madisetti, "Block chain Applications: A Hands-On Approach", Arshdeep Bahga.

Online Resources

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

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

Program	Bachelor of Computer Applications				
Year	III	**Semester**	V		
Course Name	Storage Area Network				
Code	BCAN15323				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces students to the fundamental principles, architectures, technologies, and management practices of Storage Area Networks (SANs). Students will gain hands-on experience with SAN components, protocols, and administration tools.				
Course Outcomes					
CO1	To understand the basic concept of SAN and Underlying Technologies.				
CO2	To understand the Architecture and Components of SAN.				
CO3	To understand the basic concept Storage in SAN				
CO4	To understand the network components used in SAN and Data Center Application.				

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

Suggested Readings

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

Online Resources

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

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

Program	Bachelor of Computer Applications				
Year	III	**Semester**	V		
Course Name	Machine Learning				
Code	BCAN15324				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To acquire the fundamental knowledge of Machine Learning and Convolutional Neural Networks.				
Course Outcomes					
CO1	To understand the basics of machine learning concepts.				
CO2	To learn various algorithms of machine learning.				
CO3	To learn and apply extended concepts of machine learning.				
CO4	To learn and solve the Neural Network concepts and problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Definition of Machine Learning, Key elements of Machine Learning, The origins of Machine Learning, Machine learning in practice, Design of a Learning System, Types of Machine Learning: Supervised Learning, Semi-Supervised Learning, Unsupervised Learning, Reinforcement Learning and Artificial Neural Network, Applications of Machine Learning; **Major Task in Data Pre-processing:** Cleaning, Integration, Reduction, Transformation, and discretization; **Scaling:** Types of Scaling, Normalization and Standardization.	15	CO1
2	**Supervised Learning:** Classification and Regression, Generalization, Overfitting, and Underfitting, Supervised Machine Learning Algorithms, K-Nearest Neighbors (KNN), Support Vector Machine (SVM): Working of SVM, Implementation; **Decision Tree**: Working and Implementation; **Naïve Bayes Classifier**: Introduction to Naïve Bayes Algorithm, building a model Using Naïve Bayes.	15	CO2 & CO3
3	**Unsupervised Learning:** Types of Unsupervised Learning, Introduction to Clustering, K-means Clustering Algorithm, Working and Implementation of K-means Clustering, Introduction to Hierarchical Clustering, Agglomerative Hierarchical Clustering, Density-Based Method. **Reinforcement Learning:** Overview of Reinforcement Learning, The Learning Task, Markov Decision process, Q-learning, The Q function, Algorithm for Learning Q.	15	CO2 & CO3
4	**Convolutional Neural Network:** Fundamentals of Convolutional Neural Networks, **CNN Architecture**: Convolutional Layers, Pooling Layers, Fully Connected Layer; **CNN Building Blocks:** Filters/Kernels, Strides, Padding, and Activation Functions. Training and Optimization: Loss Functions, Optimizers (SGD, Adam), and Learning Rate Schedules.	15	CO3 & CO4

Suggested Readings

1. Tom M. Mitchell, "Machine Learning", First Edition by 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/106/106/106/106/139/
2. https://archive.nptel.ac.in/courses/504/505/506/507/508/

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

Program	Bachelor of Computer Applications				
Year	III	**Semester**		V	
Course Name	Neural Network				
Code	BCAN15325				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Introduce the fundamental concepts of Neural Network. Equip students with the learning process of ANN, RNN and CNN. Students will get the basic understanding of neural network fundamentals.				
Course Outcomes					
CO1	To understand how human brain works and how ANN mimics that.				
CO2	To understand ANN architecture and perceptron.				
CO3	To understand RNN, RNN types, architecture and LSTM.				
CO4	To understand CNN, CNN architecture, its layers and learning.				

