THE NATIONAL INSTITUTE OF ENGINEERING

MYSORE – 8

(Autonomous Institution under VTU)

B.E - CSE

Scheme of V - VI Semester

Department of Computer Science and Engineering

The National Institute of Engineering

Scheme of Teaching & Examination (2022 Scheme)

Department: Computer Science and Engineering (BE in CS&E)

B.E. 2022 and 2023 Admitted Batch

V Semester

Sl.No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper setting Board (PSB)	Teaching Hrs/Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	HSMS	BCS501	Software Engineering & Project Management	CS	CS	3	0	0		3	50	50	100	**3**
2	IPCC	BCS502	Computer Networks	CS	CS	3	0	2		3	50	50	100	**4**
3	PCC	BCS503	Automata Theory and Computation	CS	CS	3	2	0		3	50	50	100	**4**
4	PCCL	BCSL504	Full Stack Development Lab	CS	CS	0	0	2		3	50	50	100	**1**
5	PCC	BCS505	Full Stack Development	CS	CS	3	0	0		3	50	50	100	**3**
6	PEC	BXX516X	Professional Elective Course (Industry suggested course) - Group I	CS	CS	3	0	0		3	50	50	100	**3**
7	PROJ	BXX586	Minor Project	CS	CS	0	0	2		-	50	-	50	**1**
8	AEC	BRMK557	Research Methodology and IPR	CS	CS	2	0	0		2	50	50	100	**2**
9	MC	BESK508	Environmental Studies	Civil Engg	Civil	1	0	0		-	50	-	50	**1**
10	MC	BNSK559	National Service Scheme (NSS)	NSS Coordinator		0	0	2		_	100	_	100	**0**
		BPEK559	Physical Education (PE) (Sports & Athletics)	PED										
		BYOK559	Yoga	Yoga Teacher										
										Total	**550**	**350**	**900**	**22**

Professional Elective Course - Group I

BCS516A	Computer Graphics	BCS516D	Elective-IV
BCS516B	Artificial Intelligence		
BCS516C	Unix System Programming		

Code: BCS501 **Course: Software Engineering & Project Management**
Credits: 3 **L:T:P - 3:0:0**
SEE: 100 Marks **CIE: 50 Marks**
SEE Hours:3 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers. 2. Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation. 3. Explain the role of DevOps in Agile Implementation. 4. Discuss various types of software testing practices and software evolution processes. 5. Recognize the importance Project Management with its methods and methodologies. 6. Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the activities involved in software engineering and analyze the role of various process models.	Understanding
CO2	Discuss the basics of Modeling techniques and illustrate the usage of the modeling techniques.	Apply
CO3	Illustrate the use of Testing Strategies and understand the importance of Agile methodology and DevOps	Apply
CO4	Illustrate the role of project planning, Management, and quality management in software development	Apply
CO5	Discuss the importance of activity planning and planning models and Software Quality	Understanding

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	2	-	-		2	1
CO2	3	-	3	2	-	-	-	-	-	-	-	-		-	-
CO3	3	-	2	-	3	2	2	-	-	-	-	-		3	2
CO4	3	-	3	2	3	-	2	-	3	2	3	3		3	3
CO5	3	-	-	-	3	2	-	-	-	-	3	1		-	3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Introduction to Software Engineering				
1.1	Introduction: The evolving role of software, Software, The changing nature of software	2	-	-
1.2	Software Engineering, A Process Framework, Process Patterns	2	-	-
1.3	Process Assessment, Personal and Team Process Models	1	-	-
1.4	Process Technology, Product and Process	1	-	-
	Textbook 1: Chapter 1: 1.1 to 1.3	-	-	-
1.5	Process Models: Prescriptive models, Waterfall model	1	-	-
1.6	Incremental process models, Evolutionary process models, Specialized Process Models	1	-	-
	Textbook 1: Chapter 2: 2.1, 2.2, 2.4 to 2.7	-	-	-
Module – 2: Requirement Engineering				
2.1	**Requirements Engineering:** Requirements Engineering Task	1	-	-
2.2	Initiating the Requirements Engineering process, Eliciting Requirements	1	-	-
2.3	Developing use cases, Building the analysis model, Negotiating Requirements, Validating Requirements, Software Requirement Document	2	-	-
	Textbook 1: Chapter 3: 3.1 to 3.6, Textbook 5: Chapter 4: 4.2	-	-	-
2.4	**Building the Analysis Models**: Requirement Analysis, Analysis Model Approaches	1	-	-
2.5	Data modeling Concepts, Object Oriented Analysis	1	-	-
2.6	Scenario-Based Modeling, Flow-Oriented Modeling	1	-	-
2.7	class Based Modeling, Creating a Behavioral Model	1	-	-
	Textbook 1: Chapter 8: 8.1 to 8.8	-	-	-
Module – 3: Software Testing & Agile Methodology				
3.1	**Software Testing**: A Strategic Approach to Software Testing	1	-	-
3.2	Strategic Issues, Test Strategies for Conventional Software	1	-	-
3.3	Test Strategies for Object -Oriented Software, Validation Testing	1	-	-

3.4	System Testing, The Art of Debugging	1	-	-
	Textbook 1: Chapter 13: 13.1 to 13.7		-	-
3.5	**Agile Methodology &DevOps:** Before Agile – Waterfall, Agile Development	1	-	-
3.6	What is DevOps?, DevOps Importance and Benefits, DevOps Principles and Practices, 7 C's of DevOps Lifecycle for Business Agility	1	-	-
3.7	DevOps and Continuous Testing, How to Choose Right DevOps Tools? Challenges with DevOps Implementation	2	-	-
	Textbook 3: Chapter 2: 2.1 to 2.9	-	-	-
Module – 4: Project Management				
4.1	**Introduction to Project Management:** Introduction, Project and Importance of Project Management	1	-	-
4.2	Contract Management, Activities Covered by Software Project Management	1	-	-
4.3	Plans, Methods and Methodologies, Some ways of categorizing Software Projects	2	-	-
4.4	Stakeholders, Setting Objectives, Business Case, Project Success and Failure	2	-	-
4.5	Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices	2	-	-
	Textbook 2: Chapter 1: 1.1 to 1.17	-	-	-
Module – 5: Activity Planning & Software Quality				
5.1	**Activity Planning:** Objectives of Activity Planning, When to Plan	1	-	-
5.2	Project Schedules, Sequencing and Scheduling Activities	1	-	-
5.3	Network Planning Models, Forward Pass– Backward Pass, Identifying critical path, Activity Float	1	-	-
5.4	Shortening Project Duration, Activity on Arrow Networks	1	-	-
	Textbook 2: Chapter 6: 6.1 to 6.16	-	-	-
5.5	**Software Quality:** Introduction, The place of software quality in project planning	1	-	-
	Importance of software quality, software quality models	1	-	-
	ISO 9126, quality management systems, process capability models	1	-	-
	Techniques to enhance software quality, quality plans	1	-	-
	Textbook 2: Chapter 13: (13.1 to 13.6 , 13.9, 13.11, 13.14)	-	-	-
	Total No. of Lecture Hours	**40**	-	-
		Total No. of Tutorial Hours	**00**	**-**
			Total No. of Practical Hours	**00**

Textbook :

Textbook 1: Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.

Textbook 2: Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill Education, 2018.

Textbook 3: Deepak Gaikwad, Viral Thakkar, DevOps Tools From Practitioner's Viewpoint, Wiley. 5. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.

Reference Book:

1. PankajJalote: An Integrated Approach to Software Engineering, Wiley India.
2. Sommerville, Software Engineering,10thEdititon,Pearson Education,2016

Online Resources:

1. NPTEL :: Computer Science and Engineering - NOC:Software Engineering
2. Introduction to Software Engineering Course by IBM | Coursera

Course Code: BCS502 **Course Name: Computer Networks**
Credits: 3 **L:T:P - 3:0:2**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Data Communications and Networking
Learning objectives	1. To understand the services of network layer, functioning of unicast and multicast routing protocols. 2. To learn the IPv4, IPv6 and subnetting concepts. 3. To learn the transport and application layer protocols.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Analyze the functionalities of different layers in TCP/IP model to develop comprehensive solution.	Apply
CO2	Compare IPV4 and IPV6.	Apply
CO3	Algorithms of Routing and Congestion control to solve the problems related to computer networks.	Apply
CO4	Analyze the working of transport and application layer protocols.	Apply

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.no	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Network Layer-I				
1.1	What is a Network? Types of Networks, Different Topologies, Centralized& Decentralized Networks	1	-	-
1.2	Different Models (ISO/OSI &TCP/IP)with Functions of Layer, Comparison	1	-	-
1.3	Error Detection and correction: parity checking, CRC Checksum	2	-	-
1.4	Network layer services: Packetizing, Routing and forwarding other services	1	-	-
1.5	Packet switching: Datagram approach, Virtual circuit approach	1	-	-
1.6	Network layer performance, IPv4 addresses: Address space, Classful addressing	2	-	-
Module – 2: Network Layer-II				
2.1	Classless addressing,	1	-	-
2.2	DHCP, AddressTranslation	1	-	-
2.3	Forwarding IP packets: based on Destination Address and longest matching	1	-	-
2.4	Network Layer Protocols: Internet Protocol (IP): IPV4 Datagram format	1	-	-
2.5	Fragmentation and options	1	-	-
2.6	IPv6 Addressing: Representation, Address space, Address space allocation	1	-	-
2.7	Auto configuration, The IPv6 Protocol: Packet Format, Extension Header	1	-	-
2.8	ICMPv4: Messages, debugging tool, ICMP Checksum	1	-	-
Module – 3: Network Layer-III				
3.1	Routing Algorithms: Distance Vector Routing	1	-	-
3.2	Link state Routing (OSPF)	1	-	-
3.3	Unicast Routing Protocols: Routing Information Protocol (RIP)	1	-	-
3.4	Border Gateway Protocol (BGP): operation of External BGP (eBGP), Operation of Internal BGP (eBGP)	2	-	-
3.5	Multicast Routing: Introduction, Unicasting, Multicasting, broadcasting	2	-	-
Module – 4:Transport Layer				
4.1	Transport Layer: Introduction, Transport Layer Services	1	-	-
4.2	End -to -End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP), End-to-End issues,	1	-	-
4.3	Segment format, Connecting Establishment and Termination, Sliding Window Revisited	1	-	-

4.4	Triggering Transmission, Adaptive retransmission, Record Boundaries	1	-	-
4.5	Queuing Disciplines, FIFO, Fair Queuing Congestion Control,	1	-	-
4.6	Adaptive Increase /Multiplicative Decrease	1	-	-
4.7	Slow Start, Fast Retransmit	1	-	-
4.8	Congestion Control and Resource Allocation: Congestion-Avoidance Mechanisms, dec bit	1	-	-
4.9	Random Early Detection (RED), Source based Congestion Avoidance	1	-	-
Module – 5: Application Layer				
5.1	Application Layer: Domain Name System (DNS)	2	-	-
5.2	Electronic Mail (SMTP, POP, IMAP, MIME)	3	-	-
5.3	standard client server protocols: WWW	1	-	-
5.4	HTTP	1	-	-
5.5	Telnet	1	-	-
List of Experiments				
1	Write a program to implement the following Error detection technique: a) Single Parity Check b) Cyclic Redundancy Check(CRC) c) Internet Checksum			1
2	Configure and implement DHCP service in a Local Area Network.			1
3	Capture c)Capture ICMPv4 packets generated by utility programs like ping, traceroute and tabulate all the captured c)Capture ICMPv4 packets generated by utility programs like ping, traceroute and tabulate all the captured Capture ICMPv4 packets generated by utility program like ping, trace route and tabulate all the captured parameters.			
4	Configuring IP Routing using i) RIP ii) OSPF			1
5	Performing an Initial Switch Configuration. (Host name, Console password, vty password, Privileged EXEC mode password, Privileged EXEC mode secret, IP address on VLAN1 interface, Default gateway)			1
6	Performing an Initial Router Configuration. (Configure the router host name, configure the passwords, configure the banner messages, verify the router configuration)			1
7	Implement the following types of routing: a. Static Routing. b. Dynamic Routing. c. Default Routers.			1
8	Configure User Datagram Protocol (UDP) and Transmission Control Protocol(TCP).			1

9	Configure File Transfer Protocol (FTP). d.Configure Hypertext Transfer Protocol (HTTP). a. Configure i) FTP ii) HTTP ii) SMTP iii) POP iv) IMAP b. Use TELNET to login to Remote Machine			1
10	Configure and implement DNS service			1
11	Write a program which uses Socket to establish connections between client and server to exchange messages.			1
	Total No. of Lecture Hours	**40**	**-**	**-**
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**10**

Textbook:

1. BehrouzForouzan,"Data Communications and Networking", Tata McGraw-Hill, 5th Edition, 2013.
2. Larry Peterson and Bruce S Davis "Computer Networks: A System Approach 5th Edition, Elsevier -2014

Reference Book:

1. Computer Networks, Andrew S. Tanenbaum, Pearson Education, 4th Edition, 2002.
2. Data and Computer Communication, William Stallings, Pearson Education, 8th Edition, 2007

Online Resources:

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

Code: BCS503
Credits: 4
SEE: 100 Marks
SEE Hours: 3

Course: Automata Theory of Computation
L:T:P - 3:2:0
CIE: 100 Marks
Max. Marks:100

