

SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE) UNIVERSITY, BHOPAL

Scheme & Syllabus

for

**Bachelor of Technology CSE (Hons) –Data Science
With LITHAN**



SAGE School of Advanced Computing

2021-22 Batch

Bachelor of Technology CSE (Hons)- Data Science

4 Years Degree Program

Program Educational Objectives (PEOs)

PEO-1: Graduates shall have the ability to apply knowledge across the disciplines and in emerging areas of Computer Science and Engineering such as for higher studies, research, employability, full stack web development, and artificial intelligence solutions to handle the realistic problems.

PEO-2: Graduates shall have good communication skills, possess ethical conduct, sense of responsibility to serve the society and protect the environment.

PEO-3: Graduates shall possess academic excellence with high ethical values, soft skills, managerial skills, leadership qualities, knowledge of contemporary issues and understand the need for lifelong learning for a successful professional career.

PEO-4: To imbibe in graduates the team-spirit and problem-solving skills so they can lead organizations they join in or initiate their own ventures.

PEO-5: To disseminate the ability to analyze the requirements, understand the technical specifications and design the innovative solutions by applying the principles of computing.

Program Outcomes (POs)

Program aims at:

PO1: Scientific Knowledge: An ability to apply knowledge of mathematics, science, and engineering. PO2: Problem Analysis: An ability to design and conduct experiments, as well as to analyze and interpret data

PO3: Design/Development of solutions: An ability to design an enterprise application with the cutting- edge technologies of the 21st century such as Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP), to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

PO4: Team work and Communication: An ability to function on multidisciplinary teams and communicate effectively.

PO5: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO6: Ethics: An understanding of professional, ethical, security, legal and social issues and responsibility for the computing profession.

PO7: The software engineer and society: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.

PO8: Life-long learning: Recognition of the need for and ability to engage in continuing professional development.

PO9: Modern tools usage: A knowledge of contemporary issues and an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

PO10: Environment and sustainability: Understand the impact of the professional software engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

First Semester																
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
UC20B101	Environmental Science and Disaster Management	2	-	-	2	3	30	05	05	10	50	100	-	-	-	100
UC20B102	Communication Skills	2	-	-	2	3	30	05	05	10	50	100	-	-	-	100
MA20B103	Engineering Maths-I	4	-	-	4	3	30	05	05	10	30	100				100
LT21B121	Front End Web Development	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
LT21B122	Programming Foundation	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
LT21B123	UI Frameworks	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
LT21B124	Database Design and Implementation	3	-	2	4	3	30	05	05	10	30	100	20	30	50	150
		Total			24											900

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-End Semester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Second Semester																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Theory						Practical			GT	
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot		
UC20B202	Entrepreneurship Development	2	-	-	2	3	30	05	05	10	50	100	-	-	-	100	
MA20B204	Engineering Maths-II	4	-	-	4	3	30	05	05	10	30	100				100	
LT21B221	Application Implementation	2	-	4	4	3	30	05	05	10	50	100	20	30	50	150	
LT21B222	Web Development Foundation	2	-	4	4	3	30	05	05	10	50	100	20	30	50	150	
LT21B223	Application Development and Process	2	-	4	4	3	30	05	05	10	50	100	20	30	50	150	
LT21B224	Web Development using Platforms	2	-	4	4	3	30	05	05	10	50	100	20	30	50	150	
LT21B225	Capstone Project-Web Development	-	-	4	2	2	-						50^	50	100	100	
		Total			24												900

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Third Semester																
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
UC20B302	Quantitative Aptitude-I	2	-	-	2	3	30	05	05	10	50	100	-	-	-	100
CS20B302	Data Structure and Algorithms	3	-	2	4	3	30	05	05	10	30	100	20	30	50	150
LT21B225	Develop Enterprise Applications	2	-	4	4	3	30	05	05	10	50	100	20	30	50	150
LT21B226	Application Integration	2	-	4	4	3	30	05	05	10	50	100	20	30	50	150
LT21B321	Capstone Project Application Development	-	-	28	14	2	-						200^	200	400	400
		Total			28											950

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-End Semester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Fourth Semester																
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
UC20B402	Quantitative Aptitude-II	2	-	-	2	3	30	05	05	10	50	100	-	-	-	100
CS20B401	Object Oriented Analysis and Design	3	-	2	4	3	30	05	05	10	30	100	20	30	50	150
LT21B421	IT systems & Networks	4	-	4	6	3	30	05	05	10	50	100	20	30	50	150
PB21B401	Project -I	-	-	16	8	2	-						50^	50	100	100
		Total			20											600

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-End Semester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Fifth Semester																
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
UC20B501	Introduction to Management and Leadership	2	-	-	2	3	30	05	05	10	50	100	-	-	-	100
CS20B504	Analysis and Design of Algorithm	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
LT21B521	IT Security	2	-	4	4	3	30	05	05	10	30	100	20	30	50	150
LT21B522	Data Science Essentials	2	-	4	4	3	30	05	05	10	30	100	20	30	50	150
PB21B501	Project-II	-	-	16	8	2	-						50^	50	100	100
		Total			22											650

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-End Semester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Sixth Semester																
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
UC20B601	Social and Professional Ethics	3	-	-	2	3	30	05	05	10	50	100	-	-	-	100
CS20B602	Software Engineering	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
LT21B622	Python Programming for AI	2	-	8	6	3	30	05	05	10	30	100	20	30	50	150
PB21B601	Project-III	-	-	16	8	2	-						100^	100	200	200
		Total			20											600

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-End Semester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Seventh Semester																
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
LT21B721	Machine Learning	2	-	4	4	3	30	05	05	10	30	100	20	30	50	150
LT21B722	Deep Learning	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
LT21B723	Summer Internship Project			32	16	2	-						200 [^]	200	400	400
		Total			24											700

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation , ESE-End Semester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Eighth Semester																
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
LT21B821	Reinforcement Learning	3	-	2	4	3	30	05	05	10	50	100	20	30	50	150
LT21B822	Capstone Project AI	-	-	40	18	2	--						200 [^]	300	500	500
		Total			22											650

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-End Semester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Expert

COURSE CODE	ENVIRONMENT STUDIES & DISASTER MANAGEMENT	TOTAL LECTURE: 30
UC20B101	(LTP=2-0-0=2)	
<p>Course Objectives:</p> <ul style="list-style-type: none"> • Understand the natural environment and its relationships with human activities. • Characterize and analyze human impacts on the environment. • Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. • Capacity to integrate knowledge and to analyses, evaluate and manage the different public health aspects of disaster events at local and global levels. • Capacity to obtain, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios . 		
UNIT	CONTENTS	HOURS
I	<p>Introduction to Environment: Definition, Components of Environment, Relationship between different components, Man- Environment relationship, Impact of Technology on the environment, Environmental Degradation, Sustainable Development, Environmental Education.</p>	5
II	<p>Ecology & Ecosystems: Introduction: Ecology- Objectives and Classification, Concepts of an ecosystem- structure & function of ecosystem, Components of ecosystem- Producers, Consumers, Decomposers, Energy flow in the ecosystem - Ecological succession, Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems and its types, Bio- Geo- Chemical Cycles - Hydrological Cycle, Carbon cycle, Oxygen Cycle, Nitrogen Cycle, Sulfur Cycle.</p>	7
III	<p>Environmental Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like SPM, SO₂, NO_x , Natural & Anthropogenic Sources, Effects of common air pollutants, Air Pollution Episodes, Sound and Noise measurements, Sources of Noise Pollution, Ambient noise levels, Effects of noise pollution, Noise pollution control measures, Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants, Eutrophication, Water Pollution Episodes, Global Warming and Green Houses Effect, Acid Rain, Depletion of Ozone Layer.</p>	7
IV	<p>Energy Resources: Renewable & Nonrenewable Resources: Renewable Resources, Nonrenewable Resources, Indian Scenario, Conventional Energy Sources & its problems, non-conventional energy sources- Advantages and its Limitations</p>	4
V	<p>Disaster Management: Natural Disasters and its types, Accidental Disasters, Impact of Disasters on Trade and International Trade, Introduction, Natural disasters , Earthquakes, Hurricanes, Tornadoes, Floods, Drought, Tsunami, Volcanoes, Cyclones and Storms, Forest Fires, Severe Heat Waves, Landslides and Avalanches, Epidemics and Insect Infestations, Technological and Social Disasters Types of Technological Hazards, Social Disasters, Political and Crowd Disasters, War and Terrorism, Components of Disaster Management, Government's Role in Disaster Management through Control of Information, Actors in Disaster Management, Organizing Relief measures at National and Local Level, Psychological Issues, Carrying Out Rehabilitation Work,</p>	7

	Government Response in Disaster	
Course Outcome as per Bloom's Taxonomy		
At the end of the course the students will be able to:		
CO1	Understand² the importance of Environment.	
CO2	Understand² the knowledge of Ecology & Ecosystems.	
CO3	Analyze³ to impart basic knowledge about Environment Pollution & theirs Remedies.	
CO4	Understand² about Energy Resources.	
CO5	Understand² about Disaster Management.	
Text Books	<ul style="list-style-type: none"> • Dr. N. S. Varandani.(2013). "<i>Basics of Environmental Studies</i>", Books India Publications, • Mukesh Dhunna.(2011)."<i>Disaster Management</i>", Vayu Education of India, Delhi Publication, • Benny Joseph.(2017).."<i>Environmental Studies</i> " , McGraw Hills Education, 	
Reference Books	<ul style="list-style-type: none"> • R. Rajagopalan .(2015)."<i>Environmental Studies</i> " , Oxford University, Press Publication, • Richard T Wright & Bernard J Nebel .(2002),"<i>Environmental Science</i>", Prentice Hall India Publication, • Daniel B. Botkin & Edward A Keller .(2014)"<i>Environmental Science</i>", Wiley Publications, 	

COURSE CODE	COMMUNICATION SKILLS	Total Lecture:15 Tutorial: 15
UC20B102		1– 1– 0-2
Course Objectives :	<p>The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. Along with the above mentioned, care has been taken to enhance the grammatical skills of the students with sufficient practical purposes. The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books. The students are advised to arrange the prescribed texts well before beginning the classes.</p> <p>The course provides good introduction and understanding about the following:</p> <ul style="list-style-type: none"> • The concept and understanding of different types of Communication • Introduce different tools of communication that are useful in various techniques of problems solving. • The Grammatical knowledge of Language learning with the enhancement of word power. <p>To introduce the tricks and methods of official and Technical writing.</p>	
Pre-requisites:	Nil	
UNIT	CONTENT	HOURS
I	Introduction: Theory of Communication, Types and Modes of Communication, Effective Communication, Barriers of Communication, Strategies to overcome the Barriers	3
II	Professional Skills: Social skills - Small talks and leading the Conversation, conducting Debate and Discussions, Public Speaking, Public Speech, Presentation skills and Meeting etiquettes, Business Communication, GD and Interview Skills, Critical Conversations	3
III	Cross Cultural Communication: Contextual Conversation, do's and don'ts of Cross Cultural Communication, Verbal and Non Verbal Communication, Bias and Prejudice, Body Language.	3
IV	Internet Etiquettes: Email writing, Social Media Articles/Blogs, Notes, Memos, Reports & Proposal Writing, Writing Letters, Formal & Informal. Self profiling - Making Job Resume/CV, Elevator Pitch (3 minutes self-introduction during interviews), Twitter/ Facebook bio.	3
V	Critical Thinking: Where the Mind is without Fear: Rabindranath Tagore The Portrait of a Lady: Khushwant Singh On the Rule of the Road: AG Gardiner Cherry Tree: Ruskin Bond	3