Module	**CourseContents**	**Contact Hrs.**	**Mapped CO**
1	**Biological Neural Network**: Structure and working, Artificial Neural Networks applications, Fundamentals, Characteristics, History of neural networks, characteristics of neural networks terminology; Topology of neural network architecture, Multilayer Neural Networks.	15	CO1
2	**Artificial Neural Networks (ANN)**: Artificial Neuron and its models, McCulloch-Pitts model, Perceptron, Adaline model; Neural Network Architectures, Single Layer Feedforward Network, Multilayer Feedforward Network, Recurrent Networks, Various Activation Functions; Characteristics of Neural Network; Perceptron, Single Layer Perceptron, Multi-Layer Perceptron.	15	CO2
3	**Recurrent Neural Network (RNN):** Introduction to RNN, RNN vs Feedforward Neural Network, Types Of RNN, Recurrent Neural Network Architecture, Applications of RNN in real world; Introduction to Long Short Term Memory (LSTM) LSTM Architecture, Forget gate, input gate, output gate, LSTM vs RNN.	15	CO3
4	**Convolution Neural Network (CNN)**: Introduction to CNN, CNN architecture, Working of Convolutional Layers, Layers of CNN, Merits of CNN, Demerits of CNN, Applications; Concept of Learning, Types of Learning, Learning Rules; Hebbian Learning Rule	15	CO4

Suggested Readings

1. B.Yegnanarayana, “Artificial Neural Networks”, Prentice Hall of India.
2. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications”, Prentice Hall of India
3. Siman Haykin,”Neural Netowrks”, Prentice Hall of India

Online Resources

1. https://www.youtube.com/watch?v=QlhHqMnd9Wo
2. https://www.youtube.com/watch?v=9-Zix81xwbo

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

Program	Bachelor of Computer Applications				
Year	III	**Semester**	V		
Course Name	Data Analytics				
Code	BCAN15326				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course provide in depth understanding about data Analytics, the collection of large quantities of data to discover behavior patterns and better understand their internal processes. Data analytics provide strong foundation for the learners to understand the underlying core concepts and emerging technologies in data analytics.				
Course Outcomes					
CO1	To understand the fundamental concepts of data analytics				
CO2	To recognize and conduct statistical inference to solve engineering problems.				
CO3	To appreciate the science of statistics and the scope of its potential applications				
CO4	To summarize and present data in meaningful ways				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Analytics** Evolution of Data Analytics, Data Analytics Overview, Types of Data Analytics: Descriptive Analytics, Diagnostic Analytics, Predictive Analytics and Prescriptive Analytics; Importance and Benefits of Data Analytics, Different Applications of Analytics in Business, Text Analytics and Web Analytics, Skills for Business Analytics.	15	CO1
2	**Probability and Statistical Methods:** Sample Space, Types of Events, Measures of probability, conditional probability, Bayes' theorem, Random variable, Probability Distributions- Binomial, Poisson and Normal, Sampling Distributions, Estimation and Hypothesis Testing- t-test, Analysis of variance (ANOVA) and Chi-square test, Correlation Analysis-Simple Correlation coefficient, Interpretation, Scatter plot. Linear Regression- Simple and Multiple, Polynomial Regression, Logistic Regression- with one variable and with multiple variables, Logistic Regression vs. Linear Regression.	15	CO2
3	**Data Visualization:** Introduction to data visualization, Visualization foundations, Introduction to Power BI, Power BI – Advantages and Scalable Options, Power BI Architecture and Data Access, Visualization Techniques for Spatial Data, Geospatial Data, Time-Oriented Data, Multivariate Data, Trees, Graphs, and Networks, Text and Document Visualization, Power Query & M Language	15	CO3
4	**Case Study:** Importance and types of case studies: case study of Twitter, Netflix, Uber, COVID- 19: for understanding business scenarios and how they applied the analytics to improve their decision making, cost reduction, logistics planning and other benefits.	15	CO4

Suggested Reading

1. Kumar, U.D. "Business Analytics–The Science of Data–Driven Decision Making", Wiley.
2. Johnson, R.A., Miller, I. and Freund,"Probability and Statistics for Engineers" Pearson Publication.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs45/preview
2. https://archive.nptel.ac.in/noc/courses/noc17/SEM2/noc17-mg24/

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

Program	Bachelor of Computer Applications				
Year	III	Semester	V		
Course Name	Mobile Application Development Lab				
Code	BCAN15351				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		0	0	4	2
Course Objectives	The capabilities and limitations of mobile platforms that affect application development and deployment. The technology and business trends impacting mobile application development. The characterization and architecture of mobile applications. The techniques for deploying and testing mobile applications, and for enhancing their performance and scalability.				
Course Outcomes					
CO1	To understand the basic concepts of Mobile application development Design and develop user interfaces for the Android platforms.				
CO2	Able to designing and develop mobile applications using a chosen application development framework.				

