Vidyavardhaka Sangha®, Mysore
VIDYAVARDHAKA COLLEGE OF ENGINEERING
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(Approved by AICTE, New Delhi & Government of Karnataka)
Accredited by NBA (CV, CS, EE, EC, IS & ME) | NAAC with 'A' Grade
P.B. No. 206, Gokulam III Stage, Mysuru-570 002, Karnataka, India
Phone: +91 821 4276201 /202 /225, Fax: +91 824 2510677
Web: http://www.vvce.ac.in @vvceofficial
VVCE

Scheme of Teaching and Examination for BE (Autonomous Scheme: 2022)

V SEMESTER – Computer Science & Engineering

Sl. No.	Course Area	Course Code	Course Name	Teaching Department	Contact Hours / week			Examination				Credits
					L	T	P	Duration (Hrs.)	CIE Marks	SEE Marks	Total	
1	IPCC	BCSCN501	Computer Networks	CS	3	0	2	3	50	50	100	4
2	IPCC	BCSDO502	DevOps	CS	3	0	2	3	50	50	100	4
3	HSMS	BCSME503	Management and Entrepreneurship for IT*	CS	3	0	0	3	50	50	100	3
4	PCC	BCSAT504	Automata Theory#	CS	3	0	0	3	50	50	100	3
5	AEC	BCSXX515	Professional Elective – I	CS	3	0	0	3	50	50	100	3
8	OE	BCSXX556	Open Elective – I	CS	3	0	0	3	50	50	100	3
6	PE	BCELK557X	Career Elective-I	CS	2 0	0 0	0 4	3	50	50	100	2
7	AEC	BITTP508	Technical Proficiency Enhancement Course – III	CS	0	0	2	2	50	50	100	1
9	HS	BENSK509	Environmental Studies	CV	2	0	0	2	50	50	100	1
TOTAL					**20|22**	**0**	**6|20**	**-**	**450**	**450**	**900**	**24**

Professional Elective – I		Open Elective – I		Career Elective – I	
BCSFS515	Full Stack Development-I*	BCSAI556	Basics of Artificial Intelligence (AIML)	BCELK557X	Mini Project
BCSCR515	Cryptography	BCSDS556	Introduction to Data Structures (CSE)	BCELK557X	Research
BCSDM515	Data Mining and Data Warehousing#	BCSCN556	Introduction to Computer Networks (CSE)	BCELK557X	Add on course
BCSCG515	Computer Graphics and Visualization	BISDB556	Introduction to Database Management System (ISE)	BCELK557X	Foreign language
		BISSE556	Introduction to Software Engineering and Testing (ISE)	BCELK557X	Online Course

*common to (AI&ML/CSE/ISE), #common to (CSE/ISE), $common to (AI&ML/CSE), @common to (AI&ML/ISE)

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Scheme of Teaching and Examination for BE (Autonomous Scheme: 2022)

VI SEMESTER - Computer Science & Engineering

Sl. No.	Course Area	Course Code	Course Name	Teaching Department	Contact Hours / week			Examination				Credits
					L	T	P	Duration (Hrs.)	CIE Marks	SEE Marks	Total	
1	IPCC	BCSML601	Machine Learning	CS	3	0	2	3	50	50	100	4
2	IPCC	BCSSS602	System Software and Compiler Design	CS	3	0	2	3	50	50	100	4
3	PC	BCSBT603	Blockchain Technology	CS	3	0	0	3	50	50	100	3
5	PE	BCSXX614	Professional Elective – II	CS	3	0	0	3	50	50	100	3
6	OE	BCSXX655	Open Elective – II	CS	3	0	0	3	50	50	100	3
4	AEC	BCELK656X	Career Elective- II	CS	2 0	0 0	0 4	3	50	50	100	2
7	AEC	BITTP607	Technical Proficiency Enhancement Course-IV	CS	0	0	2	2	50	50	100	1
8	HS	BRIPK608	Research Methodology and Intellectual Property Rights	CS	1	0	0	2	50	50	100	1
9	AEC	BIKSK609	Indian Knowledge System	CS	1	0	0	2	50	50	100	1
TOTAL					**17|19**	**0**	**6|10**	**-**	**450**	**450**	**900**	**22**

*-

Professional Elective - II		Open Elective – II		Career Elective- II	
BCSFS614	Full Stack Development-II	BCIBI655	Introduction to Business Intelligence(AIML)	BCELK656X	Mini Project
BCSCS614	Cloud Computing	BCSML655	Introduction to Machine Learning(CSE)	BCELK656X	Research
BCSNS614	Network Security	BISWT655	Fundamentals of Cloud Computing(ISE)	BCELK656X	Add on course
BCSDI614	Fundamentals of Digital Image Processing	BISFS655	Introduction to Full Stack Development(ISE)	BCELK656X	Foreign language
		BISOS655	Introduction to Operating System(ISE)	BCELK656X	Online Course

*common to (AI&ML/CSE/ISE), #common to (CSE/ISE), $common to (AI&ML/CSE), @common to (AI&ML/ISE)

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Scheme of Teaching and Examination for BE (Autonomous Scheme: 2022)

VII SEMESTER – Computer Science & Engineering

Sl. No.	Course Area	Course Code	Course Name	Teaching Department	Contact Hours / week			Examination				Credits
					L	T	P	Duration (Hrs.)	CIE Marks	SEE Marks	Total	
1	IPCC	BCSST701	NoSQL Database	CS	3	0	0	3	50	50	100	4
2	PCC	BCSND702	UI/UX Design	CS	3	0	0	3	50	50	100	3
3	PE	BCSXX713	Professional Elective – III	CS	3	0	0	3	50	50	100	3
4	PE	BCSXX714	Professional Elective – IV	CS	3	0	0	3	50	50	100	3
5	PRI	BMEPR785	Major Project (Phase- I)	CS	Two contact hours/week for interaction between faculty and students			3	50	50	100	4
TOTAL					**12**	**0**	**0**	**-**	**250**	**250**	**500**	**17**

Professional Elective - III		Professional Elective – IV	
BCSBD713	Big Data Analytics	BCSSA714	Storage Area Networks
BCSCF713	Cyber Security and Forensics	BCSNL714	Natural Language Processing
BCSUD713	Computer Vision	BCSRP714	Robotic Process Automation
BCSFL713	Federated Learning	BCSGA714	Generative AI

*common to (AI&ML/CSE/ISE), #common to (CSE/ISE), $common to (AI&ML/CSE), @common to (AI&ML/ISE)

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Scheme of Teaching and Examination for BE (Autonomous Scheme: 2022)

VIII SEMESTER – COMPUTER SCIENCE & Engineering

Sl. No.	Course Area	Course Code	Course Name	Teaching Department	Contact Hours / week			Examination				Credits
					L	T	P	Duration (Hrs.)	CIE Marks	SEE Marks	Total	
1	PRI	BCSMO801	MOOCS (NPTEL/SWAYAM) 8/12 WEEKS	CS	-			-	-	100	100	3
2	PRI	BCSIN802	Research Internship/ Industry Internship	Industry	16 weeks			03 (Batch wise)	50	50	100	8
3	PRI	BCSPR883	Major Project (Phase-II)	CS	Two contact hours/week for interaction between faculty and students			3	50	50	100	6
4	NC MC	BNSSK804 / BPEDK804 / BYOGK804	NSS/ PE / Yoga	NSS / PE / Yoga	Completed during the intervening period of III semester to VII semester			-	100	-	100	-
TOTAL					-	-	-	-	**200**	**200**	**400**	**17**

BCSIN802 Research Internship/ Industry Internship/Rural Internship

Research internship:

A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

AICTE Activity Points

Apart from technical knowledge and skills, to be successful as professionals, students should have excellent soft skills, leadership qualities and team spirit. They should have entrepreneurial capabilities and societal commitment. To match these requirements, AICTE has created a unique mechanism of awarding minimum 100 Activity Points for regular students and 75 Activity Points for Lateral Entry students over and above the academic grades.

The activities can be spread over the entire duration of the programme and will be reflected in the Student's VIII Semester Grade Card. It shall not be considered for computation of SGPA/CGPA and for vertical progression. The total duration of the activities for the entire programme is 320 hours for regular students and 240 hours for lateral entry students.

Break-up of CCE marks for activity points:

Evaluation by the Proctor/Coordinator	50 marks
Evaluation by the Dept. Committee	
(i) Report	20 marks
(ii) Presentation	20 marks
(iii) Outcome	10 marks
Total	**100 marks**

1. No SEE for AICTE Activity Points.
2. Students will be awarded either NP or P grade based on marks obtained.

Students will be awarded 'Degree' only on earning P grade in the Activity Points.

SEMESTER – V

Course Name	: Computer Networks	**Course Code:**	BCSCN501
Number of Lecture Hours / Week	: 03	**CIE Marks:**	50
Number of Tutorial / Practical Hours / Week	: 02	**SEE Marks:**	50
Total Number of Lecture + Tutorial/Practical Hours	: 40+24=64	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:2	**Credits:**	04

Course Prerequisites
Basic knowledge of problem-solving skills, Computer hardware are required to learn the course.

Course Overview
This course will enable students to,
This course provides fundamental understanding of all the layers for TCP/IP model and different protocols used in the layers. Provides basic knowledge of different types of networks and their applications.

Course Learning Objectives (CLOs)

- Study the TCP/IP protocol suite, switching criteria and Medium Access Control protocols for reliable and noisy channels.
- Study network layer services and IP versions
- Discuss transport layer services and understand UDP and TCP protocols.
- Demonstrate the working of different concepts of networking layers and protocols.

Modules	Teaching Hours
Module 1 **Introduction:** Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer: Transmission media, Guided Media, Unguided Media: Wireless. **SLT**: Switching: Packet Switching and its types. **Textbook:** Ch. 1.1 - 1.3, 2.1 - 2.3, 7.1 – 7.3, 8.3.	**08**
Module 2 **Data Link Layer:** Error Detection and Correction: Introduction, Block Coding, Cyclic Codes. **Data link control**: DLC Services: Framing, Flow Control, Error Control, Connectionless and Connection Oriented, Data link layer protocols, High Level Data Link Control. **Media Access Control**: Random Access, Controlled Access. **SLT :** Check Sum and Point to Point Protocol **Textbook :** Ch. 10.1-10.4, 11.1 -11.3, 12.1 - 12.2	**08**
Module 3 **Network Layer: Network layer Services, Packet Switching, IPv4 Address,** IPv4 Datagram, IPv6 Datagram**,** Introduction to Routing Algorithms, Unicast Routing Protocols: DVR, LSR, PVR, Unicast Routing protocols: RIP, OSPF, BGP **SLT**: Multicasting Routing-MOSPF **Textbook 1:** Ch. 18.1, 18.2, 18.4, 22.2,20.1-20.3, 21.3.2	**08**
Module 4	**08**

Introduction to Transport Layer: Introduction, **Transport-Layer Protocols:** Introduction, User Datagram Protocol, Transmission Control Protocol: services, features, segments, TCP connections, flow control, Error control, Congestion control. **SLT**: Transport Layer Protocols **Textbook 1:** Ch. 23.1- 23.2 , 24.1-24.3.4, 24.3.6-24.3.9	
Module 5 **Introduction to Application Layer:** Introduction, Client-Server Programming, **Standard Client-Server Protocols:** World Wide Web and HTTP, FTP, Electronic Mail, Domain Name System (DNS) **SLT: TELNET, Secure Shell (SSH)** **Textbook 1:** Ch. 25.1-25.2, 26.1-26.6	**08**

Part – A

Practical Module

1. Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth, and find the number of packets dropped.
   Demonstration
2. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
   Demonstration
3. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
   Demonstration
4. Develop a program for error detecting code using CRC-CCITT (16- bits).
   Demonstration
5. Develop a program to implement a sliding window protocol in the data link layer.
   Exercise
6. Develop a program to find the shortest path between vertices using the Bellman-Ford and path vector routing algorithm.
   Exercise
7. Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
   Exercise
8. Develop a program on a datagram socket for client/server to display the messages on client side, typed at the server side.
   Exercise
9. Develop a program for a simple RSA algorithm to encrypt and decrypt the data.
   Structured Enquiry
10. Develop a program for congestion control using a leaky bucket algorithm.
    Structured Enquiry

Part - B

Open Ended Experiments

1. Given a graph with adjacency list representation of the edges between the nodes, the task is to implement Dijkstra's Algorithm for single-source shortest path using Priority Queue in Java.
2. Implementation of stop and wait protocol using socket programming.
3. Implementation of group chat application using multicast socket Programming.
4. Implementation of address resolution protocol.
5. Implementation of Open Shortest Path First (OSPF).