Prerequisites if any	Any Programming language, Discrete Mathematical structures
Learning objectives	1. To give an overview of the theoretical foundations of computer science from the perspective of formal languages and illustrate finite state machines to solve problems in computing 2. To familiarize Regular grammars, context frees grammarand also to explain the hierarchy of problems arising in the computer sciences.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Discuss basic concepts of formal languages of finite automata techniques	Understand
CO2	Design Finite Automata's for different Regular Expressions and Languages	Apply
CO3	Construct context free grammar for various languages	Apply
CO4	Solve various problems of applying normal form techniques, push down automata and Turing Machines	Analyze

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Introduction to Automata Theory				
1.1	Central Concepts of Automata Theory	1		
1.2	Finite Automata - Deterministic Finite Automata	2	1	
1.3	Non Deterministic Finite Automata, NFA to DFA	2		
1.4	Finite Automata with Epsilon Transitions	1		
1.5	Elimination of Epsilon Transitions	2	1	
Module – 2: Regular Expressions and Languages				
2.1	Regular Expressions	2		
2.2	Finite Automata and Regular Expressions – DFA to Regular Expression – Kleen's closure	2	1	
2.3	Finite Automata to Regular Expression – State elimination	2		
2.4	Regular Expression to Finite automata	1	1	
2.5	Applications of Regular Expressions	1		
Module – 3: Properties of Regular Languages, Context Free Grammars				
3.1	Proving Languages not to be regular, Closure Properties of regular languages	2		
3.2	Equivalence and Minimization of Automata	2	1	
3.3	Context Free Grammars	2	1	
3.4	Leftmost, rightmost Derivations, Parse Trees, Ambiguity in Grammars	2		
Module – 4: Pushdown Automata				
4.1	Pushdown Automata, Languages of PDA	2	1	
4.2	Equivalence of PDA and CFG – Grammars to PDA	2		
4.3	Elimination of Epsilon, Unit Productions, Useless productions	2	1	
4.4	Chomsky Normal Form	2	1	
Module – 5: Turing Machines				
5.1	Introduction to Turing Machines	2		
5.2	Notation , Instantaneous description and transitions of Turning Machine	2	1	
5.3	Post's Correspondence Problem	2		
5.4	Introduction to Class P and NP problems	2		
	Total No. of Lecture Hours	**40**	**-**	**-**
	Total No. of Tutorial Hours		**10**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. Textbook 1
   John E Hopcroft, Rajeev Motwani, Jeffrey D Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson Education

Reference Book:

1. Sipser, Michael. Introduction to the Theory of Computation. 3rd ed. Cengage Learning, 2012. ISBN: 9781133187790.
2. Peter Linz, An Introduction to Formal Languages and Automata, 6/e

Code: BCSL504 **Course: Full stack development LAB**
Credits: 1 **L:T:P - 0:0:2**
SEE: 50% **CIE: 50 (SEE): practical**
Hours:2 **Max.Marks: 100**

Course Outcomes:

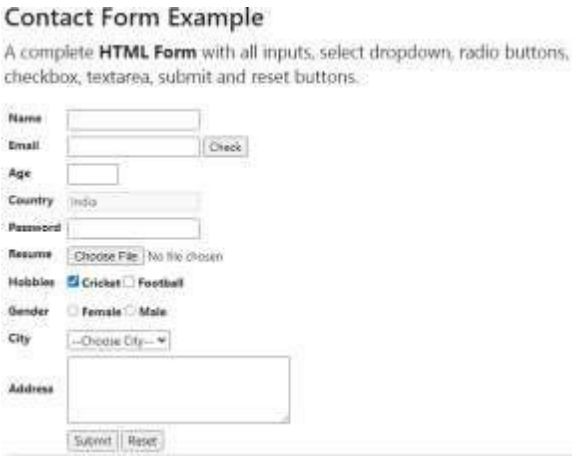
On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Implement web pages using XHTML and CSS.	Apply
CO2	Demonstrate core constructs and event handling mechanisms of JavaScript to develop web Pages.	Apply
CO3	implement interactive web applications using ReactJS and NodeJS.	Apply
CO4	Demonstrate the creation of dynamic web pages and connecting to MYSQL/MongoDB	Apply

Mapping with POs and PSOs

COs	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12		PSO1	PSO2
CO1	3	2	3	2	2	1	-	1	-	-	1	2		3	3
CO2	3	2	2	2	2	1	-	1	-	-	1	2		3	3
CO3	3	2	3	2	3	1	-	1	-	-	1	2		3	3
CO4	3	2	3	2	3	1	-	1	-	-	2	2		3	3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Sl.No	LAB EXPERIMENTS	COURSE OUTCOME
1	Create a html page as shown below. Author: Title: Submit Reset	CO1
2	Create the below registration form using form using HTML 	CO1
3	Build a responsive web application for shopping cart with registration, login, catalog and cart pages using CSS features .	CO1
4	Write JavaScript to validate the following fields of the Registration page. 1. First Name (Name should contains alphabets and the length should not be less than 6 characters). 2. Password (Password should not be less than 6 characters length). 3. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com) 4. Mobile Number (Phone number should contain 10 digits only). 5. Last Name and Address (should not be Empty).	CO2
5	Develop and demonstrate JavaScript with POP-UP boxes and functions for the following problems: a) Input: Click on Display Date button using on click( ) function Output: Display date in the textbox	CO2

	b) Input: A number n obtained using prompt Output: Factorial of n number using alert	
6	Write a Java Script program where the program takes a random integer between1 and10, and the user is then prompted to input a guess number. The program displays a message “Good Work" if the input matches the guess number otherwise "Not matched".	CO2
7	Write a Java Script program where the program takes a random integer between1 and10, and the user is then prompted to input a guess number. The program displays a message “Good Work" if the input matches the guess number otherwise "Notmatched".	CO2
8	Write a JavaScript program to create a new string from a given string by changing the position of the first and last characters. The string length must be broader than or equal to 1.	CO2
9	Implementation of components and props in react.	CO3
10	Demonstrate component creation, props and Hooks.	CO3
11	Demonstrate life cycle of component in reactjs	CO3
12	Demonstrate error handling in Reacts using error boundaries	CO3
13	Write a program of Adding React Router in application.	CO3
14	Demonstrate Redux in reactjs.	CO3
15	Implement Modules and events in Nodejs.	CO3
16	Develop a query using MongooDB to implement CURD operations (create, read, projection, update, delete aggregate).	CO4
17	Develop a web application to display the contents from employee table Mysql/MongoDB.	CO4
18	Illustrate inserting a row into Mysql/MongoDB table from ReactJS/NodeJs/HTML.	CO4
	Develop an application and connects with database (MongoDB) and perform CURD operations on the database table	

Code: BCS505 **Course: Full stack development**
Credits: 3 **L:T:P - 3:0:2**
SEE: 50% **CIE: 50%**
SEE Hours: 3Max. Marks: 100

Prerequisites if any	Computer networks
Learning objectives	1. Create web page using HTML & CSS 2. Develop familiarity with the JavaScript language, realize concepts commonly used in dynamic language programming, such as introspection, higher-order functions, closures, familiar with common libraries and tools that are used in web application development. 3. To Create React Components, lifecycle of components, rendering list and portal and perform some simple tests, and error handling. 4. To create Node.js modules, events and database access and interact with databases using MongoDB .

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Prepare web pages using XHTML and CSS.	Apply
CO2	Apply core constructs and event handling mechanisms of JavaScript to develop web Pages.	Apply
CO3	Build interactive web applications using ReactJS and NodeJS.	Analyze
CO4	Demonstrate the creation of dynamic web pages and connecting to MYSQL/MongoDB	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12		PSO 1	PSO 2
CO1	3	2	3	2	2	1	-	1	-	-	1	2		3	3
CO2	3	2	3	2	2	1	-	1	-	-	1	2		3	3
CO3	3	2	3	2	3	1	-	1	-	-	1	2		3	3
CO4	3	2	3	2	3	1	-	1	-	-	1	2		3	3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structures

Nos.	Modules -1:HTML &CSS	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.1	Introduction to XHTML , Basic syntax, Standard HTML Document Structure, Images,	1	-	
1.2	Paragraphs, Line Breaks, Heading Tags, Font Styles, Sizes, Color, Character Entity	1	-	
1.3	links, Lists, tables, form tags, Font properties, text decoration, List property,	2	-	1
1.4	CSS Colors and background, CSS Box Model, CSS Margins, Padding, Borders. Background images, span and div tags, Grid and flex.	2	-	1
	Module 2: JavaScript			
2.1	Introduction to JavaScript, General syntactic characteristics	1	-	
2.2	Primitives, operations, expressions	1	-	-
2.3	Screen output and keyboard input, Control statements,	1	-	1
2.4	Object creation &modification, arrays, array methods, Functions,	1	-	1
2.5	JavaScript and XHTML Documents: The JavaScript execution environment, The Document Object Model, Element access in JavaScript, Events and event handling,	2	-	-
2.6	Handling events from the Body elements, Button elements, Text box and Password elements.	2	-	1
	Module – 3: ReactJS			
3.1	Introduction, Templating using JSX	1	-	-
3.2	Components, State, Props,Hooks	2	-	1
3.3	Lifecycle of Components	2	-	1
3.4	Rendering List and Portals	2	-	1
3.5	Error Handling, Routers	2	-	2
3.6	Redux and Redux Saga	2	-	2
	Module4: NodeJS			
4.1	Node.js overview, Node.js – basics and setup.	1	-	-

4.2	Node.js console, Node.js command utilities	1	-	1
4.3	Node.js modules, Node.js concepts	3	-	2
	Node.js events, Node.js database access.	2		2
	Module 5: MongoDB			
5.1	MongoDB basics: Documents, collections, database query language, mongo shell.	2	-	1
5.2	MongoDB CRUD operations (create, read, projection, update, delete aggregate)	2	-	2
5.3	reading from MongoDB, writing from MongoDB	2	-	-
5.4	MongoDB with PHP, MongoDB with NodeJS	2	-	2
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hour		00	
	Total No. of Practical Hours			22

Textbook:

1. Programming the World Wide Web, Robert W. Sebesta, 4th Edition, Pearson Education, 2008.
2. Full-Stack React Projects: Learn MERN Stack Development by Building Modern Web Apps Using MongoDB, Express, React, and Node.js, 2nd Edition.

Reference Book:

1. Open-Source Web Development with Lamp, James Lee and Brent Ware, Pearson Education, 2009.
2. Internet and World Wide Web: How to Program -Harvey M. Deitel, Paul J. Deitel, 4thedition, Pearson, 2009.
3. The Web Programming Building Internet Applications- Chris Bates, 3rd Edition, Wiley India, 2006

Online Resources:

1. MongoDB Notes for Professionals book Tutorial for Beginners in PDF by GoalKicker.com
2. https://docs.google.com/viewer?url=https://www.computer-pdf.com/pdf/0840-mongodb-notes-for-professionals-book.pdf
3. https://www.javatpoint.com/reactjs-tutorial

Code: BCS516A **Course: Computer Graphics and Visualization**
Credits: **L:T:P - 3:0:0**
SEE: 100 Marks **CIE: 50 Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Computer concepts and programming
Learning objectives	• To understand Graphic system and use open GL APIs • To perform geometric transformations and understand different viewing projections

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Explain the basic components in computer graphic system	Understand
CO2	Illustrate the OpenGL APIs and components of interactive programming	Apply
CO3	Explain and Illustrate basics of geometric objects and transformations	Understand
CO4	Explain and demonstrate geometric transformations in homogeneous coordinates using OpenGL	Analyze
CO5	Analyze and compare parallel and perspective projections with relevant examples	Analyze

Mapping with Pos and PSOs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	2	-	-	-	-	-	-	-	-	-	-		-	-
CO2	1	2	-	-	3	-	-	-	-	-	-	-		-	-
CO3	2	2	-	-	2	-	-	-	-	-	-	-		-	-
CO4	3	2	-	-	3	-	-	-	-	-	-	-		2	2
CO5	2	2	2	-	3	-	-	-	-	-	-	-		2	2

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No.	Module Name	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1: Introduction			
1.1	Applications of computer graphics	1	-	-
1.2	A graphics system	1	-	-
1.3	Images: Physical and synthetic	1	-	-
1.4	Imaging Systems	1	-	-
1.5	The synthetic camera model	1	-	-
1.6	The programmer's interface, Graphics architectures	1	-	-
1.7	Programmable Pipelines, Performance characteristics	1	-	-
	Module – 2: Graphics Programming			
2.1	The Sierpinski Gasket	1	-	-
2.2	Programming Two Dimensional Applications	1	-	-
2.3	The OpenGL API, Primitives and attributes	1	-	-
2.4	Color; Viewing	1	-	-
2.5	Control functions	1	-	-
2.6	The Gasket program	1	-	-
2.7	Polygons and recursion	1	-	-
2.8	Adding interactions, Menus	1	-	-
	Module – 3: Geometric Objects and Transformations-I			
3.1	Scalars, Points, and Vectors	2	-	-
3.2	Three-dimensional Primitives	1	-	-
3.3	Coordinate Systems and Frames	1	-	-
3.4	Frames in OpenGL	1	-	-
3.5	Matrix and vector classes	1	-	-
3.6	Affine Transformations	1	-	-
3.7	Rotation	1	-	-
	Module – 4:Geometric Objects and Transformations-II			