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

Suggested Readings

1. Michael Burton, Donn Felker, "Android Application Development for Dummies", DummiesPradeep Kothari, " Android Application Development (with Kitkat Support)", Kogent Learning Solutions Inc.
2. W. Frank Ableson, Robi Sen, Et. Al., " Android in Action", Manning
3. 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

Program	Bachelor of Computer Applications				
Year	III	**Semester**	V		
Course Name	Server Side Scripting Using PHP Lab				
Code	BCAN15352				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The course demonstrates an in depth understanding of the tools and server side scripting language using PHP which is necessary for design and development of web applications, developing form handling, validation and creating databases using MySQL.				
Course Outcomes					
CO1	Able to Applying the concept of loops, Conditional statements, functions, Arrays, Strings using PHP to develop interactive web pages.				
CO2	To understand the concept of HTML forms in designing web pages including form validation, error correction, and connecting the forms to database using MySQL.				

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

Suggested Readings:

1. Robin Nixon," Learning PHP, MySQL & JavaScript_ with jQuery, CSS & HTML5", O' Reilly Media.
2. Larry Ullman, "Php for the Web Visual Quickstart Guide", Peachpit Press.
3. Vikram Vaswani, "PHP: A Beginner's Guide", McGraw-Hill.
4. Larry Ullman, "PHP 5 Advanced: Visual Quickpro Guide", Peachpit Press.

Online Resources:

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

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

SIXTH SEMESTER

Program	Bachelor of Computer Applications				
Year	III	**Semester**		VI	
Course Name	Advance Computer Technologies				
Code	BCAN16301				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre -Requisite		3	1	0	4
Course Objectives	To present fundamentals of advanced technologies and cover computing processes for managing vast data. To gain an overview of NLP, its applications, and challenges. To learn text processing techniques like tokenization, stemming, lemmatization, and stop word removal.				
Course Outcomes					
CO1	To Develop the understanding of Data Science and its stream uses.				
CO2	To Develop the understanding of data compilation.				
CO3	To explore the applications of block chain in various fields such as e-governance, smart cities, smart industries, and anomaly detection.				
CO4	To develop an understanding of processing of natural language				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction of Data Science**: Definition, History of Data Science , Era of Data Science, Business Intelligence vs Data Science, Life cycle of Data Science, Tools of Data Science Data Extraction, Wrangling & Exploration, Data Analysis Pipeline; Types of Data: Raw and Processed Data, Data Wrangling, Exploratory Data Analysis; **Visualization of Data**: Introduction to Visualization, Human Perception and Information Processing; Data types: Graphical perception or information display, Color management system; **Charts and standard views**: relevance and appropriateness, Advanced and innovative tools for data visualization and advanced quantitative analysis.	15	CO1
2	**Introduction of Big Data Analytics:** Introduction, Evolution of Big data, Big data characteristics, Big Data Modelling- Hadoop Eco system; An Overview of Clustering- K-means clustering, Use Cases - Determining the Number of Clusters; Classification- Decision Trees- Decision Tree Algorithms, Evaluating a Decision Tree- Decision Trees in R, Bayes Theorem- Naive Bayes Classifier.	15	CO2
3	**Introduction of Block chain Technology:** Introduction: History, Architecture, Types of block chain, **Base technologies**: dockers, docker compose, data structures, hashes, micro-services; **Blockchain hyper ledger:** Fabric architecture, implementation, networking, fabric transactions, demonstration, smart contract ; **Applications of block chain**: e governance, smart cities, smart industries, anomaly detections, use case.	15	CO3

4	**Introduction to NLP:** Overview of NLP, Applications of NLP, Challenges in NLP; **Text Processing: Overview of** Tokenization, Stemming and Lemmatization, Stop Word Removal; **Part-of-Speech Tagging:** Understanding POS tags (Rule-based, Stochastic, and Machine Learning approaches), **Named Entity** Recognition: Introduction to different approaches of NE.	15	CO4

Suggested Readings:

1. Blum, A., Hopcroft, J., & Kannan, R. "Foundations of Data Science".
2. White, T. "Hadoop: The Definitive Guide" O'Reily Publication.
3. MC Education Services."Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data". Wiley publishers.