	Close Reading, Comprehension, Analysis and Interpretation, Paraphrasing and Summary	
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students will be able to:		
CO 1	Students will apply ³ correct usage of English grammar in writing and speaking.	
CO 2	Students will analyze ⁴ and improve their speaking ability in English both in terms of fluency and comprehensibility	
CO 3	Students will evaluate ⁵ themselves by giving oral presentations and will receive feedback on their performances.	
CO 4	Students will develop ³ their reading speed and comprehension of academic articles	
CO 5	Students will compare ⁵ their reading fluency skills.	
Text Books:	<ul style="list-style-type: none"> • ASTWOOD, J. Oxford practice grammar 1999 - Oxford University Press – Oxford • URPHY, R. English grammar in use 2012 - Cambridge University Press - Cambridge • fluency in English - Part II, Oxford University Press, 2006. • anguage, Literature and Creativity, Orient Black s • an, 2013. 	
Reference Books:	<ul style="list-style-type: none"> • arriner's English Grammar and Composition: Complete Course - John E. Warriner, Harcourt, Brace, Jovanovich (1973) • ALEXANDER, L. G. Longman English grammar practice 1999 - Longman - New York • EAUMONT, D. AND GRANGER, C. The Heinemann English grammar 1992 - Heinemann – Oxford 	

COURSE CODE	ENGINEERING MATHS- I	Total Lecture: 60
MA20B103		(LTP=4-0-0=4)

Course Objectives:

The objective is to provide essential knowledge of basic tools of Matrix Algebra, Differential Calculus, Integral Calculus, Vector Calculus and Vector spaces.

The course provides good introduction and understanding about the following:

- Working with matrices and using it as tool in solving the system of equations, learning to find eigen values and eigenvectors of a matrix and use it for diagonalization of a matrix.
- The concept and use of differential calculus in tracing of curves in different coordinate systems, partial differentiation, Homogeneous functions and its use in Euler's theorem and minimization/ maximization of the function.
- The concept of higher order integration and its application in finding length, area and volume.
- The concept of vector differentiation and integration.
- The concept of Vector Spaces, Sub spaces, Basis of a vector space and Linear Transformations.

UNIT	CONTENTS	HOURS
I.	Rank of a matrix, Inverse of the matrix, solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal and Unitary matrices and their elementary properties. Eigen values and Eigen vectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix.	12
II.	Expansion of functions of one variable using Taylor's and Maclaurin's theorem,, Partial differentiation, homogeneous functions, Euler's theorem and its extension up to second order, Differentiation of composite functions, Taylor's series expansion of function of two or more variable, Maxima and Minima of function of two or more variables, Lagrange method of undetermined multipliers.	12
III.	Brief review of curve tracing (Cartesian, polar and parametric), area of curve, length of curve, volume and surface area of the surface formed by revolution of curve about an axis, beta and gamma functions and their applications in real integration, Double, triple integrals, change of order of integration, area and volume of the surfaces using multiple integrals.	12
IV.	Vector differentiation, gradient, directional derivative, divergence & curl of vector point function, Line Integral, Surface Integral, Gauss Divergence Theorem, Stokes theorem & Green's Theorem.	12
V.	Vector Space, Vector Sub Space, Linear Combination of Vectors, Linearly Dependent, Linearly Independent, Basis of a Vector Space, Linear Transformations	12

Course Outcome as per Bloom's Taxonomy

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

CO1	Utilize³ matrices as tool in solving linear systems and determine if a given matrix is diagonalizable.
CO2	Apply³ differential calculus in tracing of curves, series expansion of functions, solving maximization/ minimization problems.
CO3	Utilize³ concepts of integral calculus in finding area and volume over higher dimensional domain
CO4	Evaluate⁵ integrals of functions or vector-related quantities over curves, surfaces, and domains in two- and three-dimensional space.
CO5	Define¹ vector spaces, sub spaces, basis of a vector space and Linear Transformations.

Text Books	<ul style="list-style-type: none"> • Grewal. B. S. (2017): Higher Engineering Mathematics, 43rd Edition, Delhi: Khanna Publishers. • as H K (2019): Advanced Engineering Mathematics, 22nd Edition, Bhopal Madhya Pradesh: S. Chand. • ill Tim (2018): Essential Permutations & Combinations. A Self-teaching Guide, Questing Vol. Press.
Reference Books	<ul style="list-style-type: none"> • reyszig E (2011): Advanced Engineering Mathematics, 9th edition, U. K: John Wiley and Sons, Inc. • oole D (2005): Linear Algebra: A Modern Introduction, 2nd Edition: Brooks/Cole. • . V. Ramana (2010): Higher Engineering Mathematics, 11th Reprint, New Delhi: Tata McGraw Hill.

COURSE CODE	FRONT END WEB DEVELOPMENT	(LTP=3-0-2=4)
LT21B121		
Course Objectives:		
<ul style="list-style-type: none"> • Explain website design concepts and the methodology behind designing, implementing, and testing interactive websites. • Identify the purpose of mark-up languages and its applications in structuring a page. • Describe the purpose of styling and its application in styling the page. • Describe the purpose of scripting and its application in developing an interactive website • Develop a Single Page Application using HTML5, CSS3, JavaScript/ jQuery and AJAX. 		
UNIT	CONTENTS	HOURS
I	Introduction to Web Technologies: Server, Server Component, Web Server, HTTP, DNS, Website builders, CMS, Hosted and Non-Hosted CMS, Limitations of hosted CMS, Front End Design, Server-side Scripting, Publishing Website, Purchase domains and hosting, Setup domain and hosting, FTP/STP, WordPress, Web Development Process, Content Strategy, Persona, Information Architecture, Wireframe, User flow design, Storyboard	12
II	HTML: Importance of HTML, Basic HTML Syntax, Code Editor, HTML resources, Exploring HTML Document, Doctype Declarations, Document Head and Body, Understanding Content Models, Formatting content with HTML, Formatting Paragraphs, Controlling Line Breaks, Emphasizing Text, Displaying Special Characters, Controlling Whitespace, Displaying Image, NAV Element, Article Element, Section Element, Aside Element, Div Element, Semantic Elements, WAI-ARIA Roles, Internal and External linking, Types of lists – Ordered List, Unordered List, and Definition List,	12
III	CSS: Inline, Internal & External CSS, Syntax, terminology and naming conventions, Simple selectors, Pseudo class selectors, RGB, HEX, and Keyword color values, Cascading, inheritance, and specificity, Typography, Layouts	12
IV	JavaScript and jQuery: Web Browsers for Learning JavaScript, Declaring and assigning variable, Numbers, Strings, Booleans and the quest for truth, Manipulation Objects, Objects and References, Arrays, Manipulating Arrays, Readability Comments, Regular expressions, Simple comparisons, Arithmetic operators, Logical operators, Conditionals: if and switch, ternary operators, Type checking, Flow: Sequential, Iterative and Enumerative, Functions, Understanding variable scope, jQuery: Selectors, Filters, Creating and modifying Page Content, Handling Events, Animating page content, Working with AJAX, jQuery UI: Spinner, Slider, Accordion, Menu, Tabs	12
V	Single Page Application and Testing: Introduction to Ajax, Rich Internet Application, Benefits and Drawbacks, Business Process and Workflow, Ajax: Technical Components, Operations, XMLHttpRequest, XMLHttpRequestResponse, JSON, XML, AJAX-Server Communication with JSON, W3 Standards, W3C Technology Stack, Testing, Types of Testing, Cross Browser Testing, HTML, CSS Validator, Fiddler	12
Course Outcomes as per Bloom's Taxonomy		
CO1	Understand mark-up, styling, and scripting languages and its applications to develop the web applications	

CO2	Develop the user flow using Information Architecture, Wireframe, and storyboard based on the requirements.
CO3	Design the User Interface according to the business requirements
CO4	Construct Single Page Web Application using HTML, CSS, JavaScript, jQuery, jQueryUI, and Ajax
CO5	Evaluate the user interface to meet the business requirements and browser compatibility
Text Book	<ul style="list-style-type: none"> • Jon Duckett, 2014. Web Design with HTML, CSS, JavaScript, and jQuery Set, 1st ed. John Wiley & Sons, Inc. • Powell, T. A., 2008. Ajax: The Complete Reference. 1st ed. s.l.:McGraw-Hill.
Reference Books	<ul style="list-style-type: none"> • Wiley Brown, E., 2016. Learning JavaScript add sparkle and life to your web pages. 3rd ed. CA: O'Reilly Media, Inc.,. • Hogan, B. P., 2013. HTML5 and CSS3, Level Up with Today's Web Technologies. 2nd ed. USA: The Pragmatic Programmers, LLC.. • Frank W. Zammetti., 2007, Practical JavaScript, DOM Scripting, and Ajax Projects, Apress

COURSE CODE	PROGRAMMING FOUNDATIONS	
LT21B122		(LTP=3-0-2=4)
Course Objectives:		
<ul style="list-style-type: none"> Describe the attributes of different programming paradigms Explain the application design process and different algorithm types Identifying opportunities to write modularized code using Java and Java Class Libraries with documentation. Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs. Recognize Syntax, Logical, and Runtime errors and its rectification techniques 		
UNIT	CONTENTS	HOURS
I	Introduction to Programming: Program Paradigm: Procedural, Event, Functional, and Object-Oriented Programming, Algorithms, Flowcharts, Pseudo code, Formal Specification Method, Event Driven, Data Driven, Finite State Machines, Application design process.	12
II	Java Basics – Part 1: Anatomy of Java Program, Comments, Data type, Comments, Strings, Patterns, Arithmetic operators, Relational Operators, Logical operators, Conditionals: if and switch, ternary operators, Type checking, Flow: Sequential, Iterative and Enumerative, Functions, Understanding variable scope, Methods, Parameters, Arrays, Array List, Error Handling: Exception, Custom Exceptions, and try ... catch	12
III	Java Basics – Part 2: Data Flow: Sequential, Iterative and Enumerative, Functions, Understanding variable scope, Methods, Parameters, Arrays, Array List, Error Handling: Exception, Custom Exceptions, and try ... catch	12
IV	Object Oriented Programming: Anatomy of Object, Object Oriented Programming Principles Encapsulation, Abstraction, Inheritance, and Polymorphisms, Method overloading, Method overriding, Attributes, Types of variables instance, static, and final,	12
V	Java Documentation and Unit Testing: Naming Conventions, Documenter block, JavaDoc, Junit Architecture, JunitPlatform, Assertions, Tagging and Filtering Tests, Conditional Testing, Nested and Repeated Tests, Dynamic Tests, Test Interfaces	12
Course Outcomes as per Bloom's Taxonomy		
CO1	Explain the problem solving, Programming Basics, OOP principles and Software Design Techniques	
CO2	Analyze user requirements, and document the specifications of the application	
CO3	Construct Command line application using Java	
CO4	Create API documentation using JavaDoc	
CO5	Evaluate the software design using Junit framework	
Text Book	<ul style="list-style-type: none"> Harry.H.Chaudhary, 2014. Introduction to Java Programming. 2nd ed. s.l.:Programmers Mind Createspace Inc. OD Publishing, LLC USA.. Shekhar Gulati, R. S., 2017. Java Unit Testing With JUnit 5. s.l.:Apress. 	