4.1	Transformation in Homogeneous Coordinates	2	-	-
4.2	Concatenation of Transformations	3	-	-
4.3	Transformation Matrices in OpenGL	3	-	-
Module – 5: Viewing				
5.1	Classical and computer viewing;;;; ;	1	-	-
5.2	Viewing with a Computer; Parallel Projections	1	-	-
5.3	Perspective Projections; Perspective Projections with OpenGL	1	-	-
5.4	Perspective Projection Matrices	1	-	-
5.5	Hidden-surface removal	2	-	-
5.6	Displaying Meshes	3	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**00**

Textbook:

1. Edward Angel: **Interactive Computer Graphics A Top-Down Approach with OpenGL**, 6th Edition, Pearson Education, 2012

Reference Book:

1. Donald Hearn and Pauline Baker: Computer Graphics- OpenGL Version, 3rd Edition, Pearson Education, 2004.
2. F.S. Hill Jr.: Computer Graphics Using OpenGL, 2nd Edition, Pearson education, 2001.
3. James D Foley, Andries Van Dam, Steven K Feiner, John F Hughes, Computer Graphics, Addison-Wesley 1997

Course Code: BCS516B **Course: Artificial Intelligence**
Credits: 3 **L:T:P** 3:0:0
CIE: 50 Marks **SEE:** 50 Marks
SEE Hours: 3 **Max. Marks:** 100

Pre requisites if any	None
Learning objectives	1. Develop an understanding of the historical context of AI and its fundamental principles. 2. Acquire proficiency in applying basic AI principles to solve problems effectively. 3. Familiarize oneself with the methodologies of inference, perception, knowledge representation, and learning in AI.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Utilize fundamental AI principles to address problems involving problem-solving, inference, knowledge representation, and learning.	Understand
CO2	Evaluate search and inference algorithms within the context of problem-solving	Apply
CO3	Exhibit understanding of reasoning, uncertainty, and knowledge representation for tackling real- world problems.	Apply
CO4	Execute experiments to address problems utilizing AI techniques.	Analyze

Mapping with Pos and PSOs:

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

Mapping Strength: Strong–3 Medium–2 Low–1

Course Structure

Sl. no	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module–1: Introduction to AI			
1.1	**Introduction:** What is AI? Foundations of AI.	2	-	-
1.2	History of Artificial Intelligence	1	-	-
1.3	The State of the Art	1	-	-
1.4	**Intelligent Agents:** Agents and environment	1	-	-
1.5	Concept of Rationality	1	-	-
1.6	The nature of environments	1	-	-
1.7	The structure of agents	1	-	-
	Module–2: Problem solving based on searching			
2.1	Problems solving Agents, Example problems	2	-	-
2.2	Searching for solutions	1	-	-
2.3	Uniformed Search strategies–Uniform cost search	1	-	-
2.4	Breadth First Search, Depth First Search	1	-	-
2.5	Depth Limited Search	1	-	-
2.6	Iterative Deepening Depth First	2	-	-
	Module–3: Heuristic Search Strategies			
3.1	Heuristic functions	1	-	-
3.2	Greedy best first search	1	-	-
3.3	A*algorithm	2	-	-
3.4	Local Search & Optimization: Hill Climbing	1	-	-
3.5	Genetic Algorithms	2	-	-
	Module–4: Logical Agents, First Order Logic, Inference in First Order Logic			
4.1	**Logical Agents:** Knowledge–based agents	1	-	-
4.2	The Wumpus world, Logic	1	-	-
4.3	Proposition allogic	1	-	-
4.4	Reasoning patterns in Propositional Logic	2	-	-
4.5	**First Order Logic:** Representation Revisited, Syntax and Semantics of First Order logic	2	-	-
4.6	Using First Order logic.	1	-	-
4.7	**Inference in First Order Logic:** Propositional Versus First Order Inference	1	-	-
4.8	Unification, Forward Chaining	1	-	-
4.9	Backward Chaining, Resolution.	1	-	-
	Module–5: Quantifying Uncertainty			
5.1	Acting under Uncertainty	1	-	-
5.2	Probability Notation	1	-	-
5.3	Inference using Full Joint Distributions	1	-	-
5.4	Independence	1	-	-
5.5	Baye's Rule and its use	1	-	-
5.6	Wumpus World Revisited	1	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**00**

Textbook:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence, 3rd Edition, Pearson, 2015

Reference Book:

1. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition, Tata McGraw Hill, 2013
2. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011

Online Resources:

1. Artificial Intelligence: https://nptel.ac.in/courses/106105077

Code: BCS516C
Credits: 3
SEE: 100 Marks
SEE Hours: 03 hour

Course: **UNIX System Programming**
L:T:P - 3:0:0
CIE: 50 Marks
Max. Marks: 100

Prerequisites if any	NIL
Learning objectives	Develop the ability to writing efficient and robust UNIX applications, utilizing system calls, libraries, and tools effectively to develop scalable and portable software solutions for diverse computing environments.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Understand Unix Architecture, File system and use of Basic Commands	Understand
CO2	Analyze Shell Programming and to write Shell Scripts	Analyze
CO3	Categorize, compare and make use of Unix System Calls	Analyze
CO4	Build an application/service over a Unix system.	Apply

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Unix Components/Architecture. Meaning of Internal and external commands.	1		
1.2	Features of Unix. The UNIX Environment and UNIX Structure	1		
1.3	Posix and Single Unix specification. General features of Unix commands/ command structure.Command arguments and options. Basic Unix commands such as echo, printf, ls, who, date, passwd, cal, Combining commands.	1		
1.4	The type command: knowing the type of a command and locating it. The root login. Becoming the super user: su command.	1		
1.5	Naming files. Basic file types/categories. Organization of files. Hidden files. Standard directories. Parent child relationship.	1		
1.6	The home directory and the HOME variable. Reaching required files- the PATH variable, manipulating the PATH, Relative and absolute pathnames. Directory commands – pwd, cd, mkdir, rmdir commands.	2		
1.7	The dot (.) and double dots (..) notations to represent present and parent directories and their usage in relative path names. File related commands – cat, mv, rm, cp, wc and od commands.	1		
	Module – 2			
2.1	File attributes and permissions	2		
2.2	The shells interpretive cycle	2		
2.3	Connecting commands	2		
2.4	Shell Programming	2		
	Module – 3			
3.1	UNIX File APIs	1		
3.2	UNIX Processes and Process Control	2		
3.3	The Environment of a UNIX Process	1		
3.4	Process Control	2		
	Module – 4			

4.1	Changing User IDs and Group IDs, Interpreter Files, system Function, Process Accounting, User Identification, Process Times, I/O Redirection.	3		
4.2	Overview of IPC Methods	2		
4.3	Shared Memory	3		
Module – 5				
5.1	Signals: The UNIX Kernel Support for Signals, signal, Signal Mask, sigaction, The SIGCHLD Signal and the waitpid Function, The sigsetjmp and siglongjmp Functions, Kill, Alarm, Interval Timers, POSIX.lb Timers.	4		
5.2	Daemon Processes: Introduction, Daemon Characteristics, Coding Rules, Error Logging, Client-Server Model.	3		
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. Sumitabha Das., Unix Concepts and Applications., 4thEdition., Tata McGraw Hill (Chapter 1,2 ,3,4,5,6,8,13,14)

2. W. Richard Stevens: Advanced Programming in the UNIX Environment, 2nd Edition, Pearson Education, 2005 (Chapter 3,7,8,10,13,15)

3. Unix System Programming Using C++ - Terrence Chan, PHI, 1999. (Chapter 7,8,9,10)

Reference Book:

1. M.G. Venkatesh Murthy: UNIX & Shell Programming, Pearson Education.

2. Richard Blum , Christine Bresnahan : Linux Command Line and Shell Scripting Bible, 2ndEdition, Wiley,2014.

Code: BCS586
Credits: 2
CIE: 50 Marks

Course : Minor Project
L: T:P : 0:0:4
Max. Marks: 50

Pre-requisites if any	Form a Team, define Project objectives, literature survey, identify resources, define Methodology, documentation.
Learning objectives	• Clearly state the goals and objectives of the project. • Determine the scope and expected outcomes. • Collaborate with classmates for the project teamwork. • Assign roles and responsibilities based on each team member's strengths. • Identify potential risks and challenges that might arise during the project. • Maintain detailed records of your project, design, and development process. • Prepare to present your findings and results clearly and comprehensively.

Course outcomes:

On the successful completion of the course, the student will be able to

COS	Description	Bloom's level
CO1	**Conceptualize design and implementation solution for specific problems**	**Apply**
CO2	**Apply resource management skills for projects and communicate the solutions through presentations and technical**	**Apply**

Mapping with POs and PSO's

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

Mapping Strength: Strong-3 Medium-2 Low-1

Course Code: BRMK557 **Course name: Research Methodology and IPR**
Credits: 03 **L:T:P - 2:0:0**
SEE: 100 Marks **CIE: 50 Marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	NIL
Learning objectives	1. To gain knowledge on research methodology and explain the technique of formulating a research problem. 2. To understand various research designs and different types of data collections. 3. To understand various sampling designs and its characteristics. 4. To acquire the knowledge on report writing and various concepts of IPR.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Discuss different objectives of research and formulating Research Problem	Understand
CO2	Analyze various research design and methods of data collection	Analyze
CO3	Analyze various sampling design and its characteristics	Analyze
CO4	Acquire the knowledge on Report Writing and IPR	Analyze

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Research Methodology: An Introduction, Defining the research problem				
1.1	Meaning of Research, Objectives of Research Motivation in Research	1	-	-
1.2	Types of Research, Research Approaches, Research Methods versus Methodology, Research and Scientific Method.	2	-	-
1.3	Research Process.	1	-	-
1.4	Criteria of good research, what is a Research Problem?	1	-	-
1.5	Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.	1	-	-
Module – 2: Research Design, Methods of data collection				
2.1	Meaning of Research, Design, Need for Research Design	1	-	-
2.2	Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs.	2	-	-
2.3	Collection of Primary Data, Observation Method, Interview Method Collection of Data through Questionnaires.	2	-	-
2.4	Collection of Data through Schedules, Difference between Questionnaires and Schedules ,Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection	1	-	-
Module – 3:Sampling Design				
3.1	Census and Sample Survey, Implications of a Sample Design	1	-	-
3.2	Steps in Sampling Design, Criteria of Selecting a Sampling Procedure	1	-	-
3.3	Characteristics of a Good Sample Design, Different Types of Sample Designs	2	-	-
3.4	How to Select a Random Sample? Random Sample from an Infinite Universe Complex Random Sampling Designs	1	-	-
Module – 4: Interpretation and Report Writing				
4.1	Meaning of Interpretation, Why Interpretation? Technique of Interpretation Precaution in Interpretation	1	-	-
4.2	Significance of Report Writing, Different Steps in Writing Report	2	-	-
4.3	Layout of the Research Report, Types of Reports, Oral Presentation	1	-	-
4.4	Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions	1	-	-
Module – 5: Introduction to Intellectual Property				

5.1	Role of IP in the Economic and Cultural Development of the Society, IP Governance, Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention, Rights Associated with Patents, Enforcement of Patent Rights, Inventions Eligible for Patenting, Process of Patenting	1	-	-
5.2	Classes of Copyrights, Criteria for Copyright Ownership of Copyright, Copyrights of the Author, Copyright Infringements, Copyright Registration, Copyright Symbol Validity of Copyright.	2	-	-
Total No. of Lecture Hours		**25**	-	-
Total No. of Tutorial Hours			**15**	**-**
Total No. of Practical Hours				**00**

Textbook:

1. Kothari, C.R., (2014), Research Methodology, New Age International second revised edition
2. Prof. RupinderTewari, Ms. MamtaBhardwaj (2021) Intellectual Property A Primer for Academia.

Reference Book:

1. Ranjit Kumar, (2011). Research Methodology a step by step guide for beginners, Sage Publications
2. Chawla, Deepak &Sondhi, Neena (2011). Research methodology: Concepts and Cases, Vikas Publishing House Pvt. Ltd. Delhi.