Online Resources:

1. https://archive.nptel.ac.in/noc/courses/noc17/ SEM2/noc17-mg24/
2. https://archive.nptel.ac.in/courses/ 106/105/106105158/

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

SEVENTH SEMESTER

Program	Bachelor of Computer Applications				
Year	IV	**Semester**	VII		
Course Name	Statistical & Optimization Techniques				
Code	BCAN17401				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course provides a holistic understanding of statistical analysis, optimization, logistics, and project management. Students will learn to interpret data, solve optimization problems, manage logistics efficiently, and plan projects effectively, preparing them for analytical roles in diverse industries.				
Course Outcomes					
CO1	Gain proficiency in basic statistical analysis and interpretation.				
CO2	To understand 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	15	CO1
2	**Linear Programming Problem**: Introduction to LPP, Components of LPP, Formulation of LPP, Graphical Solution of LPP, Slack and Surplus Variable, Basic Feasible Solution, Unbounded Solution, Optimal Solution, Simplex Method, Artificial Variables, Two-Phase Method, Big-M Method, Duality, Dual Simplex Method, Revised Simplex Method, Problem of Degeneracy.	15	CO2
3	**Transportation Problem:** Introduction, Basic Feasible Solution of TP, North-West Corner Method, Matrix Minima Method, Row Minima Method, Column Minima Method, Vogal's Approximation Method, Degeneracy in TP, Loops in TP, Optimal Solution, Unbalanced TP. **Assignment Problem:** Introduction and Application of AP, Hungarian Algorithm for AP, Unbalanced AP.	15	CO3
4	**Inventory Management:** Introduction, Types of Inventories, Costs Involved in Inventory Decisions, Economic Order Quantity (EOQ), Determination of EOQ, EOQ Model without Shortage and with Shortage, Inventory Model with Price-Break, Replacement Problem, **Job Sequencing:** Introduction, N-Jobs Two Machines, N-Jobs Three Machines, N-Jobs M Machines. **CPM and PERT:** Introduction, Application of CPM/PERT, Network Diagram, Floats, Critical Path, Project Evaluation and Review Technique (PERT).	15	CO4

Suggested Readings

1. Gillet B.E., "Introduction to Operation Research, Computer Oriented Algorithmic approach", Tata McGraw Hill 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).

Online Resources

1. http://www.digimat.in/nptel/courses/video/111105039/L21.html
2. https://www.digimat.in/nptel/courses/video/111105077/L25.html

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

Program	Bachelor of Computer Applications				
Year	IV	**Semester**		VII	
Course Name	Research Methodology				
Code	BCAN17402				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course aims to develop research aptitude skills among the learners and to enable them to prepare a research report. To identify the relevance and role of research and differentiating between different kinds of research available, data models, data handling and analysis.				
Course Outcomes					
CO1	To Understand the basic concepts of research and Outlining the significance of research and research methodology.				
CO2	To Formulate research process for solving the business related problems. To develop ability to determine qualitative and quantitative methods of collection of data and sampling				
CO3	Able to examining the concept of measurement, sampling and hypothesis testing. Reconcile various types of charts, diagrams and statistical techniques used to analyze data.				
CO4	Able to prepare and present an effective research report.				

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

Suggested Readings:

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

Online References:

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

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

Program	Bachelor of Computer Applications				
Year	IV	Semester		VII	
Course Name	Fundamentals of Data Privacy				
Code	BCAN17421				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course will examine fundamentals of data privacy include data confidentiality, data security, limitation in data collection and use, transparency in data usage, and compliance with the appropriate data privacy laws.				
Course Outcomes					
CO1	To understand the basic concept of digital age privacy concepts and theories.				
CO2	Understanding the basic concept of privacy implications of modern digital technology.				
CO3	Understanding the basic rules and frameworks for data privacy in the age of technology.				
CO4	Understanding the basic concept of various data privacy acts and IT Acts				

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

Suggested Readings:

1. Matt Bishop, “Introduction to Computer Security”, Addition Wesley.

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

Online Resources:

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

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				
Year	IV	**Semester**		VII	
Course Name	Soft Computing				
Code	BCAN17422				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The main objective of the soft computing techniques to improve data analysis solution is to strengthen the dialogue between the statistics and soft computing research communities in order to cross pollinate both fields and generate mutual improvement activities.				
Course Outcomes					
CO1	To understand how soft computing and ANN approach influences various modern developments.				
CO2	To understand learning rule and activation function.				
CO3	To understand different types of Fuzzy System used in real world.				
CO4	To understand type II fuzzy set and genetic algorithms.				