Type of Experiment	Program Number	Weightage
Demonstration	1,2,3,4	36%
Exercise	5,6,7,8	36%
Structured Enquiry	9,10	18%
Open ended		10%

Textbooks

1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, Tata McGraw-Hill,2013

Reference Books

1. 1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2019.
2. 2. Nader F. Mir: Computer and Communication Networks, 2nd Edition, Pearson Education, 2015.
3. 3. William Stallings, Data and Computer Communication 10th Edition, Pearson Education, Inc., 2014.

Course Outcomes (COs)

At the end of the course students will be able to

CO1	**Explain** the fundamentals of computer networks.
CO2	**Apply** the concepts of computer networks to **demonstrate** the working of various layers and protocols in communication network.
CO3	**Analyze** the principles of protocol layering in modern communication systems.
CO4	**Simulate/Design & Demonstrate** various Routing protocols and their services using tools such as Cisco packet tracer, Wireshark and so on

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2													2	
CO2	2													2	
CO3		2												2	
CO4			2		2					2				2	
AVG	**2**	**2**	**2**		**2**					**2**				**2**	

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SEMESTER – V

Course Name	:DevOps	**Course Code :**	BCSDO502
Number of Lecture Hours / Week	: 03	**CIE Marks :**	50
Number of Tutorial / Practical Hours / Week	: 02	**SEE Marks :**	50
Total Number of Lecture + Tutorial/Practical Hours	: 40+24=64	**SEE Duration :**	03 Hrs.
L:T:P	: 3:0:2	**CREDITS :**	04

COURSE PREREQUISITES

- Basics of Computer Networks and Software Development Life cycle.
- Agile methodologies.
- Linux basic commands.

COURSE OVERVIEW

Course provides the insights of Continuous Integration /Continuous Deployment tools in software development life cycle.

COURSE LEARNING OBJECTIVES (CLO)

1. To acquaint students with various DevOps tools used in the industry.
2. To gain a hands-on experience for building a Continuous Integration /Continuous Deployment pipeline.

MODULES	TEACHING HOURS
MODULE 1: DevOps and Infrastructure DevOps Culture and Practices, Getting started with DevOps, Implementing CI/CD and continuous deployment, Continuous integration(CI),Implementing CI, Continuous delivery (CD),Continuous deployment, Understanding IaC practices: The benefits of IaC ,IaC languages and tools ,Scripting types, Declarative types, Optimizing Infrastructure Deployment with Packer: Technical requirements, An overview of Packer, Installing Packer, Installing manually, Installing by script, Installing Packer by script on Windows, Integrating Packer with Azure Cloud Shell, Checking the Packer installation. **chapter : 1, 4**	**08**
MODULE 2: DevOps CI/CD Pipeline I Managing Your Source Code with Git, Technical requirements, Over viewing Git and its command lines, Git installation, Configuration Git, Git vocabulary, Git command lines: Retrieving a remote repository, Initializing a local repository, Configuring a local repository, Adding a file for the next commit, Creating a commit, Updating the remote repository, Synchronizing the local repository from the remote, Managing branches, Understanding the Git process and GitFlow pattern: Starting with	**08**

the Git process, Creating and configuring a Git repository, Committing the code, Archiving on the remote repository, Cloning the repository, The code update, Retrieving updates. **Chapter : 6**	
MODULE 3: DevOps CI/CD Pipeline II Continuous Integration and Continuous Delivery, Technical requirements, The CI/CD principles, Continuous integration(CI) ,Continuous delivery(CD), Using Jenkins: Installing and configuring Jenkins, Configuring a GitHub webhook, Configuring a Jenkins CI job, Executing the Jenkins job, Using GitLab CI, Authentication at GitLab, Creating a new project and managing your code source, Creating the CI pipeline, Accessing the CI pipeline execution details **Chapter : 7**	**08**
MODULE 4: Containerized Applications with Docker Containerizing Your Application with Docker, Technical requirements, Installing Docker, Registering on Docker Hub, Docker installation, An overview of Docker's elements, Creating a Docker file , Writing a Docker file, Docker file instructions overview, Building and running a container on a local machine: Building a Docker image, Instantiating a new container of an image, Testing a container locally, Pushing an image to Docker Hub. **Chapter : 9**	**08**
MODULE 5: Containerized Applications with Kubernetes and Testing APIs Managing Containers Effectively with Kubernetes, Technical requirements, Installing Kubernetes, Kubernetes architecture overview, Installing Kubernetes on a local machine, Installing the Kubernetes dashboard, First example of Kubernetes application deployment, Testing APIs with postman: Technical requirements, creating postman collection with request, installation of postman, creating a collection, creating our first request. **Chapter : 10, 11**	**08**
PRACTICAL MODULE **A-Demonstration** **A1**. Demonstrate and Create project in local and remote repository using GitBash and GitHub and apply init, status, log, add, commit, push, config, clone and reset commands on repository. **A2**. Demonstrate to create a project in remote repository and apply fork, merge, diff, merge conflict, branch and pull request concepts on repository using GitHub. **A3**. Demonstrate the process of integration github repository with Jenkins to automate the project execution in CI/CD pipeline. **B-Exercise**	**12**

B1. Create a docker image for an application stored in local repository and run the application using docker image.

B2. Create and configure Jenkins files for workflow and build of an application and push the image

C-Structured Inquiry

C1. Create a maven projects with all dependencies required for the application in CI/CD pipeline.

C2. Integrate communication channel with Jenkins for status of project and also enable email notification for a build.

D-Open Ended Problem

D1. Create a Maven project and integrate all dependencies, integrate the project with github repository , integrate with docker and docker hub and create Continuous Integration / Continuous Deployment pipeline using Jenkins and enable email notification for status of build.

Textbooks

1. Mikel Krief: Learning DevOps, Published by Packt Publishing Ltd, October 2019.

Reference Books

1. Michael Duffy: DevOps Automation Cookbook, Published by Packt Publishing Ltd, Nov 2015.
2. Jennifer Davis: Effective DevOps, Published by O'Reilly Media,in. June 2016
3. David Gonzalez: implementing Modern DevOps, Published by Packt Publishing Ltd,Oct 2017

COURSE OUTCOMES (COs)

At the end of the course students will be able to

CO1	Describe the Devops culture and practices with respect to software development.
CO2	Apply appropriate configuration strategies for repository in a pipeline.
CO3	Analyze various containerization applications in CI/CD pipeline.
CO4	Explore various devops tools with respect to Continuous integration and deployment.

CO – PO – PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	3														
CO3		2													2
CO4					2						2				2
Avg.	**2.5**	**2**			**2**						**2**				**2**

SEMESTER – V		
Course Name	**: Management and Entrepreneurship for IT**	**Course Code**: BCSME503
Number of Lecture Hours / Week	:03	**CIE Marks :** 50
Number of Tutorial / Practical Hours / Week	:00	**SEE Marks :** 50
Total Number of Lecture + Tutorial/Practical Hours	: 40	**SEE Duration :** 03 Hrs.
L:T:P	: 3:0:0	**CREDITS :** 03

Course Prerequisites
Fundamental knowledge of Management, Administration, and familiarity with concepts of Entrepreneurship and Entrepreneurs.

Course Overview
The course covers the knowledge to apply leadership qualities to direct and control the team and to apply entrepreneurial skills in project development process. Management comprises planning, organizing, staffing, leading or directing, and controlling an organization for the purpose of accomplishing a goal.

Course Learning Outcomes (CLO)
This course will enable students to,
- To explain the principles and functions of management, organization, and entrepreneurship.
- To understand theories of Management and Organizational that assist in solving problems.
- To know different leadership styles and theories of motivation that assist in achieving organizational objectives.
- To infer the value of Intellectual property rights and vast support extended by numerous organizations to help entrepreneurship.

MODULES	TEACHING HOURS
MODULE 1 **Management: Introduction,** Meaning of management, **Nature and Characteristics of management**, Management as a science, art and profession, Managerial Knowledge and skills, Levels of management, Management and Administration, Management Functions,Roles of management, Managerial phases, Responsibilities of a Manager. **Planning**: **The Planning Process**, **Types of Plans**, Strategic Plans, Contingency Plans, Tactical Plans, Operational Plans, Directional Plans versus Specific Plans, Hierarchy Plans, **Case Study** – The Bangalore International Airport, **Importance of planning**, **Steps in planning and planning premises**, Decision-making, Sequential decision-making. **SLT:** Development of Management Thoughts, Objectives of Planning **Textbook:** Chapter 1, 2 **[NOTE:** Kindly consider the topics mentioned above from Chapter 1 and Chapter 2]	**08**
MODULE 2 **Organizing and Staffing**: **Nature and purpose of organization**, Principles of	**08**

Organization, **Types of organization Departmentation**, **Nature and Importance of staffing**, Process of selection and recruitment. **Directing and Controlling: Meaning and Nature of Directing,** Principles of direction, Leadership styles, **Case Study –** Dr. A. P. J Abdul Kalam – The Transformational Leader**, Motivation theories**, Maslow's need hierarchy theory, McClelleand's need theory, Theory X and Theory Y, **Controlling,** Steps in Controlling, Essentials of a sound control system, Methods of establishing control. **SLT**: Span of Control, Communication and Coordination- Meaning and Importance. **Textbook:** Chapter 3, 4 **[NOTE:** Kindly consider the topics mentioned above from Chapter 3 and Chapter 4]	
Module 3 **Entrepreneur: Meaning of Entrepreneur**, Functions of an Entrepreneur, Types of Entrepreneurs, **Concept of Entrepreneurship,** Development of Entrepreneurship, Stages in entrepreneurial process, **Role of entrepreneurs in economic development, Case Study –** Mokshagundam Visvesvaraya, **Barriers to entrepreneurship.** **SLT:** Intrapreneurs – Meaning and Characteristics, Entrepreneurship in India **Textbook:** Chapter 5 **[NOTE:** Kindly consider the topics mentioned above from Chapter 5]	**08**
MODULE 4 **Small Scale Industry: Small Scale Industry (SSI),** Definitions, Characteristics of SSI, Objectives of SSI, Advantages of SSI, **Government policies towards SSI**, Different policies of SSI. **Case Studies-** Bill Gates and Microsoft, Captain G R Gopinath and Air Deccan,N R Narayana Murthy, and Infosys. **Institutional Support:** MSME-DI, NSIC, SIDBI, KSIIDC, KIADB, KSFC, DIC. **SLT**: Scope and Role of SSI in Economic Development, TECSOK. **Textbook:** Chapter 6, 7 [**NOTE:** Kindly consider the topics mentioned above from Chapter 6 and Chapter 7]	**08**
MODULE 5 **Preparation of Project**: **Meaning of a project, Steps to start an SSI in India, Project report,** Need and Significance of Project report, Contents of Project report, Formulation of Project Report, Guidelines of Project report, Errors of Project report. **SLT**: **Case Study –** Tulsi Tanti – The Wind Power Entrepreneur, Naresh Goyal and Jet Airways. **Textbook**: Chapter 8 [**NOTE:** Kindly consider the topics mentioned above from Chapter 8]	**08**
Textbook 1. Management and Entrepreneurship - Kanishka Bedi, Oxford University Press-2017.	
Reference Books 1. Principles of Management, P C Tripathi, P N Reddy, 7th Edition, 2021. 2. Entrepreneurship Development and Small business enterprises, Poornima M Charatimath, Pearson education- 2006.	