Reference Books	<ul style="list-style-type: none"><li data-bbox="359 212 1493 280">• Nair, P. S., 2009. Java Programming Fundamentals- Problem Solving Through Object Oriented Analysis and Design. 1st ed. Boca Raton: CRC Press, Taylor & Francis Group.<li data-bbox="359 302 1493 369">• Weiss, M. A., 2010. Data Structures & Problem-Solving Using Java. 4 ed. s.l.:Pearson Education, Inc..
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COURSE CODE	UI FRAMEWORKS	
LT21B123		(LTP=3-0-2=4)
Course Objectives:		
<ul style="list-style-type: none"> Describe the techniques for gathering and analysing user feedback Classify the types of prototyping and techniques to develop the human-centric prototyping Use Bootstrap to construct responsive website Develop Components using TypeScript, Templates, and Decorators and device-independent Single Page Application Identify performance levels and gaps between current level of user experience and the desired user experience 		
UNIT	CONTENTS	HOURS
I	Introduction to UI/UX Design: Ideation, Analyzing User Data, Creating Persona, Understanding Ideation, Scenarios and Storyboards, Get Data to Analyze, Turn Observations into Actionable Data, Observer Users, Observation Techniques, User experience metrics: Task Success Rate, Error Rate, Time Taken to Complete, and Net Promote Score , Usability Testing, Right participants, Test plan, Participants questions, Analyze with the team, Report, Resetting, Measure UX Metrics, and Impact	12
II	Prototyping: Prototyping: Low fidelity, Medium fidelity, and High fidelity, Testing and Evaluating Prototypes, Paper Prototype, mockups, Keynote, Axure: Interactive Button, Hiding and Showing Widgets, Passing values to Next Page, Anchor Links, Embedding Media, Imaging Banner, Navigation Menu, Tooltips, Account Login, Required Fields	12
III	Responsive Framework: Essential Classes: Containers, Colors, Spacing, Display, Position, Using Elements, Typography styles, Typography elements, Backquotes and simplelists, List Groups, Tables, Images and figures, Borders, Modifying Elements, Box modifications, Sizes and ratios, Interactivity classes: Layouts with Columns and Flexbox, Basic grid layout, Rows, Responsive columns, Flexbox metrics, Flexbox content, Flexbox organization, Layout Components, Buttons, Navs, Navbar, Cards, Pagination, Progress, Spinner, Badges and breadcrumbs, Interactive Components: Carousel, Accordions, Alerts, Toasts, Model, Collapse, Dropdowns, Tooltips, Popovers, Scrollspy Form: Basic inputs, Selects and range, Floating labels, Checks and radios, Input groups	12
IV	Angular Framework - Basics: Architecture, Directives: Structural, Built-in, and Custom, Pipes Built-in and Custom, Data Binding, Dependency Injection, Services, Data Persistence, Routing, NgModule, Root Module, Component, Property binding, Event binding, Forms: Template Driven	12
V	Angular Framework - Advanced: Model Driven, Validation, Error Handling, Providing Services, Service in components, HttpClient, mock backend, POST, PUT and DELETE calls, Handling HTTP errors Routing Outlets and Router links	12
Course Outcomes as per Bloom's Taxonomy		
CO1	Illustrate the techniques to gather user requirements and analyze the user feedback	

CO2	Design and develop the prototype by adopting user experience principles
CO3	Demonstrate observation of the users through usability test while revising the prototype
CO4	Develop Responsive Website using Bootstrap framework
CO5	Develop a Single Page Application using Angular framework
Text Book	<ul style="list-style-type: none"> • Seshadri, S., 2018. Angular Up & Running, Learning Angular Step By Step. 1st ed. s.l.: O'REILLY. • Stull, E., 2018. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers. 1st ed. s.l.: Apress. • Rahman, b. S. F., 2014. Jump Start Bootstrap. 1st ed. VIC, Australia: SitePoint Pty Ltd.
Reference Books	<ul style="list-style-type: none"> • Axure, n.d. Axure Video Courses. [Online] Available at: https://www.axure.com/support/video-courses • Radfors, S., 2015. Learning web Development with Bootstrap and AngularJS. 1st ed. Birmingham: Packt Publishing Ltd..

SUBJECTCODE	DATABASE DESIGN AND IMPLEMENTATION	
LT21B104		(LTP=3-0-2=4)
Course Objectives:		
<ul style="list-style-type: none"> • Explain the different kinds of entity-relationship modeling and normalization techniques (ER,Relational Modeling) • Use Structured Query Language (SQL) to define, create and manipulate database structures(tables, view, stored procedures, and functions) and data (Create, Update, Read, and Delete) • Describe the mechanisms and processes for data maintenance, storage, and retrieval • Explain the concurrency and transaction processing mechanisms in a relational database • Develop a data-driven command-line application using connectors/ APIs 		
UNIT	CONTENTS	HOURS
I	Introduction to Database Design and Implementation: Introduction: Database Management Systems(DBMS), Relational Structures,Database development lifecycle, Remove duplicate Information, Eliminate Inconsistent Data, Prevent data conflicts, Transactions and the ACID test, Gather Requirements: understand the goal, review the current system, discover actor & tasks, interview the client, identify exceptions and irregularities, Conceptual model: entities, tables, relationships, subtypes & supertypes, lookup tables, data model,	9
II	Normalization: Normalize Data: key fields, first NF, second NF, third NF, Denormalization, Logical Design: data types, precisions, junction tables, integrity constraints, referential integrity, index, Physical database	3
III	Introduction to SQL: Create: Table, view, stored procedure, functions and triggers, Alter structure, CRUD (Create, Read, Update, Delete) operations using Insert, Select, Update and Delete, Filter rows using operations, sub queries, and regular expressions	6
IV	Advanced DB Concepts: Transactions for performance, optimizing SQL queries, Profiling and explaining queries, analyzing table structure, normalizing table, tune performance, Import and Export data, User management, DB privileges, DBbackup and recovery, schedule the DB backup activity, Testing: Structural, Schema, Stored Procedure, Trigger, Load, Documentation, Data Dictionary,Interface with Java application	6

COURSE CODE	ENTREPRENEURSHIP DEVELOPMENT	TOTAL LECTURE:30
UC20B202		(LTP=0-0-8=4)
Course Objectives :		
Develop understanding and confidence in students to venture into entrepreneurship by giving them baseline understanding of the various aspects impacting decision making on various frontiers as faced by an enterprise		
UNIT	CONTENTS	HOURS
I.	Introduction: Entrepreneurial environment, culture and stages in entrepreneurial process, changing dimensions in entrepreneurship – Digital entrepreneurship. Entrepreneur Vs. Intrapreneur, Entrepreneur Vs. Entrepreneurship, Entrepreneur Vs. Manager; Role of Entrepreneur in Indian economy and developing economies with reference to Self-Employment Development Entrepreneurial Culture.	7
II.	Starting A New Venture: Generating business idea – sources of new ideas, methods of generating ideas, opportunity recognition. Choice of the organization : Sole Proprietorship, partnerships, Joint Stock Co., Co-Operatives Family Business – meaning, characteristics, importance, types and models. Growing and evolving family business – Complexity of family enterprise – Diversity of successions; Different Dreams and challenges. Feasibility study – market feasibility, technical/operational feasibility, financial feasibility, environmental scanning, competitor and industry analysis. Drawing business plan - preparing project report, presenting business plan to investors.	7
III.	Financing and Managing New Venture: Financing and Managing the new venture, Source of capital, Record Keeping, financial controls, Marketing and sales control. Internet advertising Features and evaluation of joint ventures. Basic Government Procedures to be complied with; Policies governing SMEs – Steps in setting up a small unit. Type of business- Large Scale/ MSME; Judging Funding requirements of the business; New Generation Funding sources- Venture Capital Funding, SME Funding, Angel Investors etc.	5
IV.	Institutional support and government initiatives for Entrepreneurs': Role of Directorate of Industries, Role of following agencies in the Entrepreneurship Development - District Industries Centers (DIC), Industrial Development Corporation (IDC), State Financial Corporations (IFCs), Commercial Banks, Small Scale Industries Development Corporations (SSIDCs), Khadi and Village Industries Commission (KVIC), Industries Service Institute (SISI), NABARD, National Small Industries corporation (NSIC), Small Industries Development, Bank of India (SIDBI) and other relevant institutions / organizations. Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants.	6
V.	New Venture Expansion and Exit Strategies: Joint Ventures, Acquisitions, mergers, franchising, public issues, right issues, bonus issues and stock issues. Exit Strategies, Reasons for exiting and long and short term preparation, CSR, Dimensions of CSR	5
Course Outcome as per Bloom's Taxonomy		
At the end of the course the students will be able to:		

CO 1	Develop ³ managerial qualities and competencies of an entrepreneur.
CO 2	Acquaint ² himself with the challenges of starting a new venture and the process of setting up a business.
CO 3	Build ³ essential skills and creativity needed to build teams and work in and with them.
CO 4	Know ¹ the essential procedure and funding avenues for setting up a new business.
CO 5	Learn ¹ the various government initiatives and accordingly plan for his business.
Text Books	<ul style="list-style-type: none"> • r. G.K. Varshainey ,(2019). “<i>Fundamental of Entrepreneurship</i> “, Sahitya Bhawan Publications, • r. A.N Bharti, Dr. Pramodh Kumar Tripathi.(2021-22). “<i>Fundamental of Entrepreneurship</i>” , Rajeev Sahitya Bhawan Publication, SBPD Publication • . Nandan.(2013). ”<i>Fundamental of Entrepreneurship</i> “, Third Edition, PHI Learning. • . Nagarajan.(2017)., ”<i>Project Management</i> “,Second Edition, New Age International,
Reference Books	<ul style="list-style-type: none"> • isrich Peters.(2017). “<i>Entrepreneurship</i> “,Tenth Edition ,Mc Graw Hills, • rigitte Berger.(1991)“<i>The Culture of Entrepreneurship</i> “, ICS Pt., • teven Brandt .(1997).” <i>Entrepreneurship: 10 Commandments for Building a Growth Company (Build Your Business Guides)</i>.3rd Ed. Archipelago Pub; • urmit Narula .(2002)”<i>The Entrepreneurial Connection</i> “, Tata McGraw Hills.