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

Suggested Readings

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications” Prentice Hall of India
2. N.P.Padhy,”Artificial Intelligence and Intelligent Systems” Oxford University Press
3. Siman Haykin,”Neural Netowrks” Prentice Hall of 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	2		1	2	3	2	2	2
CO2	2	1	2	1		2	1		1	3	2	2	2	1
CO3	2	2	2	2		2	1		2	2	2	2	2	2
CO4	2	2	3	2	2	2	1		2	2	2	2	3	3

Program	Bachelors of Computer Applications				
Year	IV	**Semester**	VII		
Course Name	Deep Learning				
Code	BCAN17423				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Machine learning	3	1	0	4
Course Objectives	The subject provides the fundamental concepts of Deep Learning and its applications in various fields as well as the training procedures for neural networks and their applications.				
Course Outcomes					
CO1	Able to understand deep learning models and how to apply.				
CO2	Able to understand the architecture of convolutional neural networks.				
CO3	Able to understand the concept of Recurrent Neural Network and their application.				
CO4	Able to understand the encoder/decoder and attention network.				

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

Suggested Readings

1. Goodfellow, Benjio Corivilli, “Deep Learning”, Mit Press.
2. Bishop, “Pattern Recognition and Machine Learning”, Springer.
3. Chollet, “Deep Learning with Python”, Manning Publications.

Online Resources

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

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

Program	Bachelor of Computer Applications				
Year	IV	Semester		VII	
Course Name	Computer Vision				
Code	BCAN17424				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces students to the fundamental concepts, techniques, and applications of computer vision. Students will learn how computers can be programmed to interpret and understand visual information from digital images and videos. Topics covered include image formation, image processing, feature extraction, object recognition, and deep learning approaches to computer vision.				
Course Outcomes					
CO1	To understand the basic principles and challenges of computer vision.				
CO2	To understand image processing techniques for image enhancement, filtering, and segmentation.				
CO3	Extract meaningful features from images for pattern recognition and object detection.				
CO4	To understand algorithms for image classification, object recognition, and scene understanding. Analyze and evaluate the performance of computer vision systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Computer Vision**, Definition and scope of computer vision, Applications of computer vision in real-world scenarios, Challenges and limitations in computer vision Image processing and low-level vision, Image sampling, interpolation, transformations Linear filters and edges, Feature extraction, Optical flow and feature tracking.	15	CO1
2	**Image**: Image Formation and Representation, Digital image fundamentals, Image formation process, Color models and color spaces, Image Processing Techniques, Image enhancement, Image filtering and convolution, Image segmentation and thresholding Grouping and fitting, Least squares fitting, robust fitting, RANSAC, Alignment, image stitching.	15	CO2
3	**Geometric vision:** Image geometric vision and formation, Camera models, Light, shading and color, Camera calibration, Epipolar geometry, Two-view and multi-view stereo, Structure from motion, Morphological operations, Point and edge detection.	15	CO3
4	**Image classification:** Recognition and beyond, Statistical learning framework, Deep learning, Object detection, Segmentation;**Deep Learning** for Computer Vision, Introduction to deep learning and neural networks	15	CO4

Suggested Readings

1. "Computer Vision: Algorithms and Applications" by Richard Szeliski.
2. "Computer Vision: A Modern Approach" by David A. Forsyth and Jean Ponce
3. "Deep Learning for Computer Vision" by Rajalingappaa Shanmugamani.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105216/