Course Outcomes (COs) At the end of the course students will be able to	
CO1(L2)	Elucidate the functions of management, entrepreneurship, project, and enterprises.
CO2 (L2)	Exemplify the importance of management through various theories, process involved and importance of project reports.
CO3 (L3)	Analyse the entrepreneurial classifications, agencies, case studies and institutional support.
CO4 (L4)	Demonstrate the significance of entrepreneurship using role plays and case studies.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	3														
CO3		2													1
CO4					2	2		2							2
AVG	**2.5**	**2**			**2**	**2**		**2**							**1.5**

SEMESTER – V

Course Name	: Automata Theory	**Course Code:**	BCSAT504
Number of Lecture Hours / Week	: 03	**CIE Marks:**	50
Number of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total Number of Lecture + Tutorial/Practical Hours	: 40	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:0	**Credits:**	03

Course Prerequisites
Basic knowledge of problem-solving skills, logical thinking and discrete mathematics are required to learn the course.

Course Overview
This course helps the student to design an abstract machine to accept any formal languages, which will help the student to understand the design process need to be followed for any problem.

Course Learning Objectives (CLOs)

- Learn about different abstract models of computing, decidability and Undecidability.
- Design regular expressions and grammar for different formal languages.
- Prove or disprove theorems in automata theory using their properties.
- Design various abstract models such as Finite State Machine, Pushdown automata & Turing machine.

Modules	Teaching Hours
Module 1 **Why study the Theory of Computation, Languages and Strings**: Strings, Languages. A Language Hierarchy, Computation, **Finite State Machines (FSM)**: Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs, From FSMs to Operational Systems, Simulators for FSMs, Minimizing FSMs. **SLT:** Canonical form of Regular languages **Textbook 1:** Ch 1,2, 3,4, 5.1 to 5.8	**08**
Module 2 **Regular Expressions (RE):** what is a RE? Kleene‟s theorem(Heuristic Approach), Manipulating and Simplifying REs. Regular Grammars: Definition, Regular Grammars and Regular languages. Regular Languages (RL) and Non-regular Languages: How many RLs, to show that a language is regular, Closure properties of RLs, to show some languages are not RLs. **SLT:** Applications of Regular Expressions **Textbook 1:**Ch 6, 7.1, 8.1 to 8.4	**08**
Module 3 **Context-Free Grammars (CFG):** Introduction to Rewrite Systems and Grammars, CFGs and languages, designing CFGs, simplifying CFGs, proving that a Grammar is correct, Derivation and Parse trees, Ambiguity, Normal Forms. **SLT:** Closure properties of CFLs **Textbook 1:** Ch 11.1 to 11.8	**08**
Module 4 Pushdown Automata (PDA): Definition of non-deterministic PDA, Deterministic and Non-deterministic PDAs, Non- determinism and Halting, alternative equivalent definitions of a	**08**

PDA. **SLT:** Alternatives that are notequivalent to PDA. **Textbook 1:** Ch 12.1 to 12.6	
Module 5 **Turing Machine**: Turing Machine model, Representation, Language acceptability by TM, design of TM, Techniques for TM construction. Variants of Turing Machines (TM), The model of Linear Bounded automata. **Decidability:** Definition of an algorithm, decidability, decidable languages, Undecidable languages, halting problem of TM, Post correspondence problem. **SLT:** Other undecidable problems **Textbook 2:** 9.1 to 9.8, 10.1 to 10.6	**08**

Textbooks

1. Elaine Rich, Automata, Computability and Complexity, 1st Edition, Pearson education, 2012 / 2013.
2. K L P Mishra, N Chandrasekaran, 3rd Edition, Theory of Computer Science, PhI, 2012.

Reference Books

1. John E Hopcroft, Rajeev Motwani, Jeffery D Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson Education, 2013.
2. Michael Sipser: Introduction to the Theory of Computation, 3rd edition, Cengage learning, 2013.
3. John C Martin, Introduction to Languages and the Theory of Computation, 3rd Edition, Tata McGraw –Hill Publishing Company Limited, 2013.
4. Peter Linz, "An Introduction to Formal Languages and Automata", 3rd Edition, Narosa Publishers, 1998.
5. Basavaraj S. Anami, Karibasappa K G, Formal Languages and Automata theory, Wiley India, 2012.
6. C K Nagpal, Formal Languages and Automata Theory, Oxford University press, 2012.

Course Outcomes (COs)

At the end of the course students will be able to

CO1	Acquire fundamental concepts of automata theory and computability
CO2	Apply the concept of regular expressions, context free grammars and automata theory in construction of programming languages
CO3	Analyze various models of computation and languages
CO4	Simplify and Design CFG, PDA and Turing machine for a given language or grammar
CO5	Demonstrate the working of an automaton using a modern tool

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3		2											2		
CO4			2										2		
CO5					2								2		
AVG	2	2	2		2								2		

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SEMESTER – V

Course Name	: Full Stack Development-I	**Course Code:**	BCSFS515
No. of Lecture Hours / Week	: 03	**CIE Marks :**	50
No. of Tutorial / Practical Hours / Week	: 00	**SEE Marks :**	50
Total No. of Lecture + Tutorial	: 40	**SEE Duration :**	03 Hrs
L:T:P	: 3:0:0	**Credits :**	03

Course Prerequisites
Basic understanding of Programming skills and JavaScript.

Course Overview
The course provides a fundamental understanding of full-stack web development tools and techniques, with a particular focus on Express and MongoDB components of the MEAN stack which is a powerful combination of technologies that enables developers to build dynamic and scalable web applications.

Course Learning Objectives (CLO)
This course will enable students to,

- Understanding the setup and integration of backend components of MEAN stack web application
- Familiarize with Express web framework for server-side programming
- Acquaintance with design and development of backend of MEAN stack web application

Modules	Teaching Hours
Module 1 **Introducing MEAN Development: Introducing Node.js**: The web server/platform, Introducing Express: The framework, Introducing MongoDB: The database, **Introducing Angular**: The frontend framework. Designing a MEAN Stack Architecture: A common MEAN stack architecture, Looking beyond SPAs, Designing a flexible MEAN architecture, Planning a real application, Breaking the development into stages. **SLT**: Hardware architecture	**08**
Module 2 **Creating and setting up a MEAN project:** A brief look at Express, Node, and npm, Creating an Express project, Modifying Express for MVC, Importing Bootstrap for quick, responsive layouts. **Building a static site with Node and Express:** Defining the routes in Express, Building basic controllers, Creating some views, Adding the rest of the views. **SLT:** Taking the data out of the views and making them smarter**.**	**08**
Module 3 **Building a data model with MongoDB and Mongoose**: Connecting the Express application to MongoDB by using Mongoose, Why model the data, Defining simple mongoose schemas, Using the MongoDB shell to create a MongoDB database and add data, Getting your database live. **SLT:** Making the application use the right database.	**08**
Module 4 **Writing a REST API: Exposing the MongoDB database to the application:** The rules of a REST API, GET methods: Reading data from MongoDB, POST methods: Adding data to MongoDB, PUT methods: Updating data in MongoDB, DELETE method: Deleting data from MongoDB	**08**

SLT: Setting up the API in Express	
Module 5 **Authenticating users, managing sessions, and securing APIs:** How to approach authentication in the MEAN stack, creating a user schema for MongoDB, creating an authentication API with Passport, Securing relevant API endpoints **SLT**: Using the JWT information inside a controller	**08**

Textbooks

1. Simon Holmes, Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node" second edition, 2019.

Reference Books

1. Jake Spurlock, "Bootstrap" First Edition 2013.
2. Steve Fenton "Pro TypeScript - Application-Scale JavaScript Development", Second Edition, Apress publications, 2018.
3. Shyam Seshadri, "Angular Up & Running - Learning Angular, Step by Step", First Edition, O'Reilly Media, 2018.

Course Outcomes (CO)

Upon the completion of the course, students will be able to

CO1	**Understand** the features and design principles of MEAN stack architecture
CO2	**Use** node, express, mongoDB and rest API frameworks to build and integrate backend components
CO3	**Examine** structure of backend components and their dependencies and interactions
CO4*	**Design and develop** MEAN stack web application for given requirements in a team

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	3				2										2
CO3		2													2
CO4			2		2				2						2
AVG	**2.5**	**2**	**2**		**2**				**2**						**2**

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SEMESTER – V

Course Name	: Cryptography	**Course Code:**	BCSCR515
No. of Lecture Hours / Week	: 03	**CIE Marks:**	50
No. of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total No. of Lecture + Tutorial / Practical Hours	: 40	**SEE Duration:**	03 Hrs.
L: T: P	: 3:0:0	**CREDITS:**	03

Course Prerequisites
Basic knowledge of calculus and linear algebra

Course Overview
This course emphasizes on principles and practice of modern applied cryptography: classical systems, symmetric block ciphers like DES, AES and public-key cryptography algorithms. The course discusses the inner workings of cryptographic systems and how to correctly use them in real-world applications.

Course Learning Objectives (CLO)
This course will enable students to:

- To understand basic cryptographic concepts and methods
- To deeply understand how modern cryptographic schemes work and necessary mathematical concepts involved
- Illustrate the structure and working principle of DES & AES Algorithms
- Demonstrate the working of public key cryptosystem

Modules	Teaching Hours
Module 1 **Introduction to Cryptography and Data Security:** Overview of Cryptology, Symmetric Cryptography, Cryptanalysis, Modular Arithmetic and More Historical Ciphers **SLT:** How Many Key Bits Are Enough? **Textbook 1**:Ch.1.1-1.4	**08**
Module 2 **The Data Encryption Standard (DES):** Introduction to DES, Overview of the DES Algorithm, Internal Structure of DES, Decryption, Security of DES **SLT:** Analytical Attacks **Textbook 1**: Ch.3.1-3.5	**08**
Module 3 **The Advanced Encryption Standard (AES):** Introduction, Overview of the AES Algorithm, A Brief Introduction to Galois Fields, Internal Structure of AES, Decryption **SLT:** Multiplication, Inversion in GF **Textbook 1**: Ch.4.1-4.5	**08**
Module 4 **Introduction to Public-Key Cryptography, The RSA Cryptosystem:** Symmetric vs. Asymmetric Cryptography , Practical Aspects of Public-Key Cryptography, Essential Number Theory for Public-Key Algorithms **The RSA Cryptosystem:** Introduction , Encryption and Decryption ,Key Generation and Proof of Correctness, Encryption and Decryption **SLT:** Euclidean , Extended Euclidean Algorithm **Textbook 1**: Ch. 6.1-6.3, 7.1-7.4	**08**

Module 5 **Public-Key Cryptosystems Based on the Discrete Logarithm Problem:** Diffie–Hellman Key Exchange , The Discrete Logarithm Problem, Security of the Diffie–Hellman Key Exchange ,The Elgamal Encryption Scheme **SLT:** Security of the Diffie–Hellman Key Exchange **Textbook 1:**Ch.8.1, 8.3, 8.4, 8.5	**08**

Textbooks

1. Christof Paar, Jan Pelzl, Understanding Cryptography, A Textbook for Students and Practitioners, 1st edition Springer-Verlag Berlin Heidelberg 2014

Reference Books

1. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017
2. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2019
3. Nader F. Mir: Computer and Communication Networks, 2nd Edition, Pearson Education, 2015
4. William Stallings, Data and Computer Communication 10th Edition, Pearson Education, Inc., 2014

Course Outcomes (COs)

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

CO1	**Explain** cryptography and its principles.
CO2	**Illustrate** various cryptographic algorithms used for secure data transmission
CO3	Perform **cryptanalysis** of cryptographic algorithms.
CO4	Explore cryptographic primitives for a given scenario using modern tools in a team.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	3												3		
CO3		2											2		
CO4					2				2				2		
AVG	**2.5**	**2**			**2**				**2**				**2.25**		

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SEMESTER – V

Course Name	**:** Data Mining and Data Warehousing	**Course Code:**	BCSDM515
No. of Lecture Hours / Week	**:** 03	**CIE Marks:**	50
No. of Tutorial / Practical Hours / Week	**:** 00	**SEE Marks:**	50
Total No. of Lecture + Tutorial / Practical Hours	**:** 40	**SEE Duration:**	03 Hrs.
L: T: P	**:** 3:0:0	**Credits:**	03

Course Prerequisites
Basic knowledge of algorithms, statistics for data analytics or equivalent working knowledge is required.