COURSE CODE	ENGINEERING MATHS - II	Total Lecture: 60
MA20B204	(LTP=4-0-0=4)	
<p>Course Objectives:</p> <p>The objective is to acquaint the students with basic knowledge of Ordinary and Partial Differential Equations, Calculus of complex functions, Laplace and Inverse Laplace Transform, and Sequences and Series and specifically Fourier Series. The course provides good introduction and understanding about the following:</p> <ul style="list-style-type: none"> • The concept and understanding of different analytical techniques of solving first and higher order ordinary and partial differential equations. • Introduce the tools of differentiation and integration of functions of complex variable that are used in various techniques dealing engineering problems. • The concept of Laplace and Inverse Laplace Transform and its application. • The method of testing convergence of sequences and series and concept of Fourier series. 		
UNIT	CONTENTS	HOURS
I.	Differential Equation of First Order and Higher Degree, Linear Differential Equation with Constant Coefficient of Higher Order, Cauchy's Differential Equation, Method of Variation of Parameter, Simultaneous Differential Equation, Introduction to series solution method.	12
II.	Formation of first and second order partial differential equations. Linear & Non-Linear partial differential equation of First Order, Homogeneous & Non-Homogeneous Linear P. D. E with constant coefficient of Higher Order, Separation of Variables, Wave equation & Heat Equation.	12
III.	Analytic functions, C-R equations, necessary and sufficient conditions, Harmonic conjugates, Milne's method, complex line integration, Cauchy's theorem for simply and multiply connected domains, Cauchy's integral formula for the derivatives of an analytic function, Taylor series, Laurent series, Zeros and poles of a function, residue at a singularity, Residue theorem, its applications for the Evaluation of Real Definite Integral.	12
IV.	Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of derivatives and integrals. Convolution theorem. Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function. Solution of differential equation by using Laplace transforms.	12
V.	Sequences, Series, Convergence, Tests for convergence of series (Comparison tests, D'Alembert's Ratio test, Integral test, Raabe's, Cauchy's Root test, Logarithmic), Fourier series: Half range sine and cosine series.	12
Course Outcome as per Bloom's Taxonomy		
CO 1	Define¹ and differentiate between ordinary and partial differential equations and solve different boundary value problems in engineering	
CO 2	Define¹ functions of complex variable, their differential and integral calculus and utilize it in evaluating real integrals	

CO 3	Understand ² and apply Laplace transformation in finding solution of differential equations in engineering
CO 4	Evaluate ⁵ the convergence or divergence of various sequences and series utilizing appropriate tests.
CO 5	Formulate ⁶ and find solution of more complicated engineering problems.
Text Books	<ul style="list-style-type: none"> • Newar B. S (2017): Higher Engineering Mathematics, 43rd Edition, Delhi: Khanna Publishers. • Ramaswami H. K. (2019): Advanced Engineering Mathematics, New Delhi, 22nd Edition: S Chand. • Jain R. K. and Iyenger S. R. K. (2016): Advanced Engineering Mathematics, 5th Edition, New Delhi. : CRC Press, Narosa Publishing House.
Reference Books	<ul style="list-style-type: none"> • Kreyszig E. (2011): Advanced Engineering Mathematics, 9th edition, U. K.: John Wiley and Sons, Inc. , • Strang C. (2005): Linear Algebra: A Modern Introduction, 2nd Edition: Brooks/Cole. • Ramana B. V(2010): Higher Engineering Mathematics, 11thReprint. , New Delhi: Tata McGraw Hill.

SUBJECTCODE	APPLICATION IMPLEMENTATION	
LT21B221		(LTP=2-0-4=4)
Course Objectives:		
<ul style="list-style-type: none"> Describe Software Development Life Cycle (SDLC) methodologies to develop the applications Classify different types of testing methods with its pros and cons Conduct feasibility study regarding configuration, integration, or portability of applications Explains the components of Phases of testing with associated activities Describes the stages of problem management life cycle with a business continuity plan 		
UNIT	CONTENTS	HOURS
I	Introduction to SDLC: SDLC, Phases in SDLC: Requirements gathering, Analysis and Design, Implementation, Testing, Deployment, and Maintenance, SDLC Models: Waterfall, Incremental, Iterative, Spiral, V-Shaped, Agile, ScrumDevelopment,	3
II	Feasibility Study: Types of feasibility: Technical, Operational, Economical, Legal, Cost Benefit Analysis, Alternative Solutions, Project Planning and Management	3
III	Introduction to Testing: Types of testing: Functional, Non-Functional, White Box, Black Box, and Gray box testing, Unit testing, Integration Testing, System Testing, Interface testing, sanity testing, smoke testing, load testing, compatibility testing, usability testing, portability testing,	3
IV	Test Planning and Execution: Test Planning: Analyse the product, Design test Strategy, Define Test Objectives, Plan Test Environment, Resource Planning, Define Test Criteria, Schedule & Estimation, Determine Test Deliverables, Optimal Test Schedule methods: Work break down structure, Functional point, Three point estimation, Phase test plan, Test Scenario, Test Cases, Test Scripts, Execution, Test Metrics	3
V	Problem Management: Principles of problem management, Problem Management Life Cycle, Problem Identification, Investigation, Analysis, Resolve, and Review, Root cause analysis: Brain Storming, Ishikawa, Kepner Tregoe, 5 Whys, Problem Management Methodologies: Agile, Waterfall and Hybrid, Problem Management process, Incident Management, Service Desk, Issue tracking, Change management, and Known Error Database	3
Course Outcomes as per Bloom's Taxonomy		
CO1	Manage the application implementation by adopting the appropriate SDLC methodology.	
CO2	Identify the appropriate testing method and prepare the optimal schedule to assure the quality of the application	
CO3	Adopt standard practices and prepare Phase Test Plan, Test Cases, and Test Scripts.	
CO4	Organize the test results with test metrics to communicate with the stakeholders.	
CO5	Analyze the problems by using appropriate tools and techniques to document the resolutions as per the industry standards.	
Text Book	<ul style="list-style-type: none"> Ellis, G., 2016. Project Management in Product Development. 1st ed. Waltham: Elsevier Inc.. Sproull, B., 2018. The Problem-Solving, Problem-Prevention, and Decision-Making Guide. 1st ed. Boca Raton: Taylor & Francis Group, LLC. 	

Reference Books	• Appel, F., 2015. Testing with JUnit. 1st ed. Birmingham: Packt Publishing.
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SUBJECT CODE	WEB DEVELOPMENT FOUNDATIONS	
LT21B222	(LTP=2-0-4=4)	
<p>Course Objectives:</p> <ul style="list-style-type: none"> • Gain an understanding of the Model, View, and Controller (MVC) framework. • Get in-depth knowledge of the syntax and structures of the framework and their respective Application Programming Interfaces (API). • Recognize how to analyze and verify the technical design of a business solution. • Implement the architectures, protocols, and standards required to integrate the client and server components. • Evaluate trade-offs in software development practices to recommend the areas for improvement. 		
UNIT	CONTENTS	HOURS
I	<p>Introduction to SDLC & Technical Design: SDLC, Phases in SDLC: Requirements gathering, Analysis and Design, Implementation, Testing, Deployment, and Maintenance, System Requirements Specifications, UML: Use Case, Activity, Sequence, Class Diagram, Technical Design</p>	6
II	<p>Introduction to JSP and Servlets: Purpose of the servlets, HTTP Request, GET Request in Web App, Connecting with DB, Querying DB, Building Servlet response, POST Requests, Collect Data from forms, Call DAO to process, Forwarding and redirecting requests, Configure servlet, Servlet Context, Parameters vs Attributes, Servlet Lifecycle, Request Dispatcher, JSP Lifecycle, JSP Elements: Scriplet, Expression, Declaration, Implicit Objects of JSP, Query String, Session Management, Cookies,</p>	6
III	<p>Introduction to Spring MVC: Spring framework overview: Inversion of Control (IoC), Dependency Injection (DI), Modules: Core (DI, Internationalization Events, Validation, Aspect Oriented Programming (AOP), Data Access (DAO, ORM, JDBC), Web – Servlet API (Spring MVC), Reactive API (Spring WebFlux), Web Sockets, Integration – Java Message Service (JMS), Java Management Extension (JMX), and Remote Method Invocation (RMI), Testing, Components of Web App – Presentation Layer, Web Layer, Application Layer, Data Access Layer, Database Server, MVC Pattern, Configuring MetaData, Annotation based meta data, Instantiating a bean, Bean Properties, Bean Scope, Callbacks</p>	6
IV	Spring CRUD:	6

COURSE CODE	APPLICATION DEVELOPMENT & PROCESS	
LT21B223		(LTP=2-0-4=4)
Course Objectives:		
<ul style="list-style-type: none"> • Prepare a project plan to manage a small to a medium-scale web application. • Plan to develop reusable components and Design reusable User Interface templates and components • Develop applications in alignment with design specifications using a range of tools and techniques, by adopting the security standards and features for the application • Conduct Quality Assurance testing by using identified software security and testing techniques • Deploy the application build in a virtual machine after evaluating the test results against desired performance, standards, and usability outcomes. 		
UNIT	CONTENTS	HOURS
I	Spring MVC: Spring framework overview: Inversion of Control (IoC), Dependency Injection (DI), Modules: Core (DI, Internationalization Events, Validation, Aspect Oriented Programming (AOP), Data Access (DAO, ORM, JDBC), Web – Servlet API (Spring MVC), Web Sockets, Integration – Java Message Service (JMS), Java Management Extension (JMX), and Remote Method Invocation (RMI), Testing, Components of Web App – Presentation Layer, Web Layer, Application Layer, Data Access Layer, Database Server, MVC Pattern, Configuring Meta Data, Annotation based meta data, Instantiating a bean, Bean Properties, Bean Scope, Callbacks	12
II	Spring Boot: Introduction to Spring Boot Features, Value Proposition of Spring Boot, Creating a simple Boot application using Spring Initializr website, Spring Boot Dependencies, Auto-configuration, and Runtime, Dependency management using Spring Boot starters, Configuration properties, Overriding auto-configuration , Using CommandLineRunner	12
III	Spring Data: Spring data commons, ORM, Logical model vs physical model, Java Persistence API, Map a database table to a Java Class, Multiple tables to Java Classes, Java Persistence Query Language, Spring Data Repositories interfaces, CRUDRepository Interface, JPA Repository, Paging and Sorting, @Query methods, Optional query response, Spring Data REST, QueryDSL, Auditing	12
IV	Integrating Angular with Spring: Configure API using Spring Java Config, Resource Modeling, EndPoint –GET, POST, PUT, and DELETE endpoint using Spring MVC, Create Angular components, Configure JPA Layer, JPA Repository, REST API POST Request	12
V	Spring Security and Testing: Spring Boot testing overview, Integration testing using @SpringBootTest, Web slice testing with MockMvc framework, Slices to test different layers of the application	12
Course Outcomes as per Bloom's Taxonomy		
CO1	Formulate business requirements into a functional and technical specification document.	
CO2	Manage the application development process as per the project management plan	
CO3	Construct software components/applications to meet the business requirement.	
CO4	Evaluate the application to meet the desired performance, standards, and usability outcomes as per the specifications	
CO5	Identify the suitable hosting environment to deploy the application	

Text Book	<ul style="list-style-type: none"> • Available at: https://docs.spring.io/spring-framework/docs/current/javadoc-api/[Accessed 28 April 2020]. • Bretet, A., 2016. Spring MVC Cookbook. 1st ed. Birmingham: Packt PublishingLtd.. • WALLS, C., 2016. Spring Boot in Action. 1st ed. Shelter Island: Manning Publications Co. .
Reference Books	<ul style="list-style-type: none"> • Kayal, D., 2008. Pro Java™ EE Spring. 1st ed. s.l.:Apress. • Sarcar, V., 2019. Java Design Patterns: A Hands-On Experience with Real-World Examples. 1st ed. s.l.:Apress. • Ganeshan, A., 2016. Spring MVC Beginner's Guide. 2nd ed. s.l.:PacktPublishing.