Online Resources:

1. https://onlinecourses.swayam2.ac.in/cec23_ge07/preview
2. https://onlinecourses.nptel.ac.in/noc22_ge08/previe

The National Institute of Engineering

Scheme of Teaching & Examination (2022 Scheme)

Department: Computer Science and Engineering (BE in CS&E)

B.E. 2022 and 2023 Admitted Batch

VI Semester

Sl.No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper setting Board (PSB)	Teaching Hrs/Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BCS601	Internet of Things	CS	CS	3	0	2		3	50	50	100	**4**
2	PCC	BCS602	Machine Learning	CS	CS	3	0	0		3	50	50	100	**3**
3	PEC	BCS613x	Professional Elective Course - Group II	CS	CS	3	0	0		3	50	50	100	**3**
4	OEC	BCS654x	Open Elective Course - Group I	CS	CS	3	0	0		3	50	50	100	**3**
5	PCC	BCS605	Cloud Computing	CS	CS	3	2	0		3	50	50	100	**4**
6	PCC	BCS606	Distributed Systems	CS	CS	3	0	0		3	50	50	100	**3**
7	PCCL	BCSL607	Machine Learning lab	CS	CS	0	0	2		3	50	50	100	**1**
8	AEC/SDC	BXX657X	Ability Enhancement Course / Skill Development Course V	CS	CS	If the course is a Theory: 1	0	0		1	50	50	100	**1**
						OR								
						If the course is a Laboratory: 0	0	2		2				
9	MC	BNSK658	National Service Scheme (NSS)	NSS Coordinator		0	0	2		_	100	_	100	**0**
		BPEK658	Physical Education (PE) (Sports & Athletics)	PED										
		BYOK658	Yoga	Yoga Teacher										
10	MC	BIKK259	Indian Knowledge Systems	Humanities		1	0	0	0	0	50	-	50	**0**
										Total	**500**	**400**	**900**	**22**

Professional Elective Course - Group II

BCS613A	Blockchain Technology	BCS613D	Advanced Java
BCS613B	Computer Vision	BCS613E	Entrepreneurship and Enterprise Resource Planning
BCS613C	Compiler Design		

Open Elective Course - Group I

BCS654A	Introduction to Java Programming	BCS654D	Introduction to AI
BCS654B	Introduction to Web Technologies	BCS654E	Introduction to Data Science
BCS654C	Mobile Application Development	BCS654F	Introduction to Blockchain Technology

Ability Enhancement Course / Skill Enhancement Course-V

BCSL657A	Progressive App Development	BCS657D	Devops
BCSL657B	Tosca – Automated Software Testing		
BCS657C	Agile Development		

Code: BCS601
Credits: 4
SEE: 100 Marks
SEE Hours: 3 Hrs

Course: Internet-of-Things
L:T:P 3:0:2
CIE: 50 Marks
Max. Marks:100

Prerequisites if any	NIL
Learning objectives	The goal of this course is to comprehend I. To assess impact of IoT in real world II. To analyze and infer the role of data, data analytics and IoT endpoints in IT and OT

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Discuss the genesis and impact of IoT applications, architectures in real world	Understand
CO2	Illustrate the diverse methods of deploying smart objects and connect them to network	Apply
CO3	Analyze the role of Data Analytics and Security in IoT	Apply
CO4	Discuss the IoT Physical Devices and programming Fundamentals	Understand
CO5	Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry	Apply

Mapping with POs and PSOs:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2		PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-		2	-
CO2	3	-	3	2	-	-	-	-	-	-	-	-		1	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-		1	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-		1	-
CO5	3	-	-	-	-	2	-	-	-	3	1	-		2	-

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1 Introduction to IoT			
1.1	Genesis of IoT, IoT and Digitization, IoT Impact	1		
1.2	Convergence of IT and IoT, IoT Network Architecture and Design	2		
1.3	Drivers Behind NewNetwork Architectures, Comparing IoT Architectures	2		
1.4	A Simplified IoT Architecture, The Core IoT Functional Stack	2		
1.5	IoT Data Management and Compute Stack	1		
	Module – 2 Smart Objects			
2.1	The "Things" in IoT	1		
2.2	Sensors	1		
2.3	Actuators and Smart Objects	1		
2.4	Connecting Smart Objects	1		
2.5	Communications Criteria	2		
2.6	IoT AccessTechnologies	2		
	Module – 3 Data and Analytics for IoT			
3.1	An Introduction to Data Analytics for IoT	1		
3.2	Machine Learning	1		
3.3	Big Data Analytics Tools and Technology	1		
3.4	Edge Streaming Analytics, Network Analytics	1		
3.5	Securing IoT, A Brief History of OT Security	1		
3.6	How IT and OT Security Practices and Systems Vary	1		
3.7	Formal Risk Analysis Structures: OCTAVE and FAIR	2		
	Module – 4 IoT Physical Devices			
4.1	Arduino UNO: Introduction to Arduino	2		
4.2	Arduino UNO	2		
4.3	Installing the Software	2		
4.4	Fundamentals of Arduino Programming	2		
	Module - 5 IoT Endpoints			
5.1	IoT Endpoints –RaspberryPi	1		
5.2	Introduction to RaspberryPi	1		
5.3	About the RaspberryPi Board	2		
5.4	Hardware Layout	1		
5.5	Operating Systems on RaspberryPi	1		
5.6	Wireless Temperature Monitoring System Using Pi	2		
	Lab Programs			
1.	Introduction to working IDE and its practice			1
2.	Sense the available networks using Arduino			1
3.	Measure the distance using ultrasonic sensors and make LED blink using Arduino			1
4.	Detect the vibration of an object using Arduino			1
5.	Connect with the available Wi-Fi using Arduino			1
6.	Temperature notification using Arduino			1

7.	LDR to vary light intensity of LED using Arduino			1
8.	MYSQL database installation in Rasberry Pi			1
9.	SQL queries by fetching data from database in Rasberry Pi			2
	Total No. of Lecture	**40**		
	Total No. of Tutorial Hours		**00**	
	Total No. of Practical Hours			**10**

Textbooks:

1) David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint).
2) Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017

Reference Books:

1 Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.

2 Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017.

Code: BCS602
Credits: 3
SEE: 50 Marks
SEE Hours: 3

Course: MACHINE LEARNING
L:T:P - 3:0:0
CIE: 50 Marks
Max. Marks: 100

Prerequisites if any	None
Learning objectives	1. Acquire theoretical Knowledge on setting hypothesis for pattern recognition. 2. Apply suitable machine learning techniques for data handling and to gain knowledge from it. 3. Evaluate the performance of algorithms and to provide solution for various real-world applications.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Explain the basic principles of Learning theories	Understanding
CO2	Explain the principles of dimensionality reduction and feature selection techniques	Apply
CO3	Develop a wide variety of supervised learning algorithms	Apply
CO4	Utilize decision trees and random forest algorithms judiciously, and choose appropriate unsupervised machine learning algorithms for unlabeled data.	Analyze

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: The Machine Learning Landscape				
1.1	**The Machine Learning Landscape**: What Is Machine Learning (ML)? Uses and Applications with examples	2	-	-
1.2	Types of Machine Learning, Main Challenges of Machine Learning, Testing and Validating.	2	-	-
1.3	**End to End Machine Learning**: Working with Real Data	2	-	-
1.4	Frame the Problem, Select the Performance Measure, Prepare the Data for ML Algorithms, Training and Evaluating the Data Set.	2	-	-
1.5	**Bayesian Decision Theory**: Introduction, Classification.	2	-	-
Module – 2: Classification and Training Models				
2.1	**Classification:** MNIST, Training Binary Classifier	2	-	-
2.2	Performance Measures, Multiclass classification.	2	-	-
2.3	**Training Models**: Linear Regression, Gradient Descent	2	-	-
2.4	Regularized Linear Models – Ridge & Lasso Regression.	2	-	-
Module – 3: Dimensionality Reduction and Support Vector Machines				
3.1	**Dimensionality Reduction**: The Curse of Dimensionality, Main Approaches for Dimensionality	2	-	-
3.2	PCA, Linear Discriminant Analysis (LDA).	2	-	-
3.3	**Support Vector Machines**: Linear SVM Classification, Nonlinear SVM	2	-	-
3.4	VM Regression, Kernelized SVMs.	2	-	-
Module – 4: Decision Trees				
4.1	**Decision Trees**: Univariate Trees: classification & Regression Trees, Training and Visualizing a Decision Tree	2	-	-
4.2	Pruning, Rule Extraction from Trees, Learning Rules from Data, Making Predictions	2	-	-
4.3	Estimating Class Probabilities, CART Training Algorithm, Computational Complexity	2	-	-
4.4	Gini Impurity or Entropy? Regularization Hyperparameters, Multivariate Trees.	2	-	-
Module – 5: Ensemble Learning and Unsupervised Learning				
5.1	**Ensemble Learning and Random Forests**: Voting Classifiers, Bagging and Pasting, Random Patches	2	-	-
5.2	Random Subspaces, Random Forests, Boosting	2	-	-
5.3	**Unsupervised Learning Techniques**: Clustering – K means, Spectral, Hierarchical	2	-	-
	Total No. of Lecture Hours	**40**	-	-
			Total No. of Tutorial Hours	**00**	-
				Total No. of Practical Hours	**00**

Textbook:

1. Introduction to Machine Learning, EthemAlpaydin, PHI Learning Pvt. Ltd, 3rd Edition, 2018.
2. Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems, AurelienGeron, O'Reilly Media, 2019.

Reference Book:

1. Machine Learning, Tom Mitchell, McGraw Hill, 2013.
2. Probability and Statistics for Computer Scientists, Michael Baron, 3rd Edition, CRC press, 2019.

Online Resources:

1. https://nptel.ac.in/courses/106106139
2. https://www.coursera.org/programs/faculty-learning-program-iqr5x/specializations/ibm-intro-machine-learning?source=search

Code: BCS613A
Credits: 3
SEE: 100 Marks
SEE Hours: 3

Course: Blockchain Technology
L:T:P 3:0:0
CIE: 25 Marks
Max. Marks:100

Prerequisites if any	NIL
Learning objectives	• Understand blockchain architecture and use Hashing. • Describe different consensus algorithms. • Design decentralized applications using blockchain.

Course Outcomes:

On the successful completion of the course, the student will be able to

Cos	Course Outcomes	Bloom's level
CO1	Describe architecture, characteristics, consensus in trust building exercise and Distributed ledger in Block chain	understand
CO2	Analyze hashing , characteristics , its types and usage of same in block chain	analyze
CO3	Compare the consensus algorithm used in Block chain technology and explain the importance of Asymmetric cryptography in Block chain	apply
CO4	Explain Bit coin and decentralized applications	understand
CO5	Discuss Ethereum and SMART Contract	understand

Mapping with POs and PSOs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-		2	2
CO2	3	3	-	-	2	-	-	-	-	-	-	-		2	2
CO3	3	2	-	-	2	-	-	-	-	-	-	2		2	2
CO4	3	2	-	-	3	-	-	-	-	-	-	-		2	2
CO5	3	2	1	-	3	-	-	-	-	-	-	-		2	2

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Sl. No.	Module Name	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1: Introduction to Blockchain			
1.1	Introduction, Concepts of Blockchain, History, Definition of Blockchain	1	-	-
1.2	Fundamentals of Blockchain, Characteristics of Blockchain, Consensus in Trust-Building Exercise	1	-	-
1.3	Public, Private, and Hybrid Blockchains, DLT, DLT Applications and databases	2	-	-
1.4	Architecture of Blockchain, Transactions	1	-	-
1.5	Blocks, chaining blocks, transactions, Value proposition of Blockchain Technology	2	-	-
	Module – 2: Decentralized System &Hash Functions			
2.1	Introduction, Distributed Decentralized Databases, Decentralized Enterprise	1	-	-
2.2	Decentralization	1	-	-
2.3	Disintermediation	1	-	-
2.4	Hash Functions: Hashing	1	-	-
2.5	MAC	1	-	-
2.6	SHA-1, SHA-256	1	-	-
2.7	Distributed Hash Tables	2	-	-
2.8	Hashing and Data Structures, Hashing in Blockchain Mining	1	-	-
	Module – 3: Consensus		-	-
3.1	Introduction, Consensus Approach, Consensus Algorithms-POW	1	-	-
3.2	POS, POA, POET	2	-	-
3.3	POB, Byzantine Agreement Methods, PBFT, DBFT	2	-	-
3.4	Symmetric Cryptography, Asymmetric Cryptography	2	-	-
	Module – 4: Bitcoins& Decentralized Applications		-	-
4.1	Introduction, Working of Bitcoin, Merkle Trees, Bitcoin Block Structure	1	-	-
4.2	Bitcoin Address	1	-	-
4.3	Bitcoin Transactions	1	-	-
4.4	Bitcoin Network, Bitcoin Wallets, Bitcoin Payments, Bitcoin Clients, Bitcoin Supply	2	-	-
4.5	Decentralized Applications- Introduction, Today's Web Applications Requirement	1	-	-
4.6	Mining in BlockchainBitcoin, Blocks Validation and identification, Bitcoins Creation	1	-	-
4.7	Mining Hardware, Mining Software, Running Miner	2	-	-

	Software, Executing several miners Reasons for Bitcoin Mining			
	Module 5: Ethereum and Smart Contract			
5.1	Introduction , Ethereum, History, Ethereum Virtual Machine	1	-	-
5.2	Working of Ethereum, Ethereum Clients, Ethereum Key Pairs	1	-	-
5.3	Ethereum Address, Ethereum Wallets	1	-	-
5.4	Ethereum Transactions, Ethereum Languages	1	-	-
5.5	Ethereum Development Tools	1	-	-
5.6	Smart Contracts- Introduction, SMART Contract	1	-	-
5.7	Benefits of SMART CONTRACT, Absolute and immutable, Contractual Confidentiality , Law Implementation & settlement, characteristics, Hyper ledger fabric Architecture	1	-	-
5.22	Supply Chain Management	1	-	-
Total No. of Lecture Hours		**40**	-	-
Total No. of Tutorial Hours			**00**	-
Total No. of Practical Hours				**00**

Textbook:

1. Mastering Blockchain- Distributed Ledger Technology, Decentralization, and Smart Contracts Explained, 2nd Edition by Imran Bashir · 2018
2. Blockchain Technology: Concepts and Applications, by Kumar Saurabh&AshutoshSaxena, WILEY Emerging Technology Series, First Edition, 2020

Reference Book:

1. Blockchain from concepts to execution, DebajaniMohanty, Second revised edition, BPB Publication, 2021
2. A Practical Guide To Blockchain And Its Applications , PARIKSHIT JAIN , Blooms Bury, Edition 2019

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs44/ - Blockchain and its Applications
2. https://www.youtube.com/watch?v=qOVAbKKSH10, Blockchain Technology Explained (2 Hour Course)

Code: BCS613B
Credits: 3
SEE: 100 Marks
SEE Hours: 3

Course: Computer Vision
L:T:P - 3:0:0
CIE: 100 Marks
Max. Marks: 100

Prerequisites if any	Linear algebra, calculus, and probability
Learning objectives	• Equip students with the skills to understand and apply key concepts in image formation, processing, and feature detection techniques. • Enable students to implement advanced segmentation methods and perform precise feature-based alignment and calibration for real-world applications.