Course Overview
The course provides an insight into the basic concepts of data warehousing, online analytical processing, and data cube technology. It also provides an opportunity to explore the concepts and techniques of knowledge discovery and data mining.

Course Learning Objectives (CLO)
This course will enable students to:
- Define multi-dimensional data models
- Interpret rules related to association, classification and clustering analysis
- Apply appropriate classification/clustering algorithm for a given task

MODULES	Teaching Hours
Module 1 **Data Warehousing: Basic Concepts,** What is a Data Warehouse? Difference between Operational database Systems and Data Warehouses, Why have a Separate data Warehouse? Data Warehousing: A Multitiered Architecture, Extraction, Transformation and loading, metadata Repository. **Data Warehouse Modeling: Data Cube and OLAP,** Data Cube: A multidimensional data model, Stars, Snowflakes and Fact constellations: Schemas for multidimensional Data models, Dimensions: The role of concept Hierarchies, Measures: Their Categorization and computation, Typical OLAP Operations. **SLT:** Data Warehouse Models: Enterprise Warehouse, Data Mart and Virtual Warehouse **Textbook 2:** Ch. 4.1, 4.2	**08**
Module 2 **Data warehouse implementation,** Efficient Data Cube computation: An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAP Queries. **Data Mining, Introduction:** What is Data Mining? Motivating Challenges, The Origins of Data Mining, Data Mining Tasks. Data, Types of Data, Data Quality, Data Preprocessing **SLT:** OLAP server Architecture ROLAP versus MOLAP Versus HOLAP **Textbook 2:** Ch. 4.4, Ch. 1.1-1.4, Ch. 2.1,2.3	**08**
Module 3 **Classification,** General Approach to solving a Classification Problem, Decision Tree Induction, Model Overfitting, Nearest-Neighbour Classifiers, Bayesian Classifiers, Artificial Neural Network(ANN). **SLT:** Evaluating the performance of a Classifier	**08**

Textbook 1: Ch. 4.2-4.5, Ch. 5.2-5.4	
Module 4 **Cluster Analysis**, Overview, K-Means, Agglomerative Hierarchical Clustering. DBSCAN, Characteristics of data, clusters, and clustering algorithms, Which Clustering Algorithm? SLT: Scalability: General Issues and Approaches **Textbook 2:** Ch. 8.1-8.4, Ch. 9.1,9.5.1,9.6	**08**
Module 5 **Association Analysis,** Problem Definition, Frequent Itemset Generation, Rule Generation, Compact Representation of Frequent itemset, FP-Growth Algorithm. **SLT:** Alternative Methods for Generating Frequent Itemsets **Textbook 1:** Ch. 6.1-6.6	**08**
Textbooks **1.** Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First impression, 2016. **2.** Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.	
Reference Books **1.** Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression, 2012. **2.** Michael.J.Berry, Gordon.S.Linoff: Mastering Data Mining, Wiley Edition, second edition, 2012.	

CO1	Interpret the need for data warehousing and online analytical processing
CO2	Apply appropriate classification/clustering technique to solve a given data mining problem
CO3	Analyze the given pattern to describe associated features in the data
CO4	Illustrate data mining solutions for exploring a given dataset either individually or in a team, using any of the data mining tools.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	3												3		
CO3		2											2		
CO4					2				2				2		
AVG	**2.5**	**2**			**2**				**2**				**2.25**		

SEMESTER – V

Course Name	: Computer Graphics and Visualization	**Course Code:**	BCSCG515
No. of Lecture Hours / Week	: 03	**CIE Marks:**	50
No. of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total No. of Lecture + Tutorial / Practical Hours	: 40	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:0	**Credits:**	03

Course Prerequisites

Basic knowledge of programming, linear algebra, data structures and algorithms.

Course Overview

This course will introduce students to all aspects of computer graphics including hardware, software and applications. Students will gain experience using a graphics application programming interface by completing several programming projects.

Course Learning Objectives (CLO)

This course will enable students to,

- Understand the basics of graphics primitives
- Familiarize with various scan conversion methods on graphics primitives
- Understand various transformations, viewing and clipping techniques on both two dimensional and three-dimensional objects

Modules	Teaching Hours
Module 1 **Introduction to Computer Graphics and OpenGL** **Computer Graphics:** Basics of computer graphics, Application of Computer Graphics, Video Display Devices: Random Scan and Raster Scan displays, graphics software. Coordinate representations, Graphics functions, Software standards **OpenGL:** Basic OpenGL syntax, Header files, Display window management using GLUT **SLT:** Other graphics packages	**08**
Module 2 **Graphics Primitives** Coordinate reference frame, specifying two-dimensional world coordinate reference frames in OpenGL, OpenGL point functions, OpenGL line functions, Fill area primitives, OpenGL Polygon Fill-Area Functions, point attributes, line attributes, curve attributes, OpenGL point attribute functions, OpenGL line attribute functions, Fill area attributes, OpenGL fill area attribute functions, Line drawing algorithms (DDA, Bresenham's), Circle generating algorithms (Midpoint), General scan line polygon fill algorithm **SLT:** Front and back polygon faces	**08**
Module 3 **Two dimensional Geometric Transformations and Two dimensional viewing** **Two dimensional Geometric Transformations:** Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates. Inverse transformations, 2DComposite transformations, other 2D transformations, OpenGL raster transformations, OpenGL geometric transformations functions **Two dimensional viewing:** 2D viewing pipeline, Clipping: clipping window, normalization and viewport transformations, clipping algorithms, 2D line clipping	**08**

algorithms: Cohen Sutherland line clipping only, polygon fill area clipping: Sutherland-Hodgeman polygon clipping algorithm only OpenGL 2D viewing functions **SLT:** 2D point clipping	
Module 4 **Three dimensional Geometric Transformations and three dimensional viewing** **Three dimensional Geometric Transformations:** 3D translation, rotation, scaling, composite 3D transformations, other 3D transformations, affine transformations, OpenGL geometric transformations functions **Three dimensional Viewing:** 3D viewing concepts, 3D viewing pipeline, 3D viewing coordinate parameters , Transformation from world to viewing coordinates, Projection transformation, orthogonal projections, perspective projections, The viewport transformation and 3D screen coordinates. OpenGL 3D viewing functions **SLT**: Affine transformations	**08**
Module 5 **Curved surfaces, Bezier spline curves**, **Color and Illumination Models** Curved surfaces, quadric surfaces, Super quadrics, OpenGL Quadric-Surface and Cubic-Surface Functions **Bezier Spline Curves:** Bezier curve equations, properties **Color Models:** Properties of light, color models, RGB and CMY color models **Illumination Models:** Light sources, basic illumination models- Ambient light, diffuse reflection, specular and Phong model **SLT:** OpenGL functions for curved surfaces, illumination models	**08**

Textbooks

1. Donald Hearn & Pauline Baker: Computer Graphics with OpenGL Version, 4th Edition, Pearson Education,2011

Reference Books

1. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL, Pearson education,2014
2. Xiang, Plastock, Computer Graphics, sham's outline series, 2nd edition, Tata McGraw hill,2015
3. Rajesh K. Maurya, Computer Graphics with Virtual Reality System, Wiley 3rd edition, 2018

Course Outcomes (COs)

At the end of the course students will be able to

CO1	**Understand** the fundamental concepts of computer graphics, Curved surfaces and Bezier spline curves.
CO2	**Illustrate** various scan conversion, geometric transformations, and viewing methods on 2D and 3D objects.
CO3	**Analyze** three dimensional geometric transformations and viewing for 3D objects.
CO4	**Explore** and implement computer graphics applications using OpenGL individually or in a team.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	3												3		
CO3		2											2		
CO4					2				2				2		
AVG	**2.5**	**2**			**2**				**2**				**2.25**		

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SEMESTER – V

Course Name	: Introduction to Data Structures	**Course Code:**	BCSDS556
Number of Lecture Hours / Week	: 03	**CIE Marks:**	50
Number of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total Number of Lecture + Tutorial/Practical Hours	: 40	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:0	**Credits:**	03

Course Prerequisites
Basic knowledge of programming is required to learn the course.

Course Overview
This course enables students to learn basic algorithms, data structures and implementation of the data structures like linked lists, stacks, queues, trees, heaps, hash tables and graphs. Course also examines algorithms for manipulating queues, traversing, and searching in trees and finding shortest paths in graphs.

Course Learning Objectives (CLOs)

- Understand the foundations of data structure and how different data structures are used for effective data access and data manipulation.
- Understand the context of problem definition and implement a suitable data structure to solve it.
- Investigate various data structures such as stacks, queues, linked lists, trees and graphs.

Modules	Teaching Hours
Module 1 **C-Recap I:** Introduction to C, constants, variables, data types, input output operations, operators, and expressions. **C-Recap II:** control Statements, arrays, strings, built-in functions, user defined functions, structures, and pointers. **SLT:** unions	**08**
Module 2 **Algorithms:** Asymptotic notations, Introduction to data structures, Types of data structures, data structure operations. **Arrays:** Types of arrays, representation of one-dimensional arrays, Array traversal, insertion and deletion, representation of multi-dimensional array, realizing matrices using two dimensional arrays, matrix operations. **SLT:** Sorting and searching	**08**
Module 3 **Linked lists:** Introduction, basic concept, linked list implementation, types of linked list, circular linked list, doubly linked list. **Stacks:** stacks, stack operations, stack implementation using arrays. **SLT:** stack implementation using linked list	**08**
Module 4 **Queues:** Introduction, basic concept, operations, queue implementations, circular queue. **Trees:** Introduction, basic concept, binary tree, binary tree representation, binary tree traversal.	**08**

SLT: Binary search tree	
Module 5 **Graphs:** Introduction, basic concept, graph terminology, graph implementation-adjacency matrix, path matrix, adjacency list, shortest path algorithm, Graph traversal-breadth first search and depth first search. **Searching:** hashing **SLT :** Sorting: Insertion sort	**08**
Textbooks 1. Data structures using C, E Balagurusamy, McGraw Hill education (India) Pvt. Ltd, 2013.	
Reference Books 1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014. 2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.	
Course Outcomes (COs) At the end of the course students will be able to	
CO1	**Explain** the fundamentals of basic data structures.
CO2	**Implement** various data structures and its applications.
CO3	**Analyze** the various operations on data structures.
CO4	**Design and Demonstrate** appropriate solution in a team by implementing suitable data structure for a given problem.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	2		3												
CO3		2													
CO4									2	2					
AVG	2	2	3						2	2					

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SEMESTER –V

Course Name	: Introduction to Computer Networks	**Course Code:**	BCSCN556
No. of Lecture Hours / Week	: 03	**CIE Marks:**	50
No. of Tutorial / Practical Hours / Week	: 02	**SEE Marks:**	50
Total No. of Lecture + Tutorial / Practical Hours	: 40	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:0	**Credits:**	04

Course Prerequisite

Basic knowledge of problem-solving skills, Computer hardware are required to learn the course.

Course Overview

This course provides the fundamental understanding of all the layers for TCP/IP model and different protocols used in the layers. Provides basic knowledge of different types of networks and their applications.