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

Program	Bachelor of Computer Applications				
Year	IV	**Semester**	VII		
Course Name	Natural Language Processing				
Code	BCAN17425				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Artificial Intelligence and Automata	3	1	0	4
Course Objectives	To understand the algorithms available for the processing of linguistic information and computational properties of natural languages. To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks. To familiarize various NLP software libraries and data sets publicly available. To develop systems for various NLP problems with moderate complexity. To learn various strategies for NLP system evaluation and error analysis.				
Course Outcomes					
CO1	Introduce the basic concepts of NLP, its applications, syntax, semantics, discourse & pragmatics of natural language.				
CO2	Demonstrate the understanding of Language Modeling and Neural Networks Basics.				
CO3	Discover the linguistic and statistical features relevance to the basic NLP task in context to parts-of-speech tagging.				
CO4	Understanding of parsing and semantic analysis.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to NLP**: NLP – introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model; Concepts of Parts-of-speech and Formal Grammar of English.	15	CO1
2	**Language Modeling:** N-gram and Neural Language Models Language Modeling with N-gram, Simple N-gram models, Smoothing (basic techniques), Evaluating language models; Neural Network basics, Training; Neural Language Model, application of neural language model in NLP system development.	15	CO2
3	**Parts-of-speech Tagging:** Basic concepts; Tagset; Early approaches: Rule based and TBL; POS tagging using HMM, Introduction to POS Tagging using Neural Model.	15	CO3
4	**Parsing**: Basic concepts: top down and bottom up parsing, tree bank; Syntactic parsing: CKY parsing; Statistical Parsing basics: Probabilistic Context Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs. **Semantics**: Vector Semantics; Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis; Embeddings from prediction: Skip-gram and CBOW; Concept of Word Sense; Introduction to WordNet	15	CO4

Suggested Readings:

1. Jurafsky D. and Martin J. H., “Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Upper Saddle River, NJ: Prentice-Hall.
2. Yoav G., “A Primer on Neural Network Models for Natural Language Processing”, AI Access Foundation
3. Vajjala S., Gupta A. and Surana H., “Practical Natural Language Processing”, O’Reilly.

Online Resources

1. https://elearn.nptel.ac.in/shop/nptel/applied-natural-language-processing/?v=c86ee0d9d7ed
2. https://www.coursera.org/learn/machine-learning-and-nlp-basics

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

Program	Bachelor of Computer Applications				
Year	IV	**Semester**		VII	
Course Name	Human Computer Interaction				
Code	BCAN17426				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Understand the fundamentals of Human computer interaction. Develop user empathy and preferences through user research, design principles of interactive systems that are usable, efficient, and satisfying for users. The skills to design user interfaces, interaction patterns, and visual design. Explore emerging trends and technologies in Human computer interaction, student to think constructively and analytically about how to design and evaluate interactive technologies				
Course Outcomes					
CO1	To understand and analyze the common methods in the user cantered design process and the appropriateness of individual methods for a given problem.				
CO2	To apply, adapt and extend classic design standards, guidelines, and patterns.				
CO3	To employ selected design methods and evaluation methods at a basic level of competence. Build prototypes at varying levels of fidelity, from paper prototypes to functional, interactive prototypes.				
CO4	To demonstrate sufficient theory of human computer interaction, experimental methodology and inferential statistics to engage with the contemporary research literature in interface technology and design.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Importance of user Interface definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface popularity of graphics; **concept of direct manipulation**: graphical system, Characteristics, Web user, Interface popularity, Principles of user interface.	15	CO1
2	**Design process:** Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions. **Screen Designing:** Design goals, Screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow,	15	CO2
3	**Visually pleasing composition**: amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics, Technological consideration in interface design. **Windows:** New and Navigation schemes selection of window, selection of devices based and screen-based controls. Components, text and messages, Icons and increases multimedia, colors, uses problems, choosing colors.	15	CO3
4	**HCI in the software process**: The software life cycle, Usability engineering, Iterative design, and prototyping Design; Focus prototyping in practice design rationale; Design rules; principles to support usability standards; Golden rules; **heuristics HCI patterns Evaluation techniques**: Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi modal interaction	15	CO4