Course Outcomes:

On the successful completion of the course, the student will be able to

Cos	Course Outcomes	Bloom's level
CO1	Describe image formation principles and basic image processing techniques.	Understanding
CO2	Explain feature detection and match features in images	Understanding
CO3	Apply different image segmentation methods	Apply
CO4	Explain 2D and 3D alignment along with calibration techniques.	Understanding

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.no	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1: Introduction			
1.1	Definition of Computer Vision, Image Formation: Geometric primitives and transformations- Geometric primitives	2	-	-
1.2	2D transformations, 3D transformations	2	-	-
1.3	Photometric image formation – Lighting, Reflectance and shading	2	-	-
1.4	The Digital Camera – Sampling and aliasing	2	-	-
	Module – 2: Image Processing			
2.1	Point Operators – Pixel transforms, Color transforms, Compositing and matting	2	-	-
2.2	Histogram equalization, Tonal Adjustment	1	-	-
2.3	Linear Filtering – Separable filtering, Examples of linear	2	-	-

	filtering			
2.4	Band pass and steerable filters	1	-	-
2.5	More neighborhood operators- Nonlinear filtering, Morphology, Distance transforms, Connected components	2	-	-
Module – 3: Feature detection and matching				
3.1	Points and patches – Feature detectors, Feature descriptors, Feature matching, Feature tracking, applications	3	-	-
3.2	Performance-driven animation; Edges – Edge detection, Edge linking, Application: Edge editing and enhancement	3	-	-
3.3	Lines – Successive approximation, Hough transforms, Vanishing points	2	-	-
Module – 4: Segmentation				
4.1	Active Contours – Snakes, Dynamic snakes and Condensation, Scissors, Level Sets, Application: Contour tracking and rotoscoping	2	-	-
4.2	Split and merge – Watershed, Region splitting (divisive clustering), Region merging (agglomerative clustering)	2	-	-
4.3	Graph based segmentation, Probabilistic aggregation	2	-	-
4.4	Mean shift and mode finding – K-means and mixtures of Gaussians, Mean Shift, Normalized cuts; Graph cuts and energy-based methods.	2	-	-
Module – 5: Feature- based alignment				
5.1	2D and 3D feature-based alignment – 2D alignment using least squares, Application-Panography	2	-	-
5.2	Iterative algorithms, Robust least squares and RANSAC	2	-	-
5.3	3D alignment; Pose estimation – Linear algorithms, Iterative algorithms, Application: Augmented reality	2	-	-
5.4	Geometric intrinsic calibration - Calibration patterns, Vanishing Points.	2	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. Computer Vision: Algorithms and Applications (CVAA), Richard Szeliski. Springer, 2010.
2. Image Processing, Analysis, and Machine Vision, Sonka, Hlavac, and Boyle. Thomson

Online Resources:

1. NPTEL Course Link: https://onlinecourses.nptel.ac.in/noc24_ee38/preview
2. MIT OpenCourseWare

   Course Link: https://ocw.mit.edu/courses/6-801-machine-vision-fall-2020/pages/lecture-notes/

Code: BCS613C
Credits: 3
SEE: 50 Marks
SEE Hours: 3

Course: Compiler Design
L:T:P - 3:0:0
CIE: 50 Marks
Max. Marks: 100

Prerequisites if any	Data Structures and Automata Theory
Learning objectives	1. Specify and analyse the lexical, syntactic and semantic structures of advanced language features. 2. Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation. 3. Gain appropriate knowledge build a compiler that converts from a non-trivial high level language to machine code.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Discuss the concepts and phases of compiler	**Understanding**
CO2	Develop the parsers and experiment with the knowledge of different parsers design	**Apply**
CO3	Implement the compiler using syntax-directed translation method and Classify various storage allocation strategies and symbol table representation	**Apply**
CO4	Generate machine code from the source code of a novel language	**Analyze**

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.no	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Lexical Analysis and Top Down Parsing				
1.1	Compilers, Compiler-construction tools	1	-	-
1.2	The phases of a compiler	1	-	-
1.3	The role of the lexical analyzer, Input buffering	1	-	-
1.4	Specification of tokens, Recognition of tokens	1	-	-
1.5	The role of the parser, Top-down parsing	4	-	-
Module – 2: Bottom Up Parsing				
2.1	Bottomup parsing,Types of Bottom up parsing	1	-	-
2.2	Operator-precedence parsing	1	-	-

2.3	LR parsers	2	-	-
2.4	SLR parsers	2	-	-
2.5	LALR parsers	2	-	-
Module – 3: Syntax-Directed Translation				
3.1	Syntax-directed definitions, Construction of syntax trees	1	--	-
3.2	Bottom-up evaluation of S-attributed definitions	1	-	-
3.3	L-attributed definitions	1	-	-
3.4	Intermediate languages	1	-	-
3.5	Declarations, Assignment statements	1	-	-
3.6	Boolean expressions, Case statements	1	-	-
3.7	For and While Statements	1	-	-
3.8	Back Patching, Procedure calls	1	-	-
Module – 4: Run-Time Environments				
4.1	Source language issues	1	-	-
4.2	Storage organization	1	-	-
4.3	Storage-allocation strategies	1	-	-
4.4	Access to nonlocal names, parameter passing	2	-	-
4.5	Symbol tables	1	-	-
4.6	Dynamic storage allocation techniques	2	-	-
Module – 5: Code generation				
5.1	Issues in the design of a code generator,	1	-	-
5.2	The target machine, Run-time storage management	1	-	-
5.3	Basic blocks and flow graphs,	2	-	-
5.4	The dag representation of basic blocks,	1	-	-
5.5	Code-generator generators	1	-	-
5.6	A Simple code generator- Register allocation and assignment	2	-	-
	Total No. of Lecture Hours	**40**	-	-
		Total No. of Tutorial Hours	**00**	-
			Total No. of Practical Hours	**00**

Textbook:

1. Aho, Sethi& Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education, 1986

Reference Book:

1. Principle of Compiler Design, A.V.Aho and J.D. Ullman, Addition – Wesley , 1977
2. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, McGraw-Hill,2003

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2. https://online.stanford.edu/courses/soe-ycscs1-compilers

Code: BCS613D
Credits: 3 credits
SEE:100 Marks
SEE Hours: 3 hours

Course: Advanced Java
L:T:P – 3:0:0
CIE:50 Marks
Max. Marks:100

Prerequisites if any	basics of java
Learning objectives	To gain knowledge of java framework and develop applications using servlets and JSP To enable interaction with database using JDBC

Course Outcomes:

On the successful completion of the course, the student will be able to

Cos	Course outcomes	Bloom's level
CO1	Understanding the fundamentals of collection framework	Understanding
CO2	Demonstrate the fundamental concepts of String operations and Swing applications	Apply
CO3	Design and develop web applications using Java servlets and JSP	Apply
CO4	Apply database interaction through Java database Connectivity	Analyze

Mapping with Pos and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Module Name				
1.1	**The collections and Framework**: Collections Overview, The Collection Interfaces	1	-	-
1.2	The Collection Classes, Accessing a collection Via an Iterator	2	-	-
1.3	Storing User Defined Classes in Collections	1	-	-
1.4	The Random Access Interface, Working With Maps, Comparators	2	-	-
1.5	The Collection Algorithms, Arrays	1	-	-
1.6	The legacy Classes and Interfaces, Parting Thoughts on Collections.	1	-	-
Module – 2: Module Name				

2.1	**String Handling** :The String Constructors, String Length	1	-	-
2.2	Special String Operations	2	-	-
2.3	Character Extraction ,String Comparison, Searching Strings	2	-	-
2.4	Modifying a String, Data Conversion Using valueOf( ),	1	-	-
2.5	Changing the Case of Characters Within a String, joining strings	1	-	-
2.6	Additional String Methods, String Buffer , String Builder	1	-	-
Module – 3: Module Name				
3.1	**Introducing Swing:** The Origin of Swing, Swing Is Built on AWT, Two Key Swing Features.	2	-	-
3.2	The MVC Connection, Components and Containers	1	-	-
3.3	The Swing Packages	1	-	-
3.4	A Simple Swing Application, Event Handling, Painting in Swing	1	-	-
3.5	**Exploring Swing :** JLabel and ImageIcon, JTextField	1	-	-
3.6	The Swing Buttons-JButton, JToggleButton, Check Boxes, Radio Buttons	2	-	-
Module – 4: Module Name				
4.1	**Introducing servlets**: Background, The Life Cycle of a Servlet, Using Tomcat for Servlet Development.	1	-	-
4.2	A simple Servlet, The Servlet API.	1	-	-
4.3	The Jakarta. Servlet Package, Reading Servlet Parameter. The Jakarta.servlet.http package	2	-	-
4.4	Handling HTTP Requests and Responses; Using Cookies; Session Tracking	1	-	-
4.5	Java Server Pages (JSP); JSP tags	1	-	-
4.6	Variables and Objects, Methods	1	-	-
4.7	Control statements, Loops, Request String, Parsing other information	1	-	-
4.8	User sessions, Cookies, Session Objects	1	-	-
Module – 5: Module Name				
5.1	**JDBC Objects**: The Concept of JDBC	1	-	-
5.2	JDBC Driver Types; JDBC Packages	1	-	-
5.3	A Brief Overview of the JDBC process, Database Connection	2	-	-
5.4	Associating the JDBC/ODBC Bridge with the Database; Statement Objects	1	-	-
5.5	Result Set, Transaction Processing	1	-	-
5.6	Meta data, Data types; Exceptions.	1	-	-
			-	-
	Total No. of Lecture Hours	**40**	-	-
		Total No. of Tutorial Hours	**00**	-
			Total No. of Practical Hours	**00**

Textbook:

1. Herbert schildt :Java the Complete Reference, 12th Edition,Tata McGraw-Hill III
2. Jim Keogh: The complete reference J2EE , Tata McGraw-Hill 2007

Reference Book:

1. Y. Daniel Liang:Introduction to Java Programming 7th edition pearsoneduction ,2007 Stephanie Bodoff:THE J2EE Tutorial 2nd edition pearsoneduction ,2004
2. Uttam K. Roy: Advanced Java Programming ,oxford university press 2015

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs43/preview
2. https://onlinecourses.swayam2.ac.in/aic20_sp13/preview

Code: BCS613E **Course: Entrepreneurship and Enterprise Resource Planning**
Credits: 3 **L:T:P - 3:0:0**
SEE: 100 Marks **CIE: 100 Marks**
SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	None
Learning objectives	1. Explain the importance of action and practice in entrepreneurship 2. To understand the basic concept of ERP systems 3. To study the steps and activities in the ERP life cycle 4. To develop a process driven thinking towards business processes

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Demonstrate a good understanding of Entrepreneurship and the basics in ERP systems	Understand
CO2	Demonstrate a good understanding of the basics in ERP with technologies	Understand
CO3	Analyze the strategic options for ERP identification and adoption and Design the ERP implementation strategies	Apply
CO4	Understand the various Business Modules of an Enterprise	Understand

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1: Entrepreneurship			
1.1	Introduction to Entrepreneurship : Meaning and concept of entrepreneurship, role of entrepreneurship in economic development,	1		
1.2	Myths about entrepreneurs, agencies in entrepreneurship management and future of entrepreneurship,	1		
1.3	Types of entrepreneurs, the skills/ traits required to be an entrepreneur, Creative and Design Thinking	2		
1.4	The entrepreneurial decision process, skill gap analysis, Importance of communication, barriers and gateways to communication	2		
1.5	Meaning and concept of E-cells, advantages to join E-cell, significance of E-cell, various activities conducted by E-cell	2		
	Module – 2: Introduction to ERP			
2.1	Enterprise—An Overview, Business Processes	1		
2.2	Introduction to ERP, Basic ERP Concepts,	1		
2.3	Justifying ERP Investments	2		
2.4	Risks of ERP, Benefits of ERP	2		
	Module – 3: ERP AND TECHNOLOGY			
3.1	ERP and Related Technologies, Business Intelligence (BI) and Business Analytics (BA) , E-Commerce and E-Business, ERP, Internet, and WWW	3		
3.2	Business Process Reengineering (BPR) , Data Warehousing and Data Mining, On-line Analytical Processing (OLAP),	3		
3.3	Product Life Cycle Management (PLM), Supply Chain Management (SCM), Customer Relationship Management (CRM)	3		
	Module – 4: ERP IMPLEMENTATION			
4.1	Implementation Challenges, ERP Implementation (Transition) Strategies, ERP Implementation Life Cycle,	3		
4.2	Implementation Methodologies ,ERP Deployment MethodsVendors and Consultants , Employees and Employee Resistance , Contracts with Vendors, Consultants, and Employees	3		
4.3	Training and Education, Data Migration , Project Management and Monitoring, Post-Implementation Activities, Success and Failure Factors of an ERP Implementation	3		