Course Learning Objectives (CLO)

This course will enable students to,

- Study the TCP/IP protocol suite, switching criteria and Medium Access Control protocols for reliable and noisy channels.
- Study network layer services and IP versions
- Discuss transport layer services and understand UDP and TCP protocols.
- Demonstrate the working of different concepts of networking layers and protocols.

MODULES	TEACHING HOURS
MODULE 1 **Introduction:** Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer: Transmission media, Guided Media. **SLT**: Unguided Media: Wireless. **Textbook:** Ch. 1.1 - 1.3, 2.1 - 2.3, 7.1 – 7.3, 8.3.	**08**
MODULE 2 **Data Link Layer:** Error Detection and Correction: Introduction, Block Coding, Cyclic Codes. **Data link control**: DLC Services: Framing, Flow Control, Error Control, Connectionless and Connection Oriented, Data link layer protocols, High Level Data Link Control. **SLT: Media Access Control**: Random Access, Controlled Access **Textbook:** Ch. 10.1-10.4, 11.1 -11.3, 12.1 - 12.2	**08**
MODULE 3 **Network Layer: Network layer Services, Packet Switching, IPv4 Address,** IPv4 Datagram, IPv6 Datagram**,** Introduction to Routing Algorithms, Unicast Routing Protocols: DVR, LSR, PVR. **SLT**: Unicast Routing protocols: RIP, OSPF, BGP **Textbook 1:** Ch. 18.1, 18.2, 18.4, 22.2,20.1-20.3, 21.3.2	**08**

MODULE 4 **Introduction to Transport Layer:** Introduction, **Transport-Layer Protocols:** Introduction, User Datagram Protocol, Transmission Control Protocol: services, features, segments, TCP connections, flow control. **SLT**: Error control, Congestion control. **Textbook 1:** Ch. 23.1- 23.2, 24.1-24.3.4, 24.3.6-24.3.9	**08**
MODULE 5 **Introduction to Application Layer:** Introduction, Client-Server Programming, **Standard Client-Server Protocols:** World Wide Web and HTTP, FTP, Electronic Mail, **SLT:** Domain Name System (DNS) **Textbook 1:** Ch. 25.1-25.2, 26.1-26.6	**08**

Textbooks:

1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, Tata McGraw-Hill,2013.

Reference Books:

1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2019.

2. Nader F. Mir: Computer and Communication Networks, 2nd Edition, Pearson Education, 2015.

3. William Stallings, Data and Computer Communication 10th Edition, Pearson Education, Inc., 2014.

COURSE OUTCOMES(CO's):

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

CO1	**Explain** the fundamentals of computer networks.
CO2	**Apply** the concepts of computer networks to understand the working of various layers and protocols in communication network.
CO3	**Analyze** the principles of protocol layering in modern communication systems.
CO4	**Simulate/Design & Demonstrate** various Routing protocols and their services using tools such as Cisco packet tracer, Wireshark and so on

CO – PO – PSO MAPPING

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	3												3		
CO3		2											2		

CO4			2		2					2			2		
Avg.	2.5	**2**	**2**		**2**					**2**			2.25		

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SEMESTER – V

Course Name	**:** Technical Proficiency Enhancement Course- III	**Course Code :**	BITTP508
Number of Lecture Hours / Week	: 00	**CCE Marks :**	50
Number of Tutorial / Practical Hours / Week	: 02	**SEE Marks :**	50
Total Number of Lecture + Tutorial/Practical Hours	: 24	**SEE Duration :**	2 Hrs.
L:T:P	: 0:0:2	**CREDITS :**	01

COURSE PREREQUISITES: Working knowledge of C Programming and Data Structures

COURSE OVERVIEW: This course is designed to enhance an individual's problem-solving, analytical, and critical thinking skills using data structures and dynamic programming. It also helps the students to acquire skills for career development, competitive exams, and job recruitment processes.

COURSE LEARNING OBJECTIVES (CLO)

- To enhance problem-solving skills
- To develop technical Skill in advanced Data Structures and Dynamic Programming
- To Prepare students for job recruitment process and competitive exams

MODULES	TEACHING HOURS
MODULE 1: Advanced Data Structures 1 **Priority Queues:** Introduction to Priority Queues, Ways to implement priority queues, Introduction to heaps, Introduction to Complete Binary Trees and its implementation, Insert and Delete operations in heaps, Implementing priority queues, Heap sort, Inbuilt Priority Queue.	**06**
MODULE 2: Advanced Data Structures 2 **Hashmaps:** Introduction to Hashmaps, Inbuilt Hashmap, Hash functions, Collision handling, Insert and Delete operation implementation in hashmap, Load factor, Rehashing.	**06**
MODULE 3: Advanced Data Structures 3 **Tries:** Introduction to Tries, Making a Trie Node class, Insert, Search and Remove operation implementation in Tries, Types of Tries, Huffman coding. **Graphs:** Introduction to Graphs, Graph Terminology, Graph implementation, Graph Traversals (DFS and BFS), Weighted and Directed Graphs, Minimum Spanning Trees, Cycle Detection in Graphs, Kruskal's algorithm, Prim's Algorithm, Dijkstra's algorithm.	**06**

MODULE 4: Dynamic Programming 1 **Introduction to Dynamic Programming:** Introduction to Memoization, Introduction to Dynamic Programming, Fibonacci numbers using recursion, memoization and dynamic programming.	**06**
MODULE 5: Dynamic Programming 2 **Applications of Dynamic Programming:** Longest Common Subsequence (LCS) using recursion, memoization and dynamic programming, Edit distance using recursion, memoization and dynamic programming, Knapsack problem using recursion, memoization and dynamic programming.	**06**

Reference Books:

1. Data Structures and Algorithms Made Easy by Narasimha Karumanchi
2. Data Structures through C in Depth by by S K Srivastava and Deepali Srivastava

COURSE OUTCOMES (COs):
Upon completion of the course, students will be able to

CO1	Apply and solve complex problems efficiently using Advanced Data Structures and Dynamic Programming.
CO2	Develop critical thinking skills, enabling them for job interviews and assessment tests.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2		3													
AVG	**3**	**3**													

SEMESTER – V

Course Name	: Environmental Studies	**Course Code:**	BENSK509
Number of Lecture Hours / Week	: 01	**CIE Marks:**	50
Number of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total Number of Lecture + Tutorial/Practical Hours	: 15	**SEE Duration:**	02 Hrs.
L:T:P	: 2:0:0	**Credits:**	01

Course Overview

The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, solid waste disposal, degradation of environment, Global warming, depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. This course focuses on Environment, ecosystem, natural resources and other issues related to it. It also deals with the Environmental legislation and waste management

Course Learning Objectives (CLOs)

- Identify the major challenges in environmental issues
- Develop skills, critical thinking and demonstrate socio-economic skills for Environment protection
- Analyze the impact of specific issues and plan strategies for environmental management

Modules	Teaching Hours
Module 1 : **Ecosystem and Sustainability** Ecosystem: Types & Structure of Ecosystem: Forest, Desert, Wetlands, Riverine, Oceanic. **Sustainability**: 17SDG targets and possible actions **SLT**: Components of environment	**03**
Module 2: Natural resources and Energy **Natural Resources**: Water resources – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water, Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle. **Energy** :Different types of energy, Conventional sources & Non -Conventional sources of energy : Solar energy, Wind Energy, Hydrogen as an alternative energy **SLT:** Alternative Energy sources	**03**
Module 3: Environmental Pollution **Environmental Pollution**: Water Pollution, Noise pollution, Air pollution (Sources, Impacts, Preventive measures and Public Health Aspects). **SLT:** Case studies of water act	**03**

Module 4: Waste management **Waste management :** Solid Waste Management, E - Waste Management & Biomedical Waste Management - Sources, Characteristics **Environmental Legislation :** Solid Waste Management Rules,2016 **SLT:** Case studies of water quality issues	**03**
Module 5 **Global Concerns:** Global warming, Climate change, Acid rain, Ozone depletion, **Field work:** Visit to Environmental Engg. Lab, Zero Waste Management Plant and Solid waste management plant **SLT:** Case studies of global warming	**03**

Textbooks

1. S M Prakash , "Environmental Studies" 3rd Edition, Elite Publishing House, Mangalore, 2018.
2. Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited.
3. R Rajagopalan, "Environmental Studies – From Crisis to Cure " 2nd Edition, Oxford university press, New Delhi , 2013.

Reference Books

1. Raman Sivakumar, "Principles of Environmental Science and Engineering", 2nd edition, Cengage learning Singapur, 2005.
2. G.Tyler Miller Jr., "Environmental Science – working with the Earth", Eleventh Edition, Thomson Brooks /Cole, 2006
3. Dr. Pratiba Sing, Dr.Anoop Singh and Dr. Piyush Malaviya, "Text Book of Environmental and Ecology", Acme Learning Pvt. Ltd. New Delhi.
4. P. Meenakshi, "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi, 2006.

Course Outcomes (COs)

At the end of the course students will be able to

CO1	Comprehend the principles of ecology and environmental issues pertaining to air, land, and water on a global scale
CO2	Acquire observation skills for solving problems related to the environment
CO3	Conduct survey to describe the realities of waste management system

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2						3								
CO2	2	2					3								
CO3				2		3			2						

AVG	**2**	**2**		**2**		**3**	**3**		**2**						

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SEMESTER – VI

Course Name	: Machine Learning	**Course Code :**	BCSML601
No. of Lecture Hours / Week	: 03	**CIE Marks :**	50
No. of Tutorial / Practical Hours / Week	: 02	**SEE Marks :**	50
Total No. of Lecture + Tutorial / Practical Hours	: 40+24=64	**SEE Duration :**	03 Hrs.
L:T:P	: 3:0:2	**Credits :**	04

Course Prerequisites
Basic Knowledge on variables, linear equations, graphs of functions, histograms, probability and statistics

Course Overview
This course is concerned with computer programs that automatically improve their performance through experience which illustrates methodologies, technologies, mathematics and algorithms of machine learning techniques.

Course Learning Objectives (CLO)

- This course will enable students to,
- Define machine learning and understand the basic theory underlying machine learning.
- Differentiate supervised, unsupervised and reinforcement learning
- Understand the basic concepts of learning and decision trees.
- Understand neural networks and Bayesian techniques for problems appear in machine learning
- Understand the instant based learning and statistical analysis of machine learning techniques.

Modules	Teaching Hours
Module 1 **Introduction to Machine Learning** Introduction, What is Human Learning? Types of Human Learning, What is Machine Learning, Types of Machine Learning, Problems not to be solved using Machine Learning, Application of Machine Learning, Issues in Machine Learning, **Prepare to Model** – Introduction, Machine Learning activities, Basic types of Data in Machine Learning **SLT:** Issues in Machine Learning **Textbook1:** Ch: 1.1 – 1.7, 1.9, 2.1 – 2.3	**08**
Supervised Learning: Learning a Class from Examples, Vapnik-Chervonenkis Dimension, Probably Approximately Correct Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning algorithm, **Kernel Machines**: Introduction, Optimal Separating Hyperplane, The Nonseparable Case: Soft Margin Hyperplane **SLT:** ν-SVM	**08**

Textbook3: Ch: 2.1 –2.8, 13.1 – 13.4	
Module 3 **Artificial Neural Networks** Introduction, Neural Network representation, Perceptrons, Backpropagation algorithm, Remarks on the Backpropagation algorithm **SLT:** Appropriate problems **Text Book2:** Ch: 4.1 – 4.5	**08**
Module 4 **Bayesian Learning** Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, MLH for predicting probabilities, MDL principle, Naive Bayes classifiers **SLT:** EM algorithm **Textbook2:** Ch: 6.1 – 6.6, 6.9, 6.11 - 6.11	**08**
Module 5 **Instance Based Learning** Introduction, k-nearest neighbor learning, locally weighted regression, Radial Basis Functions, Case-based reasoning, **Reinforcement Learning**: Introduction, The learning task, Q-Learning **SLT:** Remarks on Lazy and Eager Learning **Textbook2:** Ch: 8.1-8.6,13.1 – 13.3	**08**

PRACTICAL MODULE-(PART-A)

1. Implement and demonstrate the FIND-S Algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file
2. Write a program to demonstrate the working of SVM algorithm. Use an appropriate data set for building the model and apply this knowledge to classify new Samples.
3. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
5. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
6. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
7. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select the appropriate data set for your experiment and draw graphs.