COURSE CODE	WEB DEVELOPMENT USING PLATFORMS	
LT21B224		(LTP=2-0-4=4)
Course Objectives:		
<ul style="list-style-type: none"> Identify the technical and functional requirements of stakeholders' meeting their business needs Prepare a functional specification and technical blueprint for developing enterprise applications Develop an architectural proof of concept by adopting appropriate permissions and authorizations available in the platforms Develop a solution architecture using the Liferay portal by developing the content, portlets, and backend using Liferay SDK/ IDE Plugins Demonstrate how the recommended architecture address the business needs 		
UNIT	CONTENTS	HOURS
I	Java Design Patterns: Creational – Singleton, Factory, Builder, Prototype, and Abstract, Structural – Adapter, Bridge, Composite, Decorator, Façade, Flyweight, and Proxy, Behavioural - Observer, Chain of responsibility, Command, Interpreter, Iterator, Mediator, Memento, Null Object, Strategy, Template, and Visitor, Advantages and Disadvantages	12
II	Introduction to Liferay and Administration: Installation of Liferay, access portal using Tomcat server, Configure in Eclipse, Portlet, Advantage and disadvantages of Java Portlet, Configure Liferay plugin, SDK, Create, Build, and Run the project, Managing User accounts, Controlling User access, Building sites, Adding and Managing pages	12
III	Backend Development & Content Creation: Sites, Out of the box portlets, Journal Article, Message Board, Blogs, Aggregating blog entries, Blogs Administration Portlet, Document and Media Library, Reusable templates, Automate and optimize content publication, Staging content, Advanced publication with staging, Updating theme, Page Personalization and customizations, Deploy Liferay IDE components, Creating Liferay MVC Portlet, Build the portlet and deploy	12
IV	Developing a simple application: Service builder, Presentation Layer, UI Widgets and Templates, Themes, Logo, Implementing Access Control, Application Configuration and Implementation, Configure Service, Configuration - Create custom tables, Global Service information, Service Entities, Defining Attributes, custom exceptions, Build services, Build and deploy the project	12
V	Assets Management, Permissions and Authorizations: Overview of Assets Management framework, Controlling access to assets, Connecting with existing repositories, Making custom portlet registered as a Liferay Asset, Using search and indexing, Implement permission checker on custom portlet, Workflow Design in Kaleo definition,	12
Course Outcomes as per Bloom's Taxonomy		
CO1	Interpret the Liferay concepts to meet the business requirements	
CO2	Analyse the Liferay features such as content creation, assets management, and permissions and authorization to get insider knowledge.	
CO3	Formulate the requirements as a System Architecture and Technical Design.	
CO4	Develop a real-world business application for the given scenario.	
CO5	Evaluate the suitability of the architecture and design.	

Text Book	<ul style="list-style-type: none">• https://help.liferay.com/hc/en-us/articles/360017898972-Introduction-to-Developing-Plugins-with-Liferay-IDE
Reference Books	<ul style="list-style-type: none">• https://portal.liferay.dev/learn/code-sampleshttps://spring.io/guides

COURSE CODE	QUANTITATIVE APTITUDE-I	Total Lecture: 30
UC20B302		(LTP=2-0-0=2)
Course Objectives:		
<ul style="list-style-type: none"> To enhance the problem solving skills To improve the basic mathematical skills. Enable students to manage the placement challenges more effectively 		
UNIT	CONTENTS	HOURS
I	Numbers, H. C. F & L. C. M of Numbers, Decimal Fraction, Coding deductive logic, Data Sufficiency, Directional Sense	6
II	Simplification, Square root & Cube root, Average, Problem on Numbers & Problem on Ages, Percentage	6
III	Profit & Loss, Ratio & Proportion, Height & Distance Partnership, Chain Rule, Time & Work.	6
IV	Deductive Reasoning, Logical Word Sequence, Objective Reasoning, Selection decision tables, Puzzles	6
V	Inductive reasoning- Analogy Pattern Recognition, Classification Pattern Recognition, Coding Pattern Recognition, Number Series Pattern Recognition	6
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students should be able to:		
CO1	Make decisions ⁵ based on analysis and critique of quantitative information using proportional reasoning. Students will also effectively justify and communicate their conclusions in ways appropriate to the audience.	
CO2	Solve ³ real-life problems requiring interpretation and comparison of various representations of ratios (i. e. , fractions, decimals, rates, and percentages):	
CO3	Analyze ⁴ and critique mathematical models and be able to describe their limitations.	
CO4	Apply ³ probabilistic reasoning to draw conclusions, to make decisions, and to evaluate outcomes of decisions.	
CO5	Distinguish ⁴ between proportional and nonproportional situations and, when appropriate, apply proportional reasoning.	
Text Book	<ul style="list-style-type: none"> Aggarwal R. S. (2020): Quantitative Aptitude for Competitive Examinations, New Delhi: S. Chand Publication. Gupta D. P. & Burnwal Sanjeet (2020): General Quantitative Aptitude for Competitive Exams II Edition, New Delhi: Disha Publication 	
Reference Books	<ul style="list-style-type: none"> Agrawal Deepak & Gupta D. P. (2018): Rapid Quantitative Aptitude: With Shortcuts & Tricks for Competitive Exams, New Delhi: Disha Publication Guha. Abhijit (2016): Quantitative Aptitude for All Competitive Examinations VII Edition, Noida: McGraw Hill Education 	

COURSE CODE	DATA STRUCTURE AND ALGORITHMS	Total Lecture: 60 Theory: 45 Practical: 15
CS20B302		(LTP=3-0-2=4)
Course Objectives: The objective of this course is to: <ul style="list-style-type: none"> • Introduce the fundamentals and abstract concepts of data structures. • To design and implement various data structures. • Understand the usage of stacks and queue. • To teach different searching and sorting techniques • Learn how concepts of data structures are useful in problem solving. 		
UNIT	CONTENTS	HOURS
I	Introduction: Basic Terminology: Elementary Data Organization, Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time-Space trade-off. Abstract Data Types (ADT) Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices and their representations. Linked lists: Array Implementation and Dynamic Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List.	10
II	Stacks and Queues: Abstract Data Type: Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Recursion, Tower of Hanoi Problem, Simulating Recursion, Principles of recursion, Tail recursion, Removal of recursion Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue.	9
III	Trees: Basic terminology Binary Trees, Binary Tree Representation: Array Representation and Dynamic Representation, Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Array and Linked Representation of Binary trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm.	9
IV	Graphs: Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi list, Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm.	8
V	Searching and Sorting: Sequential search, Binary Search, Comparison and Analysis Internal Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort, Radix Sort, Practical consideration for Internal Sorting. Search Trees: Binary Search Trees(BST), Insertion and Deletion in BST, Complexity of Search Algorithm, AVL trees, Introduction to m-way Search Trees, B Trees & B+ Trees Hashing: Hash Function, Collision Resolution Strategies Storage Management: Garbage Collection and Compaction.	9

List of Experiments:

1. Write a program that uses functions to perform the following operations on singly linked list i) Creation ii) Insertion iii) Deletion iv) Traversal.
2. Write a program that uses functions to perform the following operations on doubly linked list i) Creation ii) Insertion iii) Deletion iv) Traversal.
3. Write a program that uses functions to perform the following operations on circular linked List i) Creation ii) Insertion iii) Deletion iv) Traversal.
4. Write a program that implement stack (its operations) using i) Arrays ii) Linked list(Pointers):
5. Write a program that implement Queue (its operations) using i) Arrays ii) Linked list(Pointers):
6. Write a program that implements Circular Queue using arrays. ii) Write a program that uses both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers: a) Linear search b) Binary search.
7. Write a program that implements the following sorting i) Bubble sort ii) Selection sort iii) Quick sort.
8. Write a program that implements the following i) Insertion sort ii) Merge sort iii) Heap sort.
9. Write a program to implement all the functions of a dictionary (ADT) using Linked List.
10. Write a program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. c) Search for a key element in a binary search tree.
11. Write a program to implement the tree traversal methods
12. Write a program to perform the following operations: a) Insert an element into a AVL tree. b) Delete an element from a AVL tree. c) Search for a key element in a AVL tree.

COURSE CODE	DEVELOP ENTERPRISE APPLICATIONS	PRACTICAL: 60
LT21B225		(LTP=2-0-4=4)
Course Objectives:		
<ul style="list-style-type: none"> • Explain the architecture of OmniCom and its components. • Create a software design blueprint based on a broad design concept, and business and user requirements. • Prepare functional and technical specifications of enterprise applications to address business and user needs. • Develop the persona-based marketing campaign on Digital channels. • Gain knowledge to measure the performance of the marketing campaign.. 		
UNIT	CONTENTS	HOURS
I	Introduction to OmniCom: Marketing, campaign, Advertising, OmniCom Solution Overview, Architecture and Components, Control panel, Users, Sites, Apps, User Roles and Access. Plugin Configurations, Server Administration, Portal Setting	12
II	Web Flow Design Tools and Process Engine: Form Builder, Rulesets, Process, Email Templates, Process Diagram, Product Engine Overview, Framework, Competency Unit, Outline, Certificate, Module, Course, Product, Product view	12
III	Lead and Opportunity Process: Business Objective, Key Performance Indicator, Target your audience. Know the competition, Create relevant content, Publish Regularly, Website Design, Compelling Offer, Call Call to Action, Landing Page, Effective Form, Lead Scoring, Customized Experience, Nurture Leads, Human Interaction, Purchase Process, Retargeting, Loyal Customers, Reward Customers, Social Monitoring, Amplify Followers, Referrals, Testimonials, Measure and Optimize	12
IV	Marketing on Digital Channels: Spring Product Catalog, Campaign Setup, Campaign Details, Campaign List, Reports and Analysis, Template Design and Upload, Create Campaign with Multiple EDM, Favourites to send Campaign, Dynamic Data List by Subscription, Adding Dynamic Data, Creating Campaign by Subscription Based	12
V	Marketing and Sales Analysis: Business Analytics, Process, Corporate, MiniSite, MiniSite Lead Analytics, Contracts, Sales Order, Marketing Analytics, Export	12
Course Outcomes as per Bloom's Taxonomy		
CO1	Describe the requisites of the OmniCom business.	
CO2	Develop solution architecture to meet the business requirements	
CO3	Implement the OmniCom Solution for an enterprise by applying the functions supported by the omni-channel platform.	
CO4	Combine email and social media marketing campaigns for promoting products/services.	
CO5	Evaluate the success of the campaigns	
Text Book	<ul style="list-style-type: none"> • .MarketingMO, 2013. The Strategic Marketing Process How to structure your Marketing Activities to Achieve Better Results. 2nd ed. s.l.:s.n. 	
Reference Books	<ul style="list-style-type: none"> • Heffelfinger., D. R., 2017. Java EE 8 application development : develop enterprise applications using the latest versions of CDI, JAX-RS, JSON-B, JPA, Security, and more. Birmingham, UK : Packt Publishing. • Marten Deinum, D. R. a. J. L., 2017. Spring recipes : a problem-solution approach. 4 ed. USA: Apress. 	