Module – 5: Business Modules				
5.1	Business Modules of an ERP Package – Financials, Manufacturing (Production)	2		
5.2	Human Resources Management, Plant Maintenance,	2		
5.3	Materials Management, Quality Management	2		
5.4	Marketing, Sales, Distribution, and Service	2		
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. Business model generation: a handbook for visionaries, game changers, and challengers.“ by A. Osterwalder and Y. Pigneur. John Wiley & Sons, 2010
2. ERP Demystified, Alexis Leon,Tthird Edition, Tata McGraw-Hill, 2007

Code:BCS654A
Credits: 3
L:T:P– 3:0:0
SEE Hours: 3

Course: Introduction to Java Programming
CIE: 50 Marks
SEE: 50 Marks
Total Marks: 100

Prerequisites if any	**C programming**
Learning objectives	1. Distinguish Object-Oriented programming paradigm from Procedure- Oriented Programming 2. Use the Java programming language for various programming technologies.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Develop Java programs using Object-Oriented paradigm	Understanding
CO2	Demonstrate Java code utilities in packages, interfaces and String class	Apply
CO3	Apply the concepts of Multi threading and Exception handling to develop efficient and error free codes.	Apply

Mapping with Posand PSOs:

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

MappingStrength: Strong–3 Medium–2 Low–1

Course Structure

Module–1:Introduction to Object Oriented development		**No. of Lecture Hours**	**No. of Tutorial Hours**	**No. of Practical Hours**
1.1	What is Object Orientation? What is OO development? OO themes	1	-	-
1.2	Evidence for usefulness of OOdevelopment; OOmodeling history	1	-	-
1.3	Modeling as Design Technique: Modeling; abstraction	2	-	-
1.4	The three models. Class Modeling: Object and class concepts	2	-	-
1.5	Link and associations concepts; Generalization and inheritance	2	-	-
Module–2: Java & JDK				
2.1	Java'smagic: Bytecode; Java Development Kit(JDK)	1	-	-
2.2	The Java Buzzwords, Simple Java programs	1	-	-
2.3	Data types, arrays, Control Statements	2	-	-
2.4	Classes: Classes fundamentals; Declaring objects	2	-	-

2.5	Constructors	2	-	-
2.6	This keyword, garbage collection	2	-	-
Module–3:Inheritance				
3.1	Inheritance: inheritance basics, using super	3	-	-
3.2	Creating multi-level hierarchy, method overriding	3		-
Module–4:Packages & Interfaces				
4.1	Packages	2	-	-
4.2	Access Protection in packages	2	-	-
4.3	Importing Packages	1	-	-
4.4	Interfaces :references and variables, Default Interface methods	2	-	-
4.5	Exception handling in Java-fundamentals	1	-	-
Module–5:Threads				
5.1	Multi-Threaded Programming: What are threads?	2	-	-
5.2	How to make the classes ‘threadable’	2	-	-
5.3	Extending threads; Implementing ‘runnable’	2	-	-
5.4	Thread Synchronization	2	-	-
Total No. Of Lecture Hours		**40**	-	-
Total No. of Tutorial Hours			**00**	-
Total No. of Practical Hours				**00**

Textbook:

1. Herbert Schildt, ***Java The Complete Reference-Eleventh Edition***,McGrawHill;11th Edition.
2. Michael Blaha, James Rumbaugh: Object- Oriented Modeling and Design withUML,2ndEdition, Pearson Education/ PHI, 2007

Reference Book:

1. Dr.R.Nageswara Rao, CoreJava, An Integrated Approach, DreamtechPress,2016.
2. Mahesh Bhaveand SunilPatekar, "Programming with Java", FirstEdition, Pearson Education, 2008
3. Rajkumar Buyya, SThamaraiselvi, xingchenchu, Object oriented Programming with java, Tata McGraw Hill Education Private Limited, 2009
4. Richard AJohnson, An Introduction to Java Programming and Object-Oriented Application Development, Delmar Cengage Learning, 2007.
5. Michael Blaha, JamesRumbaugh:Object-OrientedModelingandDesignwithUML,2nd Edition, Pearson Education/ PHI, 2007.

Online Resources:

1. Udacity Free Course

   https://www.udacity.com/course/java-programming-basics--ud282

2. Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-januaryiap-2010/
   Java Tutorial: https://www.w3schools.com/java/
3. Java Tutorial:https://www.javatpoint.com/java-tutorialJava Tutorial:https://www.geeksforgeeks.org/java/

Code: BCS654B **Course: Introduction to Web Technologies**
Credits: 3 **LTP: 3:0:0**
SEE: 50 **CIE:50**
SEEHours: 3 **Total Marks:100**

Course Outcomes:

Prerequisites if any	NIL
Learning objectives	The goal of this course is to comprehend I. Learn the language of the web. II. Develop dynamic pages using Java script, jQuery, AngularJS

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Understand the basics of Internet.	Remember
CO2	Experiment with CSS and Java Script and also develop applications using the same.	Apply
CO3	Analyze how dynamic web applications can be designed and expanded using Javascript and HTML.	Apply
CO4	Demonstrate applications of JQuery for the given problem	Apply
CO5	Demonstrate applications of AngularJS for the given problem	Apply

Mapping with Pos and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-		2	2
CO2	2	3	2	2	-	-	-	-	-	-	-	-		2	2
CO3	2	3	2	2	-	-	1	-	-	-	-	-		3	3
CO4	2	3	2	2	-	-	1	-	-	-	-	-		3	3
CO5	2	3	2	2	-	-	-	-	-	-	-	-		2	2

Mapping Strength: Strong–3 Medium–2 Low–1

Course Structure

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module–1 Fundamentals and Introduction to HTML/XHTML				
1.1	Brief introduction the internet, WWW, Web Browsers ,and Web Servers	1	-	-
1.2	URLs; MIME; HTTP; Security	1	-	-
1.3	The Web Programmers Toolbox.	1	-	-
1.4	Standard HTML document structure;	1	-	-
1.5	Basic text mark-up; Images; Hypertext Links; Lists;	2	-	-
1.6	Tables; Forms.	2	-	-
Module–2 Introduction to CSS and JavaScript Introduction				
2.1	CSS Introduction, Levels of style sheets.	1	-	-
2.2	Selector Forms.	1	-	-
2.3	Font properties, font size, Color properties, Box Model	1	-	-
2.4	Margin, Padding ,Background Image	1	-	-
2.5	Basics of JavaScript: Overview of JavaScript; Object orientation and JavaScript;	1	-	-
2.6	General syntactic characteristics; Primitives, operations, and expressions;	1	-	-
2.7	Screen out put and keyboard input; Control statements; Object creation and modification;	1	-	-
2.8	Arrays, Functions, Constructor.	1	-	-
Module–3Dynamic JavaScript				
3.1	The Java Script Execution Environment	1	-	-
3.2	Element Access in Java Script Events and Event Handling	1	-	-
3.3	Handling Events from Button Elements Handling Events from Text Box and Password Element	1	-	-
3.4	Validating Form Input	1	-	-
3.5	Dynamic Documents with Java Script	1	-	-
3.6	Absolute Positioning, Relative Positioning Static positioning	1	-	-
3.7	Moving Elements Element Visibility	1	-	-
3.8	Locating the Mouse Cursor, Reacting to a Mouse Click	1	-	-
Module–4Introduction to JQuery				
4.1	Introduction to JQuery	1	-	-
4.2	Syntax	1	-	-
4.3	selectors	2	-	-
4.4	events	2	-	-
4.5	JQuery HTML, JQuery CSS	2	-	-

Module–5Introduction to AngularJS				
5.1	Introduction to AngularJS, Directives	1	-	-
5.2	Module, Controller, scope	1	-	-
5.3	Filters	1	-	-
5.4	Events, Services	1	-	-
5.5	Expressions	2	-	-
5.6	Directive sin DOM	1	-	-
5.7	Angular JSForms, Examples	1	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Practical Hours			**00**

Textbooks:

1. Programming the World Wide Web, RobertW.Sebesta, Pearson Education-SeventhEdition
2. HTML5 Black Book by Dreamtech,2ndEdition
3. Learn AngularJS in 1 Day: Complete Angular JS Guide with Examples by Krishna Rungta
4. An Introduction to Jquery and Javascript: A Fast and Simple Way to Start Creating Web Applications by Daniel Green

Reference Books:

1. Web Programming By ChrisBates, Wiley Publications, Student Edition
2. Angular JS Programming By RayYao
3. RobinNixon, “LearningPHP, MySQL & JavaScript with jQuery, CSS and HTML5”, O’ReillyPublications,2015. 4thEdition,
4. ZakRuvalcaba AnneBoehm, “Murach'sHTML5andCSS3”, 3rdEdition, Murachs/Shroff Publishers & Distributors Pvt Ltd, 2016.

Code:BCS654C
Credits: 3
SEE: 100 Marks
SEE Hours: 03 hour

Course: Mobile Application Development
L:T:P - 3:0:0
CIE: 50 Marks
Max. Marks: 100

Prerequisites if any	Java
Learning objectives	• Learn to setup Android application development environment • Illustrate user interfaces for interacting with apps and triggering actions • Interpret tasks used in handling multiple activities • Identify options to save persistent application data • Appraise the role of security and performance in Android applications

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Create, test and debug Android application by setting up Android development environment.	Understanding
CO2	Implement adaptive, responsive user interfaces that work across a wide range of devices	Analyze
CO3	Demonstrate methods in storing, sharing and retrieving data in Android applications	Apply
CO4	Analyze performance of android applications and understand the role of permissions and security.	Analyze

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1				
1.1	Get started	1	-	-
1.2	Build your first app	2	-	-
1.3	Activities	2	-	-
1.4	Testing, debugging and using support libraries	3	-	-
Module – 2				
2.1	User Interaction	3	-	-
2.2	Delightful user experience	3	-	-
2.3	Testing your UI	2	-	-
Module – 3				
3.1	Background Tasks	3	-	-
3.2	Triggering	3	-	-
3.3	Scheduling and optimizing background tasks	2	-	-
Module – 4				
4.1	All about data	1	-	-
4.2	Preferences and Settings	2	-	-
4.3	Storing data using SQLite	2	-	-
4.4	Sharing datawith content providers	2	-	-
4.5	Loading data using Loaders	1	-	-
Module – 5				
5.1	Permissions	2	-	-
5.2	Performance and Security	3	-	-
5.3	Firebase and AdMob	2	-	-
5.4	Publish	1	-	-
	Total No. of Lecture Hours	**40**	-	-
		Total No. of Tutorial Hours	**00**	-
			Total No. of Practical Hours	**00**

Textbook:

1. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017.

Reference Book:

1. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
2. Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition,O'Reilly SPD Publishers, 2015.
3. J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition,Wiley India Pvt Ltd, 2016.
4. Anubhav Pradhan, Anil V Deshpande, " Composing Mobile Apps" using Android,Wiley 2014.

Online Resources:

1. https://www.gitbook.com/book/google-developer-training/android-developerfundamentals-course-concepts/details

Code: BCS654D
Credits: 3
SEE: 100
SEE Hours: 3

Course: Introduction to AI
L:T:P: 3:0: 0
CIE: 50
Max. Marks: 100

Prerequisites if any	Probability , Statistics and Linear Algebra
Learning objectives	To gain insights on different concepts and methods used in Artificial intelligence to solve real world problems.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand Artificial Intelligence concepts and methods.	Understand
CO2	Use knowledge representation to solve real world problems	Apply
CO3	Use neural networks to solve real world problems	Apply
CO4	solve problems using classification and clustering techniques .	Apply

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No.	Module Name	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Introduction				
1.1	Introduction	1		
1.2	Characteristics	1		
1.3	Exhaustive Searches	1		
1.4	Heuristic Search Techniques	1		
1.5	Interative Deepening	1		
1.6	Constant satisfaction	1		
1.7	General problem solving	1		
Module – 2: Problem reduction and Logic concepts				
2.1	Bounded look ahead strategy	1		
2.2	Alpha-Beta Pruning	1		
2.3	Propositional calculus	1		
2.4	Propositional logic	1		
2.5	Natural Deduction system	1		
2.6	Axiomatic system	1		
2.7	Semantic tableau system in propositional logic	1		
2.8	resolution refutation in propositional logic and Predicate logic	2		
Module – 3: Advanced problem-solving paradigm				
3.1	Planning- types of planning systems	2		
3.2	Linear planning using a goal stack	1		
3.3	Non –linear planning strategies	1		
3.4	Means-ends analysis	1		
3.5	Knowledge representation using semantic network	1		
3.6	Extended semantic networks for KR	1		
3.7	Knowledge representation using frames	1		

Module – 4: Uncertainty Measure				
4.1	Probability Theory	2		
4.2	Bayesian Belief Networks	3		
4.3	Machine Learning Paradigms	3		
Module – 5: Support vector Machine, case-based reasoning and learning ANN				
5.1	Single Layer and Multilayer	1		
5.2	RBF	1		
5.3	Design issues in ANN	1		
5.4	Recurrent Network	1		
5.5	Deductive learning,	2		
5.6	Clustering	2		
	Total No. of Lecture Hours	**40**		
	Total No. of Tutorial Hours		**00**	
	Total No. of Practical Hours			**00**

Textbook:

1. Artificial Intelligence, Saroj Kaushik Cengage Learning 2014 Editio

Reference Book:

1. Artificial Intelligence: Structures and Strategies for Complex Problem Solving, George F Luger Pearson Addison Wesley 6 th Ed, 2008.
2. Artificial Intelligence, E Rich, K Knight, and S B Nair Tata Mc-Graw Hill 3rd Ed, 2009.
3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig Prentice Hall 3rd, 2009

Code: BCS654E **Course: Introduction to Data Science**
Credits:3 **L:T:P-3:0:0**
SEE:50% **CIE:50%**
SEEHours:3 **Max.Marks:50**

Prerequisites if any	Linear Algebra, Probability and Statistics
Learning objectives	1. To understand the significance of DataScience in Industry and Academia. 2. Learn basics of Rlanguage

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom'slevel**
CO1	Describe the importance of Data Science and learn Statistical modelling, probability distributions, fitting a model, Over fitting	Understanding
CO2	Understand EDA and illustrate few machine learning algorithms and implement using Rlanguage.	Apply
CO3	Apply Bayesian lawand Use Machine learning algorithms as spam filters	Apply
CO4	Explore Feature Generation, Feature Selection, recommended system and Data engineering.	Apply

Mappingwith POs andPSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-		-	-
CO2	2	2	2	-	2	-	-	-	-	-	-	-		2	2
CO3	2	3	2	-	2	-	-	-	-	-	-	-		2	2
C04	3	-	-	-	3	-	-	-	-	-	-	-		2	2

Mapping Strength: Strong–3 Medium–2 Low –1

Course Structure

Sl. No	**Modules**	**No.of Lecture Hours**	**No.of Tutorial Hours**	**No.of Practical Hours**
Module –1: Introduction				
1.1	**Introduction**: What is Data Science?	1	-	-
1.2	Big Data and Data Science hype –and getting past the hype,	1	-	-
1.3	Why now?–Data fication, Current land scape of perspectives, A Data Science Profile, Thought Experiment: Meta-Definition, OK, So What Is a Data Scientist, Really?.	1	-	-

1.4	Needed Statistical Inference: Statistical Thinking in the Age of Big Data, Statistical Inference, Populations and samples, Populations and Samples of Big Data, Big Data Can Mean Big Assumptions	1	-	-
1.5	Modeling: What is a model? Statistical modelling, Probability distributions, Fitting a model, Overfitting	2	-	-
1.6	R Programs for the algorithms	1	-	-
Module–2:Exploratory Data Analysis and Data Science Process				
2.1	**Exploratory Data Analysis and the Data Science Process :** Basic tools (plots,graphs And summary statistics) of EDA	1	-	-
2.2	Philosophy of EDA	1	-	-
2.3	The Data Science Process, A Data Scientist's Role in This Process	1	-	-
2.4	Algorithms: Machine Learning Algorithms, Three Basic Algorithms: Linear Regression	2	-	-
2.5	k-Nearest Neighbours (kNN)	1	-	-
2.6	k-means Clustering	1	-	-
2.7	Comparison of the set three algorithms	1	-	-

Module–3:Machine Learning Algorithm and Usage in Applications				
3.1	**Machine Learning Algorithm and Usage in Applications:** Spam Filter, Linear Regression and Spam Filter, ,, , Filtering Spam,	1	-	-
3.2	K-NN and spam Filter	2	-	-
3.3	Naïve Bayes Algorithm, Spam Filter using Naïve Bayes , Laplace Smoothing, Comparing Naïve Bayes to K-NN Motivating application.	3	-	-
3.4	Data Wrangling: APIs and other tools for scrapping the Web	2	-	-
3.5	introduction to Logical Regression and M6D case study	1		
	Module -4 : Extracting Meaning from Data			
4.1	**Extracting Meaning from Data:** The Kaggle Model	1	-	-
4.2	Example: User(customer)retention.	1	-	-
4.3	FeatureGeneration(brainstorming,roleofdomainexpertise,andplaceforimagination)	1	-	-
4.4	Feature Selection algorithms: Filters; Wrappers	1	-	-
4.5	Decision Trees;	1	-	-
4.6	Random Forests	1	-	-
	Module -5: Recommended system and Data Engineering			
5.1	Recommendation Systems: A Real-World Recommendation Engine, Some Problems with Nearest Neighbors	1		
5.2	Beyond Nearest Neighbor: Machine Learning Classification	1		
5.3	The Dimensionality Problem	1		
5.4	Singular Value Decomposition.	1		
5.5	Data Engineering, Map reduce, ,	1		
5.6	Word Frequency Problem	1		
5.7	Map Reduce Solution			
5.8	Other Examples of Map Reduce, Pregel-An Introduction.	1		
5.9	Data Visualization: Basic principles.	1		
5.10	ideas and tools for data visualization.	1		
Total No. Of Lecture Hours		**40**	-	-
Total No. Of Tutorial Hours			**00**	**-**
Total No. Of Practical Hours				**00**

Textbook:

1. DoingDataScience,CathyO'NeilandRachelSchutt,StraightTalkfromTheFrontlineO'Reilly,2014

ReferenceBook:

1. DataMining:ConceptsandTechniquesJiaweiHan,MichelineKamberandJianPeiMorganKauffman,Third Edition, 2012
2. Mining of Massive DatasetsV2.1 Jure Leskovek, AnandRajaraman and Jeffrey Ullman, Cambridge University Press, 2nd Edition, 2014

OnlineResources:

1. https://onlinecourses.nptel.ac.in/noc21_cs69
2. https://www.coursera.org/programs/projects/getting-started-with-kaggle?
3. https://www.coursera.org/learn/r-programming?

Code:BCS654F **Course: Introduction to Blockchain technology**
Credits: 3 **L:T:P 3:0:0**
SEE: 50 Marks **CIE: 50 Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Computer networks, Cryptography
Learning objectives	• Impart strong technical understanding of Blockchain technologies. • Develop familiarity of current technologies • Introduce application areas and current practices

Course Outcomes:

On the successful completion of the course, the student will be able to

Cos	Course Outcomes	Bloom's level
CO1	Describe the operational aspects of the Blockchain ecosystem	Understand
CO2	Identify the cryptographic primitives behind Blockchain	Apply
CO3	Compare the consensus algorithm used in Blockchain technology	Understand
CO4	Discuss the functional aspects of Bit coin network, Ethereum and SMART Contract	Understand

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

Course Structures

Sl. No.	Module Name	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Introduction to Blockchain				
1.1	History of Bitcoin and Blockchain	2	-	-
1.2	Digital Ledger Technology (DLT), Peer-to-Peer (P2P) Network,	1	-	-
1.3	Centralized, Decentralized and Distributed Networks	2		
1.4	Public Blockchain, Private Blockchain.	1		
1.5	Applications of Blockchain	2		
	Module – 2: Decentralized System & Hash Functions			
2.1	Cryptographic Hash Functions	1		
2.2	Cryptographic Nonce	1		
2.3	Transactions, Asymmetric Key Cryptography	1		
2.4	Address and Address Derivation – Private Key Storage, Ledgers	1		
2.5	Blocks, Chaining Blocks	1		
2.6	Zero Knowledge System	1		
2.7	Attacks – 51% attack, Sybill attack.	1		
2.6	Different types of SHA , SHA-256	2		
	Module-3: Consensus algorithm			
3.1	Proof of Work Consensus Algorithm	1		
3.2	Proof of Stake Consensus Algorithm,Delegated Proof of Stake (DPoS)	2		
3.3	Proof of Burn, Practical Byzantine Fault tolerance	2		
3.4	Proof of elapsed time	1		
	Module – 4: Blockchain Mining and Forking			
4.1	Permission block chain, Permission less block chain,	1		
4.2	Forking – Soft forking, Hard Forking	2		
4.3	Cryptographic changes forking, Merkle Tree	1		
4.4	Bitcoin Mining, Mining Incentives Strategies.	2		
4.5	Bitcoin Crypto currencies - Double Spending problem and its avoidance in Block chain	1		
	Module-5: Block chain platforms			

5.1	Ethereum Platform	1		
5.2	Transactions in Ethereum – Ether wallet, Ether Accounts	1		
5.3	Ether Gas, Gas Price, Gas Limit, Ether Tokens	1		
5.4	ERC20 ethereum stands for Tokens	1		
5.5	Mining in Ethereum and Awards	1		
5.6	Smart Contract	1		
5.7	Hyperledger Platform –Hyperledger Fabric Architecture, Membership services, Blockchain services	2		
	Total hours	**40**	**0**	**0**

TEXT B0OK

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, Edition illustrated, 2016

2. Imran Bashir, "Mastering Blockchain: Distributed ledgers, Decentralization and Smart Contracts explained". PACKT PUBLICATION, 2nd edition, 2018

REFERENCE BOOKS

1. Malcolm Campbell-Verduyn, "Bitcoin and Beyond Cryptocurrencies, Blockchains, And Global Governance", publisher Routledge; 1st edition 2017.
2. Kumar Saurabh, AshutoshSaxena ,blockchain Technology: Concepts and Applications Kindle Edition, Wiley , 2020
3. Daniel Lincoln, "Blockchain Evolution Explained: A Beginners Guide to Understanding Blockchain Technology", Kindle Edition.
4. Andreas M. Antonopoulos , David A. Harding, " Mastering Bitcoin: programming the open blockchain", O'Reilly publication, third edition.
5. Andreas M. Antonopoulos , Gavin Wood , "Mastering Ethereum: Building Smart Contracts and DApps" , O'Reilly publication, 1st Edition,

Code: BCS605
Credits: 3
SEE: 100 Marks
SEE Hours: 3

Course: Cloud Computing
L:T:P - 3:0:0
CIE: 50 Marks
Max. Marks:100

Prerequisites if any	
Learning objectives	1. Overview of Cloud Computing and various distributed system models with enabling technologies. 2. Analyze various Computer Clusters for Scalable Parallel Computing. 3. Acquire the clear understanding of Virtual Machines and Virtualization of Clusters. 4. Acquire the basic knowledge of Cloud Platform Architecture over Virtualized Data Centers and acquire the clear understanding of Service-Oriented Architectures for Distributed Computing.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Overview of Cloud Computing and various distributed system models with enabling technologies	Understanding
CO2	Analyze various Computer Clusters for Scalable Parallel Computing.	Analyze
CO3	Acquire the clear understanding of Virtual Machines and Virtualization of Clusters.	Analyze
CO4	Acquire the basic knowledge of Cloud Platform Architecture over Virtualized Data Centers and acquire the clear understanding of Service-Oriented Architectures for Distributed Computing.	Analyze

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Defining Cloud Computing, Cloud Types: NIST Model, Cloud Cube Model, Deployment models, Service Models.	2	-	-
1.2	Characteristics of Cloud Computing	1	-	-
1.3	Benefits of Cloud computing, Disadvantages of cloud computing.	2	-	-
1.4	Scalable computing over the Internet,.	1	-	-
1.5	System Models for Distributed and Cloud Computing,	1	-	-
1.6	Software Environments for Distributed Systems and Clouds	1	-	-
	Module – 2			
2.1	Computer Clusters for Scalable Parallel Computing: Clustering for Massive Parallelism	2	-	-
2.2	Computer Clusters and MPP Architectures	2	-	-
2.3	Design Principles of Computer Clusters	2	-	-
2.4	Cluster Job and Resource Management	2	-	-
	Module – 3			
3.1	Implementation Levels of Virtualization	2	-	-
3.2	Virtualization Structures/Tools and Mechanisms	2	-	-
3.3	Virtualization of CPU, Memory, and I/O Devices	2	-	-
3.4	Virtual Clusters and Resource Management	2	-	-
	Module – 4			
4.1	Cloud Computing and Service Models,	2	-	-
4.2	Data-Center Design and Interconnection Networks,	2	-	-
4.3	Architectural Design of Compute and Storage Clouds,	2	-	-
4.4	Public Cloud Platforms: GAE, AWS	2	-	-
	Module – 5			
5.1	Services and Service-Oriented Architecture,	2	-	-

5.2	Message-Oriented Middleware,	2	-	-
5.3	Discovery, Registries, Metadata, and Databases,	2	-	-
5.4	Workflow in Service-Oriented Architectures.	2	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**00**

Textbook:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India (Chapter 1).
2. Distributed And Cloud Computing, Hwang, Kai; Fox, Geoffrey C; Dongarra, Jack J. ELSEVIER INDIA PVT. LTD (Chapter 1, 2, 3, 4, 5, 6) 2013, 1st Edition.

Reference Book:

1. Cloud Computing for Dummies by Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper (Wiley India Edition).
2. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India.
3. Cloud Computing, A Practical Approach, Anthony T Velte.
4. Google Apps by Scott Granneman, Pearson
5. A Brief Guide to Cloud Computing, An Essential Introduction to the Next Revolution in Computing, Christopher Barnatt.