Open Ended Enquiry Problems(PART-B)

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
2. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
3. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library.

TYPE OF LAB EXERCISE PROBLEMS	LAB EXERCISE PROBLEM NUMBERS
DEMONSTRATION	1, 2
EXERCISE	3, 4
STRUCTURED ENQUIRY	5, 6, 7
OPEN ENDED	**PART-B**

Textbooks

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Dos, "Machine Learning", 1st edition, Pearson, 2019
2. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
3. Ethem Alpaydın, Introduction to Machine Learning, 3rd Edition, The MIT Press

Reference Books

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, springer series in statistics.
2. Ethem Alpaydın, Introduction to machine learning, second edition, MIT press
3. Foundations of Machine Learning , Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, second edition, MIT Press, 2018.

Course Outcomes (COs)

At the end of the course students will be able to

CO1	Understand fundamentals of machine learning
CO2	Demonstrate the working of machine learning algorithms
CO3	Analyze input and optimization principles of machine learning for efficient and effective implementation
CO4	Design and implement machine learning techniques for solving complex problems in a team

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	2												2		
CO2	3												2		
CO3		2											2		
CO4			2	2					2				2		
AVG	**2.5**	**2**	**2**	**2**					**2**				**2**		

SEMESTER – VI

Course Name	: System Software and Compiler Design	**Course Code:**	BCSSS602
No. of Lecture Hours / Week	: 03	**CIE Marks :**	50
No. of Tutorial / Practical Hours / Week	: 02	**SEE Marks :**	50
Total No. of Lecture + Tutorial	: 40+24=64	**SEE Duration :**	03 Hrs.
L:T:P	: 3:0:2	**Credits :**	04

Course Prerequisites
Basic Knowledge of Finite Automata and Computer Organization.

Course Overview
The course provides insights to the phases of a compiler. This course also aims to convey the language specifications, use of regular expressions, context free grammars and parsing techniques involved in the design of a compiler. The course introduces the basics of assemblers, loaders and linkers.

Course Learning Objectives (CLO)
This course will enable students to,
- Understand the phases of compilers and lexical analyzer
- Generate parse table, intermediate code, and target code.
- Learn the concepts of System Software like assemblers and loaders.

Modules	Teaching Hours
Module 1 **Introduction:** Language Processors, the structure of a compilers, Evolution of programming languages, the science of building a compiler **Lexical Analysis:** The role of lexical analyzer, Input Buffering, Specifications of Token, Recognition of Tokens. **SLT:** Applications of compilers technology **Textbook 1:** Ch. 1.1-1.5, 3.1 – 3.4	**08**
Module 2 **Syntax Analysis - I**: Introduction, Writing a grammar, Top-Down Parsers, Bottom-Up Parsers. **SLT:** Context Free Grammars **Textbook 1:** Ch. 4.1 - 4.5	**08**
Module 3 **Syntax Analysis - II:** Introduction to LR parsing: Simple LR Syntax Directed Translation: Syntax-Directed Definitions, Evaluation Orders for SDD's Intermediate Code Generation: Three-Address Code **SLT:** Variants of Syntax Trees **Textbook 1:** Ch. 4.6, 5.1-5.2,6.1 - 6.2	**08**

Module 4 **Code Generation:** The Target Language, basic blocks and flow graph, Optimization of basic blocks, The Code-Generation Algorithm Introduction to Assembler Machine Architecture of SIC and SIC/XE., Basic assembler functions **SLT:** Issues in the Design of a Code Generator **Textbook 1:** Ch. 8.1-8.2,8.4-8.5,8.6.2 **Textbook 2:** Ch. 1.3.1-1.3.2,2.1	**08**
Module 5 **Assembler:** Machine dependent assembler features. Introduction to Loaders: Basic Loader Functions, Machine-Dependent loader features, Machine-Independent loader features **SLT:** Loader Design options **Textbook 2:** Ch. 2.2, 3.1-3.4	**08**
PRACTICAL MODULE 1) Write a LEX program to recognize valid ***arithmetic expressions.*** Identifiers in the expression could be only integers and operators could be + and *. Count the identifiers & operators present and print them separately. 2) Write a LEX program to eliminate ***comment lines*** in a ***C*** program and copy the resulting program into a separate file. 3) Write a LEX program to count the number of **characters, words, spaces** and **lines** in each input file. 4) Write a LEX program to recognize whether a given sentence is **simple or compound.** 5) Write YACC program to evaluate ***arithmetic expression*** involving operators: +, -, *, and /. 6) Write a YACC program to recognize valid ***identifier, operators*** and ***keywords*** in the given text (C program) file. 7) Write a YACC program to recognize a valid variable, which starts with a **letter,** followed by any number **of letters or digits.** 8) Develop, Implement and execute a program using YACC tool to recognize all strings ending with ***b*** preceded by ***n a's*** using the grammar $a^n b$ (note: input ***n*** value).	**24**

OPEN ENDED EXPERIMENT

Students can develop cross compilers, Bootstrap compilers, source to source compilers, decompilers or any other compiler applications in a team of maximum four members

Weightages:

Type of Experiment	Program Numbers	Weightage
Demonstration	1 2 & 3	33%
Exercise	4 5 & 6	33%
Structured Enquiry	7 & 8	24%
Open Ended		10%

Textbooks

1. Compilers-Principles, Techniques and Tools by Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman. Pearson, 2nd edition, 2013
2. System Software by Leland. L. Beck, D Manjula, 3rd edition, 2016.

Reference Books

1. Systems programming – Srimanta Pal , Oxford university press, 2016
2. System programming and Compiler Design, K C Louden, Cengage Learning
3. System software and operating system by D. M. Dhamdhere TMG
4. Compiler Design, K Muneeswaran, Oxford University Press 2013.

Course Outcomes (CO)

Upon the completion of the course, students will be able to

CO1	**Explain** the basic concepts of system software and compiler design
CO2	**Apply** the concepts of compiler design for parsing a given string and assembler features generating object program.
CO3	**Analyze** and trace the working of lexical analyser and syntax analyser for a given grammar
CO4*	**Design and develop** solutions to system software programs like LEX and YACC in a team

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2	3												3		
CO3		2											2		
CO4			2		2				2						2
AVG	3	2	2		2				2				2.5		2

SEMESTER – VI

Course Name	: Blockchain Technology	**Course Code:**	BCSBT603
Number of Lecture Hours / Week	: 03	**CIE Marks:**	50
Number of Tutorial / Practical Hours / Week	: 03	**SEE Marks:**	50
Total Number of Lecture + Tutorial/Practical Hours	: 40	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:0	**Credits:**	03

Course Prerequisites
Basic knowledge of computer networks and programming skills

Course Overview
The course provides a platform for students to learn more about the history, the most important blockchain concepts, the philosophy of decentralization behind blockchain and the main discussions happening within the blockchain environment. In addition, applications of blockchain and the impact it could have on the business world.

Course Learning Objectives (CLOs)
- To understand basic concepts of blockchain.
- To provide knowledge about blockchain by using new technologies.
- To provide hands-on experience with the concepts.

Modules	Teaching Hours
Module 1 **Blockchain:** Distributed systems, CAP theorem, Byzantine Generals problems, Consensus, Introduction to blockchain, various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain **SLT:** The history of blockchain	**08**
Module 2 **Decentralization:** Decentralization using blockchain, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies, Platforms for decentralization **Cryptography and Technical Foundations:** Mathematics, Cryptography, Cryptographic primitives: Symmetric cryptography, DES, AES **SLT:** Methods of decentralization	**08**

Module 3 **Cryptographic primitives:** Asymmetric cryptography, Discrete logarithm problem, Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest(MD), Secure Hash Algorithms(SHAs),Merkle trees, Patricia trees, Distributed hash tables(DHTs), Digital signatures. **SLT:** Public and private keys	**08**
Module 4 **Bitcoin:** Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, The structure of a block, The structure of a block header, The genesis block, The bitcoin network, Wallets. **Smart Contacts:** History, Definition, Ricardian contracts, Smart contract templates, Oracles, Smart Oracles, Deploying smart contracts on a blockchain, The DAO. **SLT:** Types of transaction	**08**
Module 5 **Ethereum 101:** Introduction, Ethereum clients and releases, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, The world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain, Ethereum virtual machine (EVM), Accounts, Block, Ether, Messages, Mining. **SLT:** The Ethereum stack	**08**
Textbooks 1. Imran Bashir, "Mastering Blockchain", Packt, 2017	
Reference Books 1. Mastering Bitcoin: Programing the Open Blockchain Paperback-2017 by Andreas M. O'rielly 2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.	

Course Outcomes (COs) At the end of the course students will be able to	
CO1	Explain the blockchain terminologies with its applications.
CO2	Illustrate tools and methods in Blockchain Technology.
CO3	Analyze the decentralized applications using Blockchain.
CO4	Apply ethical principles and demonstrate a private blockchain using Ethereum Tool.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	2												2		
CO2			2		2								2		
CO3		2											2		
CO4					2			1					2		
Avg.	**2**	**2**	**2**		**2**			**1**					**2**		

SEMESTER – VI

Course Name	: Full Stack Development-II	**Course Code:**	BCSFS614
Number of Lecture Hours / Week	: 03	**CIE Marks:**	50
Number of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total Number of Lecture + Tutorial/Practical Hours	: 40	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:0	**Credits:**	03

Course Prerequisites
Basic understanding of Programming skills and JavaScript.

Course Overview
The course provides a fundamental understanding of full-stack web development tools and techniques, with a particular focus on Node and ReactJS components of the MERN stack which a powerful combination of technologies that enables developers to build dynamic and scalable web applications

Course Learning Objectives (CLOs)
- Understanding of ReactJS runtime environment for JavaScript
- Familiarize with ReactJS syntax and components for scripting
- Acquaintance with ReactJS libraries for front-end web application development

Modules	Teaching Hours
Module 1 What's in a Name? UI Layer, Virtual DOM,The Philosophy of React Thinking in Components Composition vs. Inheritance React Is Declarative React Is Idiomatic Why Learn React? React vs…. React vs. Angular 18 React vs. Vue What React Is Not React Is Not a Web Server React Is Not a Programming Language React Is Not a Database Server React Is Not a Development Environment React Is Not the Perfect Solution to Every Problem JSX Is Not HTML What Is JSX? How JSX Works Transpiler . . . Huh? Compilation vs. Transpilation JSX Transform Introducing Babel Eliminating Browser Incompatibilities Syntax Basics of JSX JSX Is JavaScript XML Beware of Reserved Words JSX Uses camelCase Preface Custom Attributes in DOM Elements with data- JSX Boolean Attributes Use Curly Braces to Include Literal JavaScript Remember to Use Double Curly Braces with Objects Put Comments in Curly Braces When to Use JavaScript in JSX Conditionals in JSX Conditional Rendering with if/else and Element Variables Conditional Rendering with the && Operator Conditional Rendering with the Conditional Operator **SLT**: Expressions in JSX Using Children in JSX React Fragments	**08**
Module 2 What Is a Component? Components vs. Elements Components Define Elements Elements Invoke Components Built-in Components HTML Element Components Attributes vs. Props Passing Props Accessing Props Standard HTML Attributes Non-Standard Attributes Custom	**08**