COURSE CODE	APPLICATION INTEGRATION	
LT21B226		(LTP=2-0-4=4)
Course Objectives:		
<ul style="list-style-type: none"> Identify the elements of an application integration plan Describe the Pros and cons, and applications of various middleware components Gain knowledge on SDK/ API required to develop the components to integrate with FacebookAds, Google Ads, and oAuth integration for Social media Describe the features of the target environment or platforms on which applications operate Use appropriate troubleshooting and testing, procedures, and techniques for successful integration. 		
UNIT	CONTENTS	HOURS
I	Spring Boot: Web Dependencies, RESTful Services, Packaging Spring Boot Application, Implementing Spring Data, Security, Asynchronous Messaging, Implementing a message Consumer and Producer, Actuator, Productionalising Actuator, Info Endpoint, Metrics endpoint, Custom endpoint, Rest actuator,	12
II	REST API: Restful librarian, URL vs URI, Six Constraints of REST, Relations with HTTP, Who or What interacts with REST API, Tools to see Rest API in action, Request/Response Pairs – GET, POST, PUT, PATCH and Delete, Design and Implement REST API, Test using Postman	12
III	React JS: Introduction to React, Setting up tools, Install React App, Create React Elements, Refactoring elements using JSX, Create a React Component, Adding properties, Working with lists, Display images with react, using fragments, Fetching data with hooks, Display data from API, Handling loading states, Router – Installation, Configuration, Incorporating component, Nesting links.	12
IV	OAuth Integration: Web Security, oAuth and OpenID connect, oAuth fundamentals, tokens, authentication, Facebook Integration	12
V	Webhook Integration with External System: Webhook Overview, Concepts, Types of Webhooks, Operations of Webhooks, Webhook Integration	12
Course Outcomes as per Bloom's Taxonomy		
CO1	List the integration requirements, Techniques, and problems/ deficiencies.	
CO2	Identify suitable middleware for creating connections among various hardware and applications.	
CO3	Compose an application integration plan to bring data and functionalities of different applications together.	
CO4	Construct optimal functioning of modules of applications in newly integrated environments.	
CO5	Examine the efficiency of integration	
Text Book	<ul style="list-style-type: none"> Eisenman, B., 2016. Learning React Native. 2nd ed. s.l.:O'Reilly Media,Inc., Gutierrez, F., 2019. Pro Spring Boot 2: An Authoritative Guide to Building Microservices, Web and Enterprise Applications, and Best Practices. 1st ed.s.l.:Apress. 	

Reference Books	<ul style="list-style-type: none">• Facebook, n.d. Facebook for developers. [Online] Available at: https://developers.facebook.com/docs/react-native[Accessed 28 April 2020].• Google, n.d. Google Docs API. [Online] Available at: https://developers.google.com/docs/api/quickstart/java[Accessed 28 Apr 2020].• Paypal, n.d. PayPal Developer. [Online] Available at: https://developer.paypal.com/docs/accept-payments/express-checkout/ec-braintree-sdk/server-side/java/ [Accessed 28 Apr 2020].
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COURSE CODE	QUANTITATIVE APTITUDE-II	Total Lecture: 30
UC20B402		(LTP=2-0-0=2)
Course Objectives		
This course will enable students to		
<ul style="list-style-type: none"> • Enhance the problem solving skills • Improve the basic mathematical skills. • Enable students to manage the placement challenges more effectively 		
UNIT	CONTENTS	HOURS
I	Time & Distance, Problem on Trains, Boats & Streams Simple Interest, Compound Interest, Stocks & Shares, True Discount	6
II	Area, Volume & Surface Area, Permutation & Combination, Race & Game of Skill, Calendar, Clock, Probability	6
III	Data Interpretation: Tabulation, Bar Graphs, Pie chart & Line Graphs, Information Ordering, Information Processing Engineering Mathematics- Logarithms, Permutation and Combinations, Probability	6
IV	Exploratory Analysis- Design of experiments, Sampling, Sampling Error, Sampling Bias, Measures of Central Tendency and Dispersion, Statistical survey and Presentation of data, Statistical Inference	6
V	Correlation, Formulating Null & Alternate Hypothesis, Type I and Type II errors, Regression, z-test/t-test, p-value	6
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students will be able to:		
CO1	Make decisions ⁵ based on analysis and critique of quantitative information using proportional reasoning. Students will also effectively justify and communicate their conclusions in ways appropriate to the audience.	
CO2	Solve ³ real-life problems requiring interpretation and comparison of various representations of ratios (i. e. , fractions, decimals, rates, and percentages):	
CO3	Analyze ⁴ and critique mathematical models and be able to describe their	

COURSE CODE	OBJECT ORIENTED ANALYSIS & DESIGN	Total Lecture: 60 Theory: 30 Tutorial: 15 Practical: 15
CS20B401		(LTP=2-1-2=4)

Course Objectives:

- To Understand the Object Oriented Life Cycle
- To Know how to identify Objects, Relationships, Services and Attributes through UML
- To Understand the Use case Diagram
- To Know the Object Oriented Design Process
- To Know about Software Quality and Usability

Unit	Contents	Hours
I	Introduction to UML, Importance of Modeling, Principles of Modeling, Object oriented modeling, Conceptual model of the UML, Architecture of UML, Software Development Life Cycle.	6
II	Basic Structural Modeling, Classes, Relationships, Common Mechanisms, Basic Diagrams, Advanced Structural Modeling, Advanced Classes, Advanced Relationships, Interfaces, Types and Roles, Packages. Class and Object Diagrams, Terms, Concepts, Modeling Techniques for Class Diagrams	6
III	Basic Behavioral Modeling-I, Interactions, Interaction Diagrams. Basic behavioral Modeling-II, Usecases, Use case Diagrams, Activity Diagrams.	6
IV	Advanced Behavioral Modeling, Events and Signals, State Machines, Processes and Threads, Time and Space, State Chart Diagrams. Architectural Modeling, Component, Deployment, Component Diagrams, Deployment Diagram.	6
V	Case Study, The Unified Library application	6
	<p>List of Experiments:</p> <ol style="list-style-type: none"> 1. Library Management System 2. Point of Sale 3. E-Commerce web portal 4. Online Banking web portal 5. Online Travel Ticket Booking Portal 6. Online Hotel Booking portal 7. Hospital Management System 8. e-Governance portal 9. Content Management System 10. Web Counseling portal 	

COURSE OUTCOMES

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

CO 1	Understand² Unified Modelling Language and Rational Rose for object oriented modelling
CO 2	Illustrate² the conceptual model of UML & Represent Behavioral diagrams in UML
CO 3	Identify² the basic and advanced structural diagrams
CO 4	Relate³ forward and reverse engineering for a software system
CO 5	Assess⁶ the architectural modelling of UML
Text Books	<ul style="list-style-type: none"> • Page Meilir, Jones. (2000): Fundamentals of Object Oriented Design in UML, India: Pearson Education. • Kahate Atul. (2018): Object Oriented Analysis & Design, New Delhi: The McGraw-Hill Companies

ReferenceBooks	<ul style="list-style-type: none"><li data-bbox="405 185 1530 264">• Booch Grady, Rumbaugh James and Jacobson Ivar, The Unified ModelingLanguage User Guide, 1st Edition, Addison Wesley.<li data-bbox="405 264 1530 338">• Bahrami Ali, Object Oriented Systems Development using the unified modeling language, 1st Edition, Noida: Tata Mcgraw Hills Education.
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SUBJECTCODE	IT SYSTEMS & NETWORKS	
LT21B301		(LTP=2-0-4=4)
Course Objectives:		
<ul style="list-style-type: none"> • Explain network topology, communication, and bandwidth requirements. • Document the requirements to design a networked system to meet a given specification. • Explain the benefits and constraints of different network types, devices, server types, and standards. • Test and evaluate the design to meet the requirements and analyse user feedback. • Document and analyse test results against expected results. 		
UNIT	CONTENTS	HOURS
I	Network Infrastructure and Components: Network architecture - Wired and Wireless, IEEE 802 standards, Network components: Data, node, client, server, Peer, Network adapter media, hubs, switches, routers, transport protocol, and bandwidth, Media Access Control methods, Lan Physical Topology – Bus, Star, Ring, Hybrid, and Mesh, Virtual Lan, Wide Area Networking, Physical components of WAN – Bridge, Router, Lease Line and Backbone, Standards, Wireless Networking Components – Wireless Adapter, Access Point, Ad-hoc Network, Infra Structure Network, and SSID, Infra-red, Attenuation, Interference, Internet, Intranet, Extranet, Firewall, Proxy server, Remote access, Encryption and authentication, Virtual private networks	6
II	Implementing TCP/IP: Overview of TCP/IP: Model, suits, sockets and ports, 7 Layers: Application, Presentation, Session, Transport, Network, Data-Link, and Physical, Application Protocols: HTTP, FTP, SMTP, DNS, POP3, and SNMP, Transport Protocols: TCP and UDP, Internet Protocols: IPv4 and IPv6, Network Interface: Ethernet, Token Ring, FDDI, and WiFi, IPv4 Concepts –IP Address, Network and Host IDs, Address Classes, Subnet Masks, Implementation, Automatic configuration, IPv6 Addressing, Benefits of IPv6, Transiting and automatic configuration, NetBIOS Name Resolution, DNS infrastructure and components, Name resolving: Server and Client	6
III	Internet Protocols and Network Services: TCP/IP History, DoD model, OSI Model, DHCP Client four step process: Client Broadcast(DHCPDiscover), Server Unicast(DHCPOffer), Client Broadcast(DHCPRequest), and Server Unicast(DHCPPack), TCP Segment, UDP Segment, Key features of TCP and UDP, Port numbers, IP header, ICMP, ARP Example and Data Encapsulation, Data Units, DORA, Automatic Private IP Addressing (APIPA), assigning unique IP addresses on small office/home office (SOHO), Disable APIPA, Remote Desktop Services and connection, Routing, Internet Protocol Security (IPSec): Authentication Header(AH) and Encapsulating Security Payload(ESP), Domain Name System (DNS), Windows Internet Name Service (WINS)	6
IV	Wired and Wireless Networks: Wired Networks: Twisted Pair Cable: 568A, 568B, and BOGB standards, Categories: Cate-3, Cat-5, Cat-5e, Cat-6, Tools and patch cables, Types of cables: Straight through and Crossover, Ports: Medium Dependent Interface (MDI) and Medium Dependent Interface Crossover(MDI-X), Patch panel and RJ45 wall jack, Attenuation, Interference, Electromagnetic Interference (EMI), Radio Frequency Interference (RFI), Shielded Twisted Pair (STP) Cable: Plenum-Rated, Fiber Optic Cables Wireless Networks: Network Adapters, Access Points, Wireless LAN(WLAN), Wireless Repeater and Bridge, WLAN Standards, Encryption, SSID	6

V	Network Monitoring and Troubleshooting: Network Monitoring tools: Port scanners, Packet/ network analyser, interface monitoring tools, SNMP Management Software and Alerts, packet flow monitoring, SYSLOG,, SIEM , Embedded monitoring tools, temperature, Humidity, Power monitoring tools, Wireless survey tools, and Wireless Analysers, Monitoring and Tracking Performance tools: Baseline, Bottleneck, Log Management, Graphing, Bandwidth, Storage, CPU usage, Device memory, Wireless channel utilization, Link status, interfacemonitoring, errors, utilization, discards, packet drops, interface resets, speed and duplex, Trouble Shooting Methodology: Identify the problem, Identify the root cause, Resolve and Review. Command Line: ipconfig, ping, netstat,PathPing, Nslookup, Netsh, Route, Net, and Telnet	6
Course Outcomes as per Bloom's Taxonomy		
CO1	Comprehend the key features or services provided by different computer operating systemsand hardware	
CO2	Compare common networking principles and how protocols enable the effectiveness ofnetworked systems.	
CO3	Use network communication technology to connect computer systems and their associatedservices	
CO4	Implement a networked system based on a prepared design.	
CO5	Demonstrate diagnostic and troubleshooting skills to solve networking related issues.	
Text Book	<ul style="list-style-type: none"> • Hallberg, B., 2014. Networking : a beginner's guide. 6th ed. New York: McGraw-Hill Education. 	
	<ul style="list-style-type: none"> • Kaveh Pahlavan, P. K., 2009. Networking fundamentals : wide, local and personal area communications /. Chichester, West Sussex, U.K: Wiley. 	
ReferenceBooks	<ul style="list-style-type: none"> • Olifer, N. & Olifer, V., 2010. Computer networks : principles, technologies and protocols for network design. 3rd ed. New Delhi: Willy India. 	