Suggested Readings

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition Prentice Hall.
2. Jonathan Lazar Jinjuan, Heidi Feng, Harry Hochheiser, “Research Methods in Human Computer Interaction”, Wiley.
3. Ben Shneiderman, and Catherine Plaisant, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Reading, MA: Addison-Wesley Publishing Co.
4. Samit Bhattacharya, “Human-Computer Interaction: User-Centric Computing for Design”, McGraw Hill

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106177/
2. https://nptel.ac.in/courses/106103115

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

Program	Bachelor of Computer Applications				
Year	IV	**Semester**	VII		
Course Name	Statistical Package for Social Sciences(SPSS) Lab				
Code	BCAN17451				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite	MS-EXCEL	0	0	4	2
Course Objectives	To familiarize students with data analysis using a statistical software package like SPSS or any other equivalent. To provide skills for research analysis and increase employability.				
Course Outcomes					
CO1	Students' familiarity with the tool box of SPSS, Data transformation and Descriptive Statistics.				
CO2	A strong theoretical and empirical foundation in statistical analysis.				

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

Suggested Readings

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

Online Resources

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

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

EIGHTH SEMESTER

Program	Bachelor of Computer Applications				
Year	IV	Semester		VIII	
Course Name	R Programming				
Code	BCAN18401				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The objective is to provide fundamental understanding of R Programming/RStudio. Also able to understand needs and usages of graphical tools and statistical functions, correlations, and other R Programming related aspects				

Course Outcomes	
CO1	Able to understand R Programming/RStudio, commands, conditional and Iterative statements.
CO2	Able to identify and manage data Structures, Utilizing inbuilt functions and custom functions using R Programming
CO3	Able to identify and manage and implementation of Data management and data frames, reading and writing data in files.
CO4	Able to understand the implementation of statistical functions, handling data with graphical tools.

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of R Programming:** Basic fundamentals of R Programming, installation and use of Base-R/RStudio software, data editing, and use of R as a calculator, Writing R scripts in an editor, Vector and scalar, missing data and logical operators, Conditional executions and iterative statements .	15	CO1
2	**Data Structures and Functions:** Data management with sequences. Data management with repeats, sorting, ordering, and lists, Vector indexing, factors, Data management with strings, display and formatting, inbuilt function support, creating custom functions.	15	CO2
3	**Matrices and Data Frames:** Creating matrices and Data frames, Matrices and dataframe functions, slicing data frame, combining slicing with functions, data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames. Advanced Data frames manipulations, import of external data in various file formats.	15	CO3
4	**Plots and Statistical function:** Graphics and plots, Colors, plotting arguments, Scatterplot, Histogram, Barplot, pirateplot, Low level plotting functions, Saving plot to pdf, jpg, png file formats, statistical functions (linear and nonlinear modeling, classical statistical tests, time-series analysis, classification, clustering) for central tendency, variation, skewness and kurtosis, handling of bivarite data through graphics, correlations, Data persistency, Hypothesis test (T Test, Correlations Test, Chi Square Test).	15	CO4

Suggested Readings

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

Online Resources

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

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

Program	Bachelor of Computer Applications				
Year	IV	**Semester**	VIII		
CourseName	Intellectual Property Right				
Code	BCAN18402				
CourseType	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations.				
Course Outcomes					
CO1	To understand the need of intellectual property rights.				
CO2	To understand the concepts Patent and Copyrights.				
CO3	To understand the concept of Trade Mark and Design.				
CO4	To understand the Geographical indications and Plant Variety Protection.				

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

Suggested Readings

1. Neeraj, P., & Khusdeep, D. , Intellectual Property Rights. India, IN: PHI learning Private Limited.
2. B.L. Wadera, Patents, trademarks, copyright, Designs and Geographical Judications.
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				
Year	IV	**Semester**	VIII		
Course Name	R Programming Lab				
Code	BCAN18451				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The objective of this course is to provide students with a practical understanding of R Programming/RStudio. It will dive deep in managing the concept and significance of Data Management and Data Frames, and to understand need and usages of graphical tools and relevant statistical functions, correlations.				
Course Outcomes					
CO1	Able to work on RStudio and learn basics of R Programming, control & iterative, matrix, list, vector manipulations, inbuilt and custom Functions				
CO2	Able to Use data management through excel file, CSV File, Graphical tools and statistical functions.				

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

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

Suggested Readings

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

Online Resources

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

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