Attributes User-Defined Components Types of Components Class Components Stepping through a React Class Component React.Component Importing React.Component The Class Header The Constructor Function Managing State in Class Components The Render Function Creating and Using Props Function Components What Are Function Components? How to Write Function Components Optimizations and Function Component Shortcuts **SLT**: Managing State in Function Components Differences between Function and Class Components	
Module 3 One-Way Data Flow Understanding One-Way Data Flow Why One-Way Data Flow? Props Components Receive Props Props Can Be Any Data Type Props Are Read-Only Validating Incoming Props with PropTypes What Is PropTypes? Getting Started with PropTypes What Can PropTypes Validate? Default Props React State What Is state? Initializing state Initializing state in Class Components Initializing State in Function Components The Difference between state and props Updating state Updating a Class Component's state with setState Updating state with Function Components How Events Work in React What Is SyntheticEvent? Using Event Listener Attributes The Event Object Supported Events Event Handler Functions Writing Inline Event Handlers Writing Event Handlers in Function Components Writing Event Handlers in Class Components Binding Event Handler Functions **SLT:** Using bind Using Arrow Functions Passing Data to Event Handlers	**08**
Module 4 Forms Have State Controlled Inputs vs. Uncontrolled Inputs Updating a Controlled Input Controlling an Input in a Function Component Controlling an Input in a Class Component Lifting Up Input State Using Uncontrolled Inputs Using Different Form Elements Controlling the Input Element Controlling a textarea Controlling a Select Element Preventing Default Actions The Importance of Styles Importing CSS into the HTML File Using Plain Old CSS in Components Writing Inline Styles JavaScript Style Syntax Why to Use Inline Styles Why Not to Use Inline Styles Improving Inline Styles with Style Modules **SLT**: CSS Modules Naming CSS Module Files Advanced CSS Modules Functionality Global Classes Class Composition	**08**
Module 5 What Are Hooks? Why Were Hooks Introduced? Rules of Hooks The Built-in Hooks Managing State with useState Setting the Initial State Using the Setter Function Passing a Value to a Setter Passing a Function to a Setter Setter Function Value Comparison Hooking into the Lifecycle with useEffect Using the Default useEffect Behavior Cleaning Up After Effects Customizing useEffect Running Asynchronous Code with useEffect What Is Routing? How Routing Works in React Using React Router Installing and Importing react-router- dom The Router Component Selecting a Router Using the Router Component Linking to Routes Internal Linking with Link Internal Navigation with NavLink Automatic Linking with Redirect Creating Routes Restricting Path Matching Using URL Parameters The component Prop Render Props Switching Routes Rendering a Default Route Routing	**08**

with Redirect Behind the Scenes: location, history, and match The history Object The location Object The match Object **SLT**: React Router Hooks useHistory useLocation useParams useRouteMatch	

Textbooks

1. Chris Minnick - Beginning ReactJS Foundations Building User Interfaces with ReactJS: An Approachable Guide, John Wiley & Sons, Inc. 2022

Reference Books

1. Basarat Ali Syed - Beginning Node.js-Apress, 2014.
2. Anthony Accomazzo, Ari Lerner, Clay Allsopp, David Guttman, Tyler Mcginnis, Nate Murray, FullStack React The Complete Guide to ReactJS & Friends, Fullstack.io, 2017

Course Outcomes (COs)

At the end of the course students will be able to

CO1	**Explain** various features of ReactJS for full stack web application development using MERN
CO2	**Use** various components and libraries of ReactJS to render view and perform corresponding operations
CO3	**Examine** application structure and their dependencies and interactions in an ReactJS application
CO4	**Design** front-end component of a web application using ReactJS library

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	3												3		
CO3		2											2		
CO4					2				2				2		
AVG	**2.5**	**2**			**2**				**2**				**2.25**		

SEMESTER – VI

Course Name	: Cloud Computing	**Course Code:**	BCSCC614
No. of Lecture Hours / Week	: 03	**CIE Marks:**	50
No. of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total No. of Lecture + Tutorial	: 40	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:0	**Credits:**	03

Course Prerequisites
Basic Understanding of programming skills, familiarity with databases, basics of security and privacy, familiarity with operating systems and networking.

Course Overview
This course will emphasize on the on-demand delivery of compute power, database, storage, applications, and other IT resources through a cloud services platform via the internet. The course discusses the cloud infrastructure, application paradigms, resource management, security, google platforms, services and how to correctly use them in real-world applications.

Course Learning Objectives (CLO)
This course will enable students to,

- Identify the architecture, infrastructure and delivery models of cloud computing
- Compare and contrast different cloud services.
- Apply suitable virtualization concepts.
- Apply Cloud automation and management tools to build your own cloud application in Google Cloud Platform.

Modules	Teaching Hours
Module 1 **Introduction to Cloud Infrastructure:** Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Major Challenges Faced by Cloud Computing, Cloudcomputing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact. **SLT:** Service level agreements, User experience and software licensing. **Textbook 1:** Ch. 1.3,-1.7, 3.1-3.8	**08**
Module 2 **Cloud Computing: Application Paradigms and Concepts:** Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce	**08**

programming model. **SLT:** The GrepTheWeb application. **Textbook 1:** Ch. 4.1-4.7	
Module 3 **Cloud Resource Virtualization**: Virtualization, Layering and virtualization, Virtual machinemonitors, Virtual Machines, Performance and Security Isolation, Full virtualization and Paravirtualization. **Cloud Security**- Cloud security risks, Privacy and privacy impact assessment, Trust, Operating system security. **SLT:** Virtual machine security. **Textbook 1:** Ch. 5.1- 5.6, 9.1-9.6	**08**
Module 4 **Resource Management and Scheduling:** Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithmsfor computing clouds. **SLT:** Fair queuing and Start-time fair queuing. **Textbook 1:** Ch. 6.1-6.10	**08**
Module 5 **Google Cloud Platform and Services:** Types of Cloud Services, Cloud Computing vs. Data Center Computing. Computing Components of Google Cloud Platform, Storage Components of Google Cloud Platform, Networking Components of Google Cloud Platform, Additional Components of Google Cloud Platform. How GCP Organizes Projects and Accounts, Roles and Identities. **SLT:** Billing and Enabling APIs. **Textbook 2:** Ch. 2, 3	**08**

Textbooks

1. Dan C Marinescu: Cloud Computing Theory and Practice, 2nd edition. Elsevier (MK) 2013.
2. Dan Sullivan: Official Google Cloud Certified Associate Cloud Engineer Study Guide, 1st edition, SYBEX, 2019

Reference Books

1. John W Rittinghouse, James F Ransome: Cloud Computing Implementation, Management and Security, CRC Press 2013.

Course Outcomes (CO)

Upon the completion of the course, students will be able to

CO1	**Explain** the basic cloud computing concepts and distinguish between the various cloud infrastructures.
CO2	**Illustrate** different types of virtualizations, security and resource management techniques that can beused in designing cloud applications.
CO3	Perform **analysis** of the different virtualization and Resource Management techniques used in Google Cloud Platform.

CO4*	Investigate the various methods, algorithms for allocating and managing the resources in cloud.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2												2		
CO2	2												2		
CO3		2													
CO4				2					2						
AVG	**2**	**2**		**2**					**2**				**2**		

SEMESTER – VI

Course Name	: Network Security	**Course Code:**	BCSNS614
No. of Lecture Hours / Week	: 03	**CIE Marks :**	50
No. of Tutorial / Practical Hours / Week	: 00	**SEE Marks :**	50
Total No. of Lecture + Tutorial	: 40	**SEE Duration :**	03 Hrs.
L:T:P	: 3:0:0	**Credits :**	03

Course Prerequisites
Basic knowledge on computer networks and basic understanding of cryptography

Course Overview
This course aims to provide the concept of network security issues, services and goals, also to build protection mechanisms in order to secure computer networks. At the end of the course students will have the thorough knowledge on variety of network security applications and system-level security issues.

Course Learning Objectives (CLO)
This course will enable students to,

- Explore knowledge on security concepts in terms of attacks, services, and mechanism
- Analyze the security models of communication systems, networks and protocols used for secure transactions.
- Understand various system security to protect against the threats in the networks.

Modules	Teaching Hours
Module 1 **Introduction to Security:** Security Concepts, OSI Security Architecture, Security Attacks, Security services, Security Mechanism, A Model for Network Security **SLT:** Case studies on DoS Attack	**08**
Module 2 **Authentication Applications:** Kerberos – Motivation, Version 4, Version 5, X.509 Authentication Service, Public – Key Infrastructure **SLT:** Kerberos Encryption Techniques	**08**
Module 3 **Email privacy**: Pretty Good Privacy (PGP), S/MIME, IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management. **SLT:** Case study on Replay Attack	**08**
Module 4 **Web Security**	**08**

Web Security Consideration, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). **SLT:** Threats on Web Security	
Module 5 **System Security** Intrusion Detection, Password Management, Distributed Denial of Service, Firewall-Design Principles **SLT:** Honeypot & Types of Viruses	**08**

Textbooks

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 4th Edition, 2006

Reference Books

1. Behrouz A. Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
2. Cryptography and Network Security", by Atul Kahate 3rd edition Mc Graw Hill, 2008.

Course Outcomes (CO)

Upon the completion of the course, students will be able to

CO1	**Understand** the principles of Network security, System security and its issues
CO2	**Apply** the authentication application and services for security framework
CO3	**Analyze** Various security principles used for secure transactions
CO4*	**Demonstrate** different web and system security applications using modern tools

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2												2		
CO3		2											2		
CO4			2		2				2				2		
AVG	**2**	**2**	**2**		**2**				**2**				**2**		

SEMESTER – VI

Course Name	: Fundamentals of Digital Image Processing	**Course Code:**	BCSDI614
Number of Lecture Hours / Week	: 03	**CIE Marks:**	50
Number of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total Number of Lecture + Tutorial/Practical Hours	: 40	**SEE Duration:**	03 Hrs.
L:T:P	: 3:0:0	**Credits:**	03

Course Prerequisites
Basic knowledge of programming, linear algebra, data structures and algorithms.

Course Overview
This course introduces concepts like fundamentals of image formation, enhancement of images, segmentation, compression methods and object recognition.

Course Learning Objectives (CLOs)

- To understand image processing techniques
- To understand the concepts of enhancement, segmentation, compression
- To get familiarize with recognition and object detection methods

Modules	Teaching Hours
Module 1 **Introduction:** What is Digital Image Processing, The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System **Digital Image Fundamentals:** Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels **SLT: Elements of visual perception** Textbook: Ch 1, 2	**08**
Module 2 **Intensity Transformations and Spatial Filtering:** Some Basic Intensity Transformation Functions Histogram Processing, Fundamentals of Spatial Filtering, Smoothing (Lowpass) Spatial Filters Sharpening (High pass) Spatial Filters **Filtering in the Frequency Domain:** The Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Some Properties of the 2-D DFT and Inverse DFT, The Basics of Filtering in the Frequency Domain, Image Smoothing Using Lowpass Frequency Domain Filters, Image Sharpening Using High pass Filters **SLT: Homomorphic filtering** Textbook: Ch 3, 4	**08**

Module 3 **Image Restoration and Degradation:** A Model of the Image Degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering **Color Image Processing**: Color Fundamentals, Color Models, Color Transformations **SLT: Geometric mean filtering** Textbook: Ch 5, 6	**08**
Module 4 **Image Compression:** Fundamentals, Huffman Coding, LZW Coding **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Some basic Morphological operations- thickening, thinning, convex hull, skeletons **SLT: Pruning** Textbook: Ch 8, 9	**08**
Module 5: Image Segmentation: Fundamentals, Point, Line, and Edge Detection, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging **SLT: Super pixels** Textbook: Ch 10	**08**

Textbooks

1. Digital Image Processing- Rafael C Gonzalez and Richard E. Woods, PHI 4th Edition 2013.

Reference Books

1. Fundamentals of Digital Image Processing- A K. Jain, Pearson 2004.
2. Image Processing analysis and Machine vision with Mind Tap by Milan Sonka and Roger Boile, Cengage Publications, 2018.
3. S.Jayaraman, S. Esakkirajan,T. Veerakumar, "Digital Image Processing", TataMcGrawHill

Course Outcomes (COs)

At the end of the course students will be able to

CO1	Explain fundamental image processing techniques and pattern recognition required for computer vision.
CO2	Apply enhancement, segmentation methods on images in image processing
CO3	Analyze image segmentation and compression techniques used in image processing
CO4	Explore and implement image processing applications for a given scenario in individual or a team

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO1
CO1	3														
CO2	2												2		
CO3		1											1		
CO4					2				2						
AVG	**2.5**	**1**			**2**				**2**				**1.5**		

SEMESTER – VI

Course Name	: Introduction to Machine Learning	**Course Code:**	BCSML655
No. of Lecture Hours / Week	: 03	**CIE Marks :**	50
No. of Tutorial / Practical Hours / Week	: 00	**SEE Marks :**	50
Total No. of Lecture + Tutorial	: 40	**SEE Duration :**	03 Hrs.
L:T:P	: 3:0:0	**Credits :**	03

Course Prerequisites
Basic Knowledge on variables, linear equations, graphs of functions, histograms, Probability and statistics

Course Overview
This course is concerned with computer programs that automatically improve their performance through experience which illustrates methodologies, technologies, mathematics and algorithms of machine learning techniques.