Code: BCS606 **Course: Distributed Systems**
Credits: 3 **L:T:P 3:0:0**
SEE: 50 Marks **CIE: 50 Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. Learn the fundamentals of distributed systems, through examples 2. Learn to use appropriate remote invocation techniques for communication in DS

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Explain the applications and challenges arising from the construction of distributed systems	Understanding
CO2	Make use of appropriate remote invocation technique to communicate in distributed systems	Apply
CO3	Use distributed objects and components to develop applications using CORBA middleware	Apply
CO4	Examine algorithms for clock synchronization and use appropriate concurrency control algorithm for transactions	Analyze

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Characterization of Distributed Systems, System models				
1.1	Introduction to DS, examples	1	0	0
1.2	Trends in distributed system. Focus on resource sharing	2	0	0
1.3	Challenges	1	0	0
1.4	Physical models, Architectural Models, Fundamental Models	3	0	0

1.5	Case study: WWW	1	0	0

Module – 2: Inter Process Communication, Remote Invocation				
2.1	Introduction, API for Internet Protocols	1	0	0
2.2	External data representation and Marshalling	2	0	0
2.3	Client – Server Communication	1	0	0
2.4	RR Protocol, RPC, RMI	3	0	0
2.5	Case study: SUN RPC	1	0	0
Module – 3: OS Support, Distributed Objects, DFS				
3.1	Processes, Threads, OS Architecture	2	0	0
3.2	Introduction to Distributed Objects and components	1	0	0
3.3	Case study: CORBA – architecture, service	2	0	0
3.4	Distributed file systems, File service architecture	2	0	0
3.5	Case study: Sun Network File System	1	0	0
Module – 4: Time and Global State				
4.1	Clocks, Events and process status	2	0	0
4.2	Synchronizing physical clocks	2	0	0
4.3	Logical time and logical clocks, Global states	3	0	0
4.4	Distributed debugging	1	0	0
Module – 5: Transactions and Concurrency Control				
5.1	Introduction to Transactions, Nested Transactions	3	0	0
5.2	Locks, Optimistic Concurrency Control, Timestamp ordering	4	0	0
5.3	Comparison of methods for concurrency control	1	0	0
Total No. of Lecture Hours		**40**	-	-
Total No. of Tutorial Hours			**00**	-
Total No. of Practical Hours				**00**

Textbook:

1. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair: Distributed Systems – Concepts and Design, Fifth Edition, Pearson Publications, 2012.

Reference Book:

1. Maarten van Steen. Andrew S. Tanenbaum: Distributed Systems, Third edition, 2017

.

Online Resources:

1. www.cdk5.net/corba
2. https://www.coursera.org/specializations/pcdp
3. https://onlinecourses.nptel.ac.in/noc21_cs87/

Code: BCSL607 **Course: Machine Learning Lab**
Credits: 2 **L:T:P - 0:0:2**
SEE: 50 Marks **CIE: 50 Marks**
SEE Hours: 2 **Max. Marks: 100**

Prerequisites if any	Programming Language, Mathematics foundations (Linear algebra, Probability, Statistics).
Learning objectives	Make use of Data sets in implementing the machine learning algorithms Implementthemachinelearningconceptsandalgorithmsinanysuitablelanguageof choice.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the Basic Python Libraries	Understanding
CO2	To be able to formulate machine learning problems corresponding to different applications.	Apply
CO3	To understand a range of machine learning algorithms along with their strengths and weaknesses	Apply
CO4	To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	Analyze

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Lab Experiments:
1. Understand the Basic Python Libraries such as math. NumPy, Pandas, Matplotlib
2. Implement Simple Linear **Regression algorithm**. Select appropriate data set for your implementation and plot the results
3. Implement multiple Linear **Regression algorithm**. Select appropriate data set for your implementation and plot the results
4. Implement Polynomial **Regression algorithm**. Select appropriate data set for your implementation and plot the results
5. Implement Linear **SVM Classification algorithm**. . Select appropriate data set for your implementation and plot the results
6. Write a program to demonstrate the working of the **decision tree** based C A R T **algorithm**.Useanappropriatedatasetforbuildingthedecisiontreeandapplythis knowledge to classify a new sample.
7. Implement of K-Means Clustering Algorithm. . Select appropriate data set for your implementation and plot the results
8. Writeaprogramtoimplementthe**naïveBayesianclassifier**forasampletraining dataset storedasa.CSV file. Compute the accuracy of the classifier, considering few test datasets.
9. Apply **EM algorithm** to cluster a set of data stored in a .CSV file

Textbook:

1. AurelienGeron, Hands-on Machine Learning with Scikit-Learn &TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019
2. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013

Reference Book:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd Ed., 2013
2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001
3. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019
4. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson,2020

Online Resources:

1. https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77
2. https://nptel.ac.in/courses/106/106/106106139/
3. Coursera: Machine Learning, Andrew Ng: https://www.coursera.org/learn/machinelearning

Code: BCSL657A
Credits: 1
SEE: 50%
SEE Hours: 2

Course: Progressive App Development
L:T:P - 0:0:2
CIE: 50%
Max. Marks: 50

Prerequisites if any	Basic Web Development Knowledge, Understanding of Client-Server Architecture and Basic programming skills
Learning objectives	To bridge the gap between fundamental web development skills and advanced PWA development, ensuring students are well-equipped to create modern, performant, and user-friendly web applications.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Develop and deploy Progressive Web Apps (PWAs) with offline capabilities and responsive design.	Understanding
CO2	Implement modular applications using micro services architecture and integrate third-party RESTful APIs	Apply
CO3	Apply cloud services for deployment and manage continuous integration/continuous deployment (CI/CD) pipelines.	Apply
CO4	Optimize the performance and security of web applications.	Analyze

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1.	Implement a service worker to cache assets and enable offline functionality in your PWA.	-	-	1
2.	Use CSS techniques and frameworks (e.g., Flexbox, Grid, Bootstrap) to ensure your PWA is fully responsive across different devices.	-	-	1
3.	Implement the Push API and Service Workers to enable push notifications in your PWA.	-	-	1
4.	Create, containerize using Docker, and deploy a simple microservice.	-	-	1
5.	Fetch data from the API and display it in your application using JavaScript or a framework like React.	-	-	1
6.	Apply user-centric design principles to improve the usability and accessibility of your application.	-	-	2
7.	Deploy your application to a cloud service (e.g., AWS, Azure, Google Cloud) and ensure it scales effectively.	-	-	2
8.	Configure a CI/CD pipeline using tools like Jenkins, GitHub Actions, or GitLab CI for automated testing and deployment.	-	-	2
9.	Implement techniques to improve load time and overall performance, such as code splitting, lazy loading, and caching strategies	-	-	2
10.	Apply security best practices to mitigate common vulnerabilities, such as input validation, using HTTPS, and securing APIs.	-	-	2
	Total No. of Lecture Hours	-	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**15**

Textbook:

1. Jason Grigsby, Progressive Web Apps", A Book Apart, 2018
2. Tal Ater, Building Progressive Web Apps, O'Reilly Media, Inc., 2017

Online Resources:

1. MDN Web Docs: Progressive Web Apps: https://developer.mozilla.org/en-US/docs/Web/Progressive_web_apps
2. Google Developers: Progressive Web Apps: https://developers.google.com/codelabs/pwa-training/pwa05--empowering-your-pwa#0

Code: BCSL657B **Course: Tosca – Automated Software Testing**
Credits: 1 **L:T:P - 0:0:2**
SEE: 50 Marks **CIE: 50 Marks**
SEE Hours: 2 **Max. Marks: 50**

Prerequisites if any	Any Programming language, Discrete Mathematical structures
Learning objectives	• Gain a deep understanding of Tosca's core concepts and functionalities • Learn efficient automation of test cases using Tosca. • Develop expertise in creating effective and reusable test designs. • Acquire skills for building robust automated test scripts

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Demonstrate the creation and management of modules with a strong grasp of identification methods	Apply
CO2	Understand the fundamentals of Tricentis Tosca and its advantages over other automation tools	Understanding
CO3	Enhance testing efficiency and quality through effective Tosca automation	Apply

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Automate Web Applications, Desktop Application Testing&API Testing				
1.1	Practice creating automated tests for simple HTML applications using Tosca's capabilities1.	-	-	2
1.2	Develop test cases for desktop applications and understand the integration with Tosca.	-	-	2
1.3	Learn to automate API testing and validate responses using Tosca	-	-	1
Module – 2: Mobile Testing, Data-Driven Testing&Risk-Based Testing				
2.1	Execute automated tests on mobile applications and explore Tosca's mobile testing features.	-	-	2
2.2	Implement data-driven tests to validate application behavior under various data sets.	-	-	2
2.3	Apply risk-based testing methods to prioritize test execution based on business impact.	-	-	2
Module – 3: Continuous Integration &Test Data Management				
3.1	Integrate Tosca with CI/CD pipelines for continuous testing practices	-	-	2
3.2	Manage and maintain test data efficiently using Tosca's test data management tools.	-	-	2
	Total No. of Lecture Hours	-	-	-
	Total No. of Tutorial Hours		-	-
	Total No. of Practical Hours			**15**

Textbook:

1. Tricentis Tosca Fundamentals: A comprehensive guide to automating web application testing with Tosca4.
2. Introduction to Tosca Automation Testing: Detailed course curriculum for Tosca Automation Testing6

Reference Book:

1. Tosca Training Curriculum by Croma Campus: Industry-oriented training material aligned with certification exams

Code: BCS657C **Course: Agile Development**
Credits: 1 **L:T:P - 1:0:0**
SEE: 50 Marks **CIE:50 Marks**
SEE Hours: 2 **Max. Marks:50**

Prerequisites if any	Nil
Learning objectives	1. To Recognize the importance to be Agile 2. To understand basics of agile 3. To become Expert in Agility

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the Agile Process, its history and development	Understand
CO2	Describe the concept of Agility in Agile process.	Understand
CO3	Discuss the theories of Agile management, classification of agile methods and agility in design & testing effectively	Understand

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1: Agile			
1.1	**Agile? :** Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility	1	-	-
1.2	How to Be Agile?: Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor.	1	-	-
1.3	The Genesis of Agile, Introduction and background, Agile Manifesto, and Principles, Simple Design, User Stories, Agile Testing, Agile Tools	2	-	-
	Module – 2: Mastering Agility			
2.1	**Mastering Agility :** Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading	1	-	-

2.2	Improve the Process: Understand Your Project, Tune and Adapt, Break the Rules	1	-	-
2.3	Rely on People :Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People	1	-	-
2.4	Eliminate Waste :Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput	2	-	-
Module – 3: Agile Methodology				
3.1	Theories for Agile management – agile software development – traditional model vs. agile model -	1	-	-
3.2	classification of agile methods – agile manifesto and principles – agile project management	2	-	-
3.3	agile team interactions – ethics in agile teams	1	-	-
3.4	agility in design, testing – agile documentations – agile drivers, capabilities and values.	2	-	-
	Total No. of Lecture Hours	**15**	-	-
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. James shore, Chromatic, O'Reilly, The Art of Agile Development, 2007

Reference Book:

1. Ken Schawber, Mike Beedle, "Agile Software Development with Scrum",Pearson, 2008

Online Resources:

1. https://www.nptelvideos.com/video.php?id=904

Code: BCS657D
Credits: 1
SEE: 50 Marks
SEE Hours: 0

Course: Devops
L:T:P - 1:0:0
CIE: 50 Marks
Max. Marks:100

Prerequisites if any	--NIL--
Learning objectives	understanding of DevOps principles, tools, and practices. To effectively collaborate in a DevOps environment, automate processes, and manage infrastructure as code.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	explain the core concepts, principles, and benefits of DevOps.	Understanding
CO2	Demonstrate Proficiency in using version control systems and implementing collaborative development workflows.	Apply
CO3	Demonstrate Skill in provisioning and managing infrastructure using Infrastructure as Code (IaC) tools.	Apply

Mapping with POs and PSOs:

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

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Introduction to Devops and its Principles				
1.1	Introduction to DevOps and its Principles: Understanding DevOps: Definition, goals, and benefits	1	-	-
1.2	Key principles of DevOps: Continuous integration, continuous delivery, automation, and collaboration	1		
1.3	DevOps culture and mindset, Case studies of successful DevOps implementations	1		
1.4	Version Control and Collaboration Tools: Introduction to version control systems (e.g., Git)	1		
1.5	Branching and merging strategies, Collaborative development workflows, Introduction to code review processes and tools(example GITHUB, Bit bucket)	1		
Module – 2: Continuous Integration and Build Automation				
2.1	Continuous integration (CI) concepts and benefits	1	-	-
2.2	Introduction to build automation tools (e.g., Jenkins, Travis CI)	1	-	-
2.3	Configuring and managing CI pipelines, running automated tests and generating reports	1	-	-
2.4	Infrastructure as Code (IaC): Introduction to Infrastructure as Code (IaC) and its benefits	1	-	-
2.5	Infrastructure provisioning tools (e.g., Terraform, CloudFormation), Building and managing infrastructure using IaC	1	-	-
Module – 3: Configuration Management				
3.1	Introduction to configuration management tools (e.g., Ansible, Puppet)	1	-	-
3.2	Managing system configurations and deployments	1	-	-
3.3	Configuration drift and remediation, Automating software deployments	1	-	-
3.4	Continuous Delivery and Deployment: Introduction to	1	-	-

	continuous delivery and deployment concepts			
3.5	Release management and versioning, Automating deployment pipelines	1	-	-
	Total No. of Lecture Hours	15	-	-
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation" by Jez Humble and David Farley.
2. "DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations" by Gene Kim, Jez Humble, Patrick Debois, and John Willis.

Reference Book:

1. "Site Reliability Engineering: How Google Runs Production Systems" edited by Betsy Beyer, Chris Jones, Jennifer Petoff, and Niall Richard Murphy.
2. "Accelerate: The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizations" by Nicole Forsgren, Jez Humble, and Gene Kim.

Online Resources:

1. NPTEL Course Link: https://nptel.ac.in/courses/128106012