COURSE CODE	ANALYSIS AND DESIGN OF ALGORITHMS	Total Lecture:60 Theory:45 Practical:15
CS20B504	(LTP=3-0-2=4)	
<p>Course Objectives: Obtaining efficient algorithms is very important in modern computer engineering as the world wants applications to be time and space and energy efficient. This course enables to understand and analyze efficient algorithms for various applications.</p>		
UNIT	CONTENTS	HOURS
I	<p>INTRODUCTION: Algorithm, pseudo code for expressing algorithms, performance analysis-space complexity, time complexity, asymptotic notation- big (O) notation, omega notation, theta notation and little (o) notation, recurrences, probabilistic analysis, disjoint set operations, union and find algorithms.</p>	10
II	<p>DIVIDE AND CONQUER: General method, applications-analysis of binary search, quick sort, merge sort, AND OR Graphs.</p> <p>GREEDY METHOD: General method, Applications-job sequencing with deadlines, Fractional knapsack problem, minimum cost spanning trees, Single source shortest path problem.</p>	10
III	<p>GRAPHS (Algorithm and Analysis): Breadth first search and traversal, Depth first search and traversal, Spanning trees, connected components and bi-connected components, Articulation points.</p> <p>DYNAMIC PROGRAMMING: General method, applications - optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.</p>	10
IV	<p>BACKTRACKING: General method, Applications- n-queen problem, Sum of subsets problem, Graph coloring and Hamiltonian cycles. BRANCH AND BOUND: General method, applications - travelling sales person problem, 0/1 knapsack problem-LC branch and bound solution, FIFO branch and bound solution.</p>	8
V	<p>NP-HARD AND NP-COMPLETE PROBLEMS: Basic concepts, non-deterministic algorithms, NP-hard and NP-complete classes, Cook's theorem.</p>	7
<p>List of Experiments:</p> <ol style="list-style-type: none"> 1. Implementation and Time analysis of sorting algorithms. Bubble sort, Selection sort, Insertion sort, Merge sort and Quicksort 2. Implementation and Time analysis of linear and binary search algorithm. 3. Implementation of max-heap sort algorithm 4. Implementation and Time analysis of factorial program using iterative and recursive method 5. Implementation of a knapsack problem using dynamic programming. 6. Implementation of chain matrix multiplication using dynamic programming. 7. Implementation of making a change problem using dynamic programming 8. Implementation of a knapsack problem using greedy algorithm 9. Implementation of Graph and Searching (DFS and BFS). 10. Implement prim's algorithm 		

	11. Implement kruskal's algorithm. 12. Implement LCS problem.	
COURSE OUTCOMES		
At the end of the course student will be able to:		
CO 1	Understand¹ the concept of algorithm and how design methods impacts the performance of programs.	
CO 2	Apply² the appropriate data structure and algorithm design method for a specified application.	
CO 3	Analyze³ the performance of algorithm using various methods such as Master method, Recurrence Tree method and Substitution method.	
CO 4	Evaluate⁴ problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking and branch & bound	
CO5	Using the existing algorithms create⁵ solutions for real life problems or can even create new algorithms.	
Text Books	<ul style="list-style-type: none"> • Ellis Horowitz, Satraj Sahni, Rajasekharam (2007), Fundamentals of Computer Algorithms, 2nd edition, University Press, New Delhi. 	
Reference Books	<ul style="list-style-type: none"> • R. C. T. Lee, S. S. Tseng, R.C. Chang and T. Tsai (2006), Introduction to Design and Analysis of Algorithms A strategic approach, McGraw Hill, India. • Allen Weiss (2009), Data structures and Algorithm Analysis in C++, 2nd edition, Pearson education, New Delhi. • Aho, Ullman, Hopcroft (2009), Design and Analysis of algorithms, 2nd edition, Pearson education, New Delhi 	

SubjectCode	IT Security	
LT21B521		(LTP=2-0-4=4)
Course Objectives:		
<ul style="list-style-type: none"> • Describe organisational security procedures and risk types. • Explain the protection needed to ensure the smooth operation of the system and network of an organisation. • Discuss the interdependence of workstation hardware with relevant networking software. • Design a security policy. • Test and document the test results against expected results. 		
UNIT	CONTENTS	HOURS
I	Introduction to Security Management NSTISSC Security Model, CIA Triangle: Confidentiality, Integrity, Availability, Privacy, Identification, Authentication & Authorisation, Accountability, Assurance, Information Security Management Principles, Information Security Planning, Strategic Planning, Security Software Development Life Cycle (SecSDLC), Threats to information security, BS7799, ISO/IEC 17799, Security Management Index, RFC 2196 Site Security Handbook, NIST Security Models: NIST SP 800-12, NIST Special Publication 800-14, NIST Special Publication 800-26, best security practices, SP 800-37, Federal System Certifications, SP 800-53, Bulls-eye Model, Enterprise Information Security Policy (EISP), Issue-Specific Security Policy (ISSP), Systems-Specific Policy (SysSP), The Information Security Policy Made Easy Approach (ISPME)	6
II	Security Risk Management Incident response planning (IRP), Disaster recovery planning (DRP), Business continuity planning (BCP), Crisis management, Contingency plans testing: Desk Check, Structured walkthrough, Simulation, Parallel testing, Full interruption, Cost-Benefit Framework and Analysis, Cyber security cost, Net Present Value Model (NPV), Internal Rate of Return (IRR), Return on Investment. (ROI), Risk Management Process: Identification, Assessment, Development of Management Plan, Implementation of the plan, re- evaluation of risks, risk accountability, information assets, prioritization of risks, vulnerability, Access controls, risk control strategies: avoidance, transference, mitigation, acceptance, risk handling flow, Control categories: Control function, Architectural layer, Strategy layer, Information security principle, Asset valuation, OCTAVE Method: Build Asset-Based Threat Profiles, Identify Infrastructure Vulnerabilities, Develop Security Strategy and Plans	6
III	Issues Surrounding IT Security Laws and Security, Copyrights, Patent, Trade Secret, International Law Acts, International Laws And Legal Bodies, State and Local Regulations, Law and Ethics in Information Security, Commandments of Computer Ethics, Certifications And Professional Organizations, Threats: Joy hackers, Profit hackers, crimes, industrial espionage, inside jobs and spies, Attacks: bandwidth attacks, reflector attacks, network identity attacks, eavesdropping, sniffing credit cards	6

IV	<p>Systems/Methods to Enhance Security Part 1</p> <p>Cryptosystem, History of cryptosystem, Codes, Ciphers, Kerckhoffs' Law, Vernam/Mauborgne Cipher, Types of encryptions and cryptanalysis, Publickey cryptography, Standardised ciphers, Block ciphers, Data Encryption Standard (DES), Decryption, Modes of Operation: Electronic Code Book (ECB), Cipher Block Chaining (CBC), Cipher Feedback (CFB), Output Feedback (OFB), and Counter (CTR), Stream ciphers, Public key cryptography, Diffie-Hellman algorithm for key exchange, Digital signatures, Elliptic Curve Cryptography, Moore's Law and Public Key Cryptography, Message Integrity check, Message Authentication Code (MAC), keyed-Hash MAC (HMAC), CBC MAC, Authentication: Shared secrets, passwords, eavesdropping, tokens, securID token, Last-digit guessing attack, connection hijacking, password theft, hacking, screen dumps, subpoena attacks, Certification, Stream ciphers, Symmetric ciphers, Key Distribution Center (KDC), Cryptographic protocols: Needham- Schroeder Protocol, Coin flips, Strong passwords protocols, Encrypted KeyExchange (EKE), Kerberos, Introduction to Kerberos, its data flow and limitations, Ticket Cache security, HTTP Access Control, SSL, Session keys, Client Authentication, Client-side security, Server-side security, WebServer-side security, Email security, Fake and multiple certifications, Cookies, Active content, Cross-site scripting (XSS), Phishing, Pretty Good Privacy (PGP), Secure/Multipurpose Internet Mail Extension (S/MIME)</p>	6
V	<p>Systems/Methods to Enhance Security Part 2</p> <p>Phishing, IPsec, Packet Processing, Secure Shell (SSH), Client Authentication, Password Authentication, Public Key authentication, Host- Based Authentication, Connection Forwarding, Firewalls, Packet Filters, UDP, Point Firewalls, Network Map (NMAP), Port Scanning, Fingerprinting, Intrusion detection: Primary assumptions, IDS components (algorithmic perspective), IDS components (architecture perspective), Insertion attack, evasion attack, DoS attacks, Intrusion Detection System (IDS), Detection Paradigm, Misuse Detection, Specification-based Detection, Anomaly Detection Knowledge-based IDS, Behavior-based IDS, Host-based Information Sources, Network-based Information Sources, Bayesian Detection Rate</p>	6
Course Outcomes as per Bloom's Taxonomy		
CO1	Identify types of organisational security procedures and risks.	
CO2	Analyse the exposure of security threats to an organisation's system and data.	
CO3	Summarise the risk management methodology and its application in IT security.	
CO4	Implement a security policy for an organisation.	
CO5	Evaluate the suitability of the security policy used in an organisational policy.	
Text Book	<ul style="list-style-type: none"> • Convery, S., 2004. Network security architectures. 1st ed. Indianapolis, Ind.: Cisco Press. 	
Reference Books	<ul style="list-style-type: none"> • EC-Council, 2010. Computer Forensics Investigating Network Intrusions & Cyber Crime. USA: EC-Council Press. • Hayes., D. R., 2015. A practical guide to computer forensics investigations. 1st ed. Indianapolis, Indiana, USA: Pearson. • Pepe, M. L. J. T. K. R. M. K., 2014. Incident response & computer forensics. 2nd ed. New York: McGraw-Hill Education. 	

SubjectCode	Data Science Essentials	
LT21B522	(LTP=2-0-4=4)	
Course Objectives:		
<ul style="list-style-type: none"> • Explain the principles of Data Science • Gain knowledge on probability and statistics in Data Science • Use simulation and hypothesis testing • Describe Data Ingestion, cleansing, and transformation processes • Explain data exploration and data visualization 		
UNIT	CONTENTS	HOURS
I	Principles of Data Science: Introduction to Data science process, Azure Machine Learning and creating a new machine learning model using Azure Machine Learning studio	6
II	Probability and Statistics: Introduction to Probability, Discrete Random Variables, Discrete Probability Distributions, Binomial Distribution Examples, Continuous Probability Distributions, Cumulative Distribution Functions, Descriptive Statistics, Z scores	6
III	Simulation and hypothesis testing: Overview of Hypothesis testing, Z-Tests, T-Tests, and Other Tests, Type 1 and Type 2 Errors and Confidence Intervals	6
IV	Data Exploration: Introduction to Data Exploration, Basic Data Frame Manipulation, Computing Columns in Data Frames, Getting Started with Univariate Plots, faceting plots, joining multiple datasets, feature engineering, finding outliers and scaling	6
V	Data Model: Creating Azure machine learning model, split, train, test and evaluate regression and classification models and publish the model using webservice	6
Course Outcomes as per Bloom's Taxonomy		
CO1	Explain essential skills used in the Data Science research process	
CO2	Analyse concepts of Correlational & Experimental Design	
CO3	Adapt Sampling size planning, reliability, validity, and correlation	
CO4	Develop data integration procedures to consolidate data from multiple datasets	
CO5	Create customized visualizations	
Text Book	<ul style="list-style-type: none"> • Norvig, S. J. R. a. P., 2010. Artificial Intelligence A Modern Approach. 3rd ed. New Jersey: Pearson Education, Inc.,. 	
Reference Books	<ul style="list-style-type: none"> • Dignum, V., 2019. Responsible artificial intelligence : how to develop and use AI in a responsible way. 1st ed. Cham, Switzerland : Springer. • editor, H. Y., 2017. Artificial intelligence science and technology : proceedings of the 2016 International Conference (AIST2016) Shanghai, China, 15-17 July 2016. Singapore ; Hackensack, NJ: World Scientific. 	

COURSE CODE	SOFTWARE ENGINEERING	Total Lecture:45 Theory:45
CS20B602	(LTP=3-0-0=3)	
<p>Course Objectives: introduce software development life cycle and various software process models introduce measures and metrics for software quality, reliability and software estimation techniques develop an understanding of software analysis and design phases To introduce coding standards, guidelines and various software testing techniques introduce various activities for software maintenance and quality assurance</p>		
UNIT	CONTENTS	HOURS
I	The Software Product and Software Process Software Product and Process Characteristics, Software Process Models: Linear Sequential Model, Prototyping Model, RAD Model, Evolutionary Process Models like Incremental Model, Spiral Model, Component Assembly Model, RUP and Agile processes. Software Process customization and improvement, CMM, Product and Process Metrics	10
II	Requirement Elicitation, Analysis, and Specification Functional and Non-functional requirements, Requirement Sources and Elicitation Techniques, Analysis Modeling for Function-oriented and Object-oriented software development, Use case Modeling, System and Software Requirement Specifications, Requirement Validation, Traceability	7
III	Software Design, The Software Design Process, Design Concepts and Principles, Software Modeling and UML, Architectural Design, Architectural Views and Styles, User Interface Design, Function oriented Design, SA/SD Component Based Design, Design Metrics	10
IV	Software Analysis and Testing Software Static and Dynamic analysis, Code inspections, Software Testing, Fundamentals, Software Test Process, Testing Levels, Test Criteria, Test Case Design, Test Oracles, Test Techniques, Black-Box Testing, White-Box Unit Testing and Unit, Testing Frameworks, Integration Testing, System Testing and other Specialized, Testing, Test Plan, Test Metrics, Testing Tools. , Introduction to Object-oriented analysis, design and comparison with structured Software Engg.	10
V	Software Maintenance & Software Project Measurement Need and Types of Maintenance, Software Configuration Management (SCM), Software Change Management, Version Control, Change control and Reporting, Program Comprehension Techniques, Re-engineering, Reverse Engineering, Tool Support. Project Management Concepts, Feasibility Analysis, Project and Process Planning, Resources Allocations, Software efforts, Schedule, and Cost estimations, Project Scheduling and Tracking, Risk Assessment and Mitigation, Software Quality Assurance (SQA). Project Plan, Project Metrics	8
COURSE OUTCOMES		
At the end of the course student will be able to:		
CO1	Develop an estimation of the cost, quality, and management issues involved in software construction	

CO2	Identify and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.
CO3	Develop and apply testing strategies for software applications
CO4	Develop a thorough understanding of software development lifecycle principles
CO5	Design and plan software solutions to problems using an object oriented strategy
Text Books	<ul style="list-style-type: none"> • Fundamentals of Software Engineering, Rajib Mall, PHI, 2014. • Software Engineering, A Practitioner's Approach, Roger S. Pressman, TMG Hill.
Reference Books	<ul style="list-style-type: none"> • Software Engineering, I. Sommerville, 9th Ed. Pearson Education. • Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley. • Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies. • Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

SUBJECTCODE	PYTHON PROGRAMMING FOR AI	
LT21B401	(LTP=2-0-8=6)	
Course Objectives:		
<ul style="list-style-type: none"> Describe Artificial Intelligence and Machine Learning Concepts Gain knowledge on Python language fundamentals: basic syntax, variables, and types. Use an integrated development environment to write, compile, and run Python programs. Identify opportunities to use various statistical libraries. Gain knowledge to modularize the code and import Python packages and modules. 		
UNIT	CONTENTS	HOURS
I	Introduction to AI: Artificial Intelligence, Machine Learning Concepts and Python language fundamentals (basics and functions)	6
II	Python programming- I: Data types, variables, conditionals, looping, string manipulation, sequencehandling	6
III	Python programming - II: Lists, file handling	6
IV	Python packages: Numpy (arrays, 2d arrays, statistics), Matplotlib (basic plots, histograms),Pandas	6
V	Python packages for Image processing: Image processing basics, image classification, image types and colorchannels, haar cascading, face detection	6
Course Outcomes as per Bloom's Taxonomy		
CO1	Develop a Python program to solve the problem	
CO2	Create data models using the transformed data and plots	
CO3	Perform inferential statistical analysis	
CO4	Recognize Syntax, Logical, and Runtime errors and debug the program	
CO5	Develop a Python program to solve the problem	
Text Book	<ul style="list-style-type: none"> Denis Rothman, M. L. R. K. A. N. A. Z. A. D., 2018. Learning Path Python: Beginner's guide to Artificial Intelligence. s.l.:Packt Publishing. Morgan, P., 2016. Data Analysis from Scratch with Python. s.l.:AI Sciences LLC. 	
Reference Books	<ul style="list-style-type: none"> Singh, H., 2019. Practical Machine Learning and Image Processing. 1st ed. s.l.:Apress. 	

SUBJECTCODE	MACHINE LEARNING	
LT21B721		(LTP=2-0-4=4)
Course Objectives:		
<ul style="list-style-type: none"> • Explain the operation of classifiers and how to use logistic regression as a classifier • Describe the metrics used to evaluate classifiers and regression models • Explain the operation of regression models and how to use linear regression for prediction and forecasting • Gain knowledge to use regularization on over-parameterized models • Identify the situation to use common supervised machine learning models 		
UNIT	CONTENTS	HOURS
I	Machine Learning: High level process of machine learning	6
II	Exploratory Data Analysis (EDA) for supervised learning: Data exploration, visualizing data relationships, visualizing categorical relationships, high dimensional relationships, frequency tables	6
III	Feature engineering: data preparation, data scaling, data transformation, feature hashing, feature importance	6
IV	Supervised Machine Learning: Introduction to linear regression, Multiple Linear Regression, Evaluating Regression Models, Introduction to Classification , Loss Function for Classification, Logistic Regression, Evaluating Classifiers, Approaches for Addressing Imbalanced Data	6
V	Model Performance: Regularization, Sweeping parameters, Cross validation, Dimensionality reduction, Principle component analysis, Clustering	6
Course Outcomes as per Bloom's Taxonomy		
CO1	Describe the basics of Machine Learning	
CO2	Perform exploratory data analysis for Supervised/Unsupervised Machine Learning Solution using Python	
CO3	Transform features used in Supervised/Unsupervised Machine Learning Solution using feature engineering	
CO4	Adapt to Implement a Supervised Machine Learning Solution using Python.	
CO5	Improve model performance and implement unsupervised Machine learning solution	
Text Book	<ul style="list-style-type: none"> • Smith, T., 2019. Supervised machine learning with Python : develop rich Python coding practices while exploring supervised machine learning. 1st ed. Birmingham ; Mumbai: Packt Publishing. • Tripathi, A., 2017. Practical machine learning cookbook : resolving and offering solutions to your machine learning problems with R. 1st ed. Birmingham, UK: Packt Publishing." 	
Reference Books	<ul style="list-style-type: none"> • Al-Hawamdeh, 2018. Analytics and knowledge management. 1st ed. Boca Raton, FL: CRC Press, Taylor & Francis Group. • Gareth James, D. W. T. H. R. T., 2015. An introduction to statistical learning : with applications in R. 2nd ed. New York: Springer Science+BusinessMedia.. 	

SUBJECTCODE	DEEP LEARNING	
LT21B722		(LTP=3-0-2=4)
Course Objectives:		
<ul style="list-style-type: none"> • Explain Deep Learning Concepts • Develop Multi class classification model using Logistic Regression • Use Convolution Neural Network • Apply Recurrent Neural Network (RNN) and Long Short-Term Memory (LSTM) • Perform Text Classification with RNN and LSTM 		
UNIT	CONTENTS	HOURS
I	Deep Learning: Machine Learning, Deep Learning, Train Workflow, Validation and Test Workflow, Understanding the Dataset, Image Classification, Logistic Regression - Softmax, Loss Function, train workflow, Learners, Validation, and Predict	6
II	Multi-Layer Perception: Logistic Regression, Towards Deep Networks, Activation Functions -Sigmoid and Others, Building blocks of Multi-Layer Perception, Workflow	6
III	Convolution Neural Network (CNN): CNN Overview, Applications of CNN, building blocks of CNN, Understanding Image Data, Convolution with images, Padding, Training CNN, Workflow, Popular Convolution Networks	6
IV	Recurring Neural Network (RNN): Understanding sequence, Forecasting using historical Data, Incorporating History in Recurrence, Building blocks of recurrence, Issues of vanishing Gradients, Long Short Term Memory Block, Coding Recurrence with cognitive Toolkit, Dropout, Timeseries Forecasting, Data processing, Workflow – RNN with LSTM	6
V	Text Classification with RNN and LSTM: Sequences Many to Many, Understanding Dataset, Sequence Tagging, Embedding, Building blocks – Text classification with RNN and LSTM, Workflow – Text Classification	6
Course Outcomes as per Bloom's Taxonomy		
CO1	Explain the Machine Learning and computational modeling techniques used in DeepLearning.	
CO2	Analyse the usage of Artificial Neural Networks	
CO3	Analyse the usage of Convolution Neural Network(CNN)	
CO4	Analyse the usage of Recurrent Neural Network (RNN).	
CO5	Adapt to Long Short-Term Memory (LSTM).	
Text Book	<ul style="list-style-type: none"> • Chollet, F., 2018. Deep learning with Python. 1st ed. Shelter Island, NY:Manning Publications Co.,. 	
Reference Books	<ul style="list-style-type: none"> • Albon, C., 2018. Machine Learning with Python Cookbook. 1st ed.Sebastopol, CA: O'Reilly Media, Inc. • Bakker, I. d., 2017. Python deep learning cookbook : over 75 practical recipeson neural network modeling, reinforcement learning, and transfer learning using Python. 1st ed. Birmingham: Packt Publishing. 	

SubjectCode	Reinforcement Learning	
LT21B821		(LTP=3-0-2=4)
Course Objectives:		
<ul style="list-style-type: none"> • Explain types of information display, techniques used in data visualization with Reinforcement Learning • Gain knowledge to gather, process, optimizing accuracy, and functionality in Temporal Difference Learning • Describe the multiple streams of data using Deep neural networks • Apply project Malmö a platform for AI experimentation • Reflect trends and correlations of data using RL concepts 		
UNIT	CONTENTS	HOURS
I	Reinforcement Learning: Introduction, Trial and Error Learning, Comparisons to Other Types of Machine Learning, Approaches to Reinforcement Learning, Elements of Reinforcement Learning,	6
II	Bandit Framework: Decomposing the RL Problem, Multi-Armed Bandit Framework, Bridge to Reinforcement Learning, Markov Decision Process, Optimal Value Functions,	6
III	Reinforcement Learning Policies: Basics, Policy Evaluation