Course Learning Objectives (CLO)
This course will enable students to,

- Define machine learning and understand the basic theory underlying machine learning
- Differentiate supervised, unsupervised and reinforcement learning
- Understand the basic concepts of learning and decision trees
- Understand neural networks and Bayesian techniques for problems appear in machine learning
- Understand the instant based learning and statistical analysis of machine learning techniques

Modules	Teaching Hours
Module 1 **Introduction:** Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm. SLT: Inductive Bias Textbook1: Ch1.1,1.2,1.3 Ch2 2.2,2.3,2.4,2.5,2.7	**08**
Module 2 **Decision Tree Learning:** Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning. SLT: Why Prefer Short Hypotheses? Textbook1: Ch3.1-3.6	**08**
Module 3 **Artificial Neural Networks:** Introduction, Neural Network representation, Perceptron, Backpropagation algorithm. **SLT:** Adding Momentum Textbook1: 4.1-4.5.2.1	**08**

Module 4 **Bayesian Learning:** Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle **SLT:** Naive Bayes classifier Textbook1:6.1-6.6,6.9	**08**
Module 5 **Instance Based Learning:** Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function. Reinforcement Learning: Introduction, The Learning Task, Q Learning. **SLT:** Cased Based Reasoning Textbook 1: 8.1-8.5,13.1 to 13.3	**08**

Textbooks

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, Foundations of Machine Learning, 2nd edition, MIT Press, 2018
2. Tom M. Mitchell, Machine Learning, McGraw Hill Education, 2013

Reference Books

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, Springer Series in Statistics, 2009
2. Ethem Alpaydın, Introduction to machine learning, 2nd edition, MIT press,2010

Course Outcomes (CO)

Upon the completion of the course, students will be able to

CO1	Explain the concepts of machine learning techniques
CO2	Illustrate the working of various machine learning algorithms
CO3	Analyze theory of probability and the concepts of neural network, classifier for problems appearing in machine learning
CO4*	Design and develop machine learning models for predictive analytics

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	2														
CO3		2													
CO4			2		2				2	1					
AVG	**2**	**2**	**2**		**2**				**2**	**1**					

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SEMESTER – VI

Course Name	**:** Technical Proficiency Enhancement Course - IV	**Course Code :**	BITTP607
Number of Lecture Hours / Week	**: 00**	**CCE Marks :**	50
Number of Tutorial / Practical Hours / Week	**: 02**	**SEE Marks :**	50
Total Number of Lecture + Tutorial/Practical Hours	**: 30**	**SEE Duration :**	2 Hrs.
L:T:P	**: 0:0:2**	**Credits :**	01

COURSE PREREQUISITES: Working knowledge of C Programming and Data Structure.

COURSE OVERVIEW: This course is designed to enhance an individual's problem-solving, analytical, and critical thinking skills using competitive programming, graphs, strings and tries.

COURSE LEARNING OBJECTIVES (CLO) :

1. To enhance problem-solving skills.
2. To develop technical Skill in Recursion, Dynamic Programming, Graphs, Strings and Tries.
3. To Prepare students for job recruitment process and competitive exams.

MODULES	TEACHING HOURS
MODULE 1: Basics of Competitive Programming Introduction to Competitive Programming, Recursion, Time and Space Complexity Analysis, Language Tools, Searching and Sorting Applications, Two Pointers, and Sliding Window	**06**
MODULE 2: Recursion and Bit Manipulation Applications of Recursion: Advanced Recursion, Backtracking, Bit Manipulation and Modulo Arithmetic	**06**
MODULE 3: Dynamic Programming Dynamic Programming, Greedy Problems, Dp and Bitmasking	**06**
MODULE 4: Range Queries and Graphs **Range Queries:** Segment Tree, Fenwick Tree **Graphs:** Graph Implementation, Graph Algorithms, Advanced Graphs.	**06**
MODULE 5: Strings and Tries String Algorithms and Tries	**06**

Reference Books:

1. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests by Antti Laaksonen
2. Data Structures and Algorithms Made Easy by Narasimha Karumanchi
3. Data Structures through C in Depth by by S K Srivastava and Deepali Srivastava

COURSE OUTCOMES (COs):
Upon completion of the course, students will be able to

CO1	Apply and solve complex problems efficiently using Recursion, Dynamic Programming, Graphs, Strings and Tries
CO2	Develop critical thinking skills, enabling them for job interviews and assessment tests.

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2		3													
AVG	**3**	**3**													

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SEMESTER – VI

Course Name	**:** Research Methodology and Intellectual Property Rights	**Course Code:**	BRIPK608
No. of Lecture Hours / Week	: 01	**CIE Marks :**	50
No. of Tutorial / Practical Hours / Week	: 00	**SEE Marks :**	50
Total No. of Lecture + Tutorial	: 20	**SEE Duration :**	02 Hrs.
L:T:P	: 1:0:0	**CREDITS :**	01

COURSE OVERVIEW:

The course develops the skill of interpreting results and preparation of research reports and highlights intellectual property rights. Also, the course emphasizes various techniques of research. It involves developing theoretical and conceptual frameworks and writing a review. It sheds light on sampling designs and methods of data collection.

COURSE LEARNING OBJECTIVES (CLO):

1. To give an overview of the research methodology and explain the technique of defining a research problem.
2. To explain various research designs, sampling designs and different methods of data collections.
3. To explain the art of interpretation and the art of writing research reports and research proposals.
4. To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.

MODULES	TEACHING HOURS
MODULE 1: Introduction to Research Methodology Introduction, meaning of research, Objectives of research, Types of research, Research approaches, Research methods versus Methodology, Research process. Defining the Research Problem: Research problem, Selecting the problem, Necessity of defining the problem, Technique involved in defining a problem. **Textbook 1:** Ch.1, Ch.2. **Self-Study Component:** Criteria of good research.	**04**

MODULE 2: Research Design Introduction, meaning of research design, Features of a good design, Important concepts relating to research design, Different research designs, Basic principles of experimental designs- the Principle of Replication, the Principle of Randomization & Principle of Local Control. **Textbook 1:** Ch.3. **Textbook 2:** Ch.3, Ch.7, Ch.8. **Self-Study Component:** Need for research design.	**04**
MODULE 3: Sampling Design & Measurement Techniques Sampling Design: Introduction, Steps in sampling design, Characteristics of a good sample design, Different types of sample designs. Measurement and Scaling Techniques: Introduction, Measurement scales, Sources of error in measurement, Tests of sound measurement, Technique of developing measurement tools. **Textbook 1:** Ch.4, Ch.5. **Self-Study Component:** Criteria of Selecting a Sampling Procedure.	**04**
MODULE 4: Data Collection & Interpretation and Report Writing Data Collection: Collection of primary data-Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Collection of Secondary Data. Interpretation and Report Writing: Introduction, Technique of interpretation, Different steps in writing report, Layout of the research report, types of research report, Mechanics of writing a research report. **Textbook 1:** Ch.6, Ch.14. **Self-Study Component:** Selection of appropriate method for data collection.	**04**
MODULE 5: Intellectual Property Rights Introduction, The concept, Intellectual property system in India, Patents act-1970, Trademark act-1999, Protection of intellectual property under TRIPS, Copyright and related rights, Geographical indications, Industrial designs, Patents. **Textbook 3:** Ch.1. **Self-Study Component:** Trademarks	**04**
OTHER ASSESSMENT TOOLS (OAT): Case studies on research methodology & intellectual property rights and presenting the information in a report.	

Textbooks:

1. Research Methodology: Methods and Techniques**,** C.R. Kothari, Gaurav Garg, New Age International(P)Limited, Second Edition, 2019.
2. Research Methodology a step-by step guide for beginners, Ranjit Kumar, SAGE Publications Ltd., Fourth Edition, 2014**.**
3. Study material on Intellectual Property Rights-Law and Practice, The Institute of Company Secretaries of India, 2015.

Reference Books:

4. Research Methods: the concise knowledge base, Trochim Atomic Dog Publishing, 2004.
5. Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2010.

COURSE OUTCOMES (CO): Upon the completion of the course, students will be able to	
CO1	Describe the knowledge of research techniques for conducting research studies
CO2	Apply the knowledge of research process to provide solutions for engineering problems.
CO3	Analyze the techniques of research for solving the problems
CO4	Investigate the problems using research-based methods, appropriate techniques, resources, and engineering tools to provide valid conclusions

CO – PO Matrix

CO	**PO**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2											
CO2	2											
CO3		2				2						
CO4				2	2	-						2
AVG	**2**	**2**		**2**	**2**	**2**						2

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SEMESTER – VI

Course Name	**:** Indian Knowledge Systems	**Course Code:**	BIKSK609
Number of Lecture Hours / Week	: 01	**CIE Marks:**	50
Number of Tutorial / Practical Hours / Week	: 00	**SEE Marks:**	50
Total Number of Lecture + Tutorial/Practical Hours	: 15	**SEE Duration:**	2 Hrs.
L:T:P	: 1:0:0	**CREDITS:**	01

COURSE PREREQUISITES: The historical and cultural context of ancient India.

COURSE OVERVIEW: This course is designed to enhance knowledge in multidisciplinary approach that combines historical, linguistic, philosophical, and comparative perspectives which will provide a solid foundation for studying the Indian knowledge system.

COURSE LEARNING OBJECTIVES (CLO)

1. To understand the historical development of Indian philosophy.
2. To identify the diversity of philosophical perspectives within Indian traditions
3. To apply integrate knowledge gained from the study of Indian philosophy with other academic disciplines

MODULES	TEACHING HOURS
MODULE 1: Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance,	**3**
MODULE 2: Traditional knowledge system: Traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.	**3**
MODULE 3: Traditional Knowledge in Humanities and Sciences: Linguistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology.	**3**
MODULE 4: Traditional knowledge system: Traditional Knowledge in Crafts and Trade in India, Engineering and Technology, own planning and architecture Construction.	**3**

MODULE 5: Traditional Knowledge in Professional domain: Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.	**3**

Textbooks:

1. **Introduction to Indian Knowledge System- concepts and applications,** B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93-91818-21-0
2. **Traditional Knowledge System in India**, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230.
3. **Knowledge Traditions and Practices of India**, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334.

Reference Books(web links):

3. http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4. https://unctad.org/system/files/official-document/ditcted10_en.pdf
5. http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf

COURSE OUTCOMES (COs):
Upon completion of the course, students will be able to

CO1	**Understand** the concept of the Indian Knowledge System and its importance.
CO2	**Apply** the ideas of traditional knowledge in different engineering domains.
CO3	Analyze the engineering problems using Indian Knowledge system using appropriate techniques, resources, and engineering ideas.

CO – PO – Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2		2										
CO3								1		1		1
AVG	**2.0**	**2.0**						**1.0**		**1.0**		**1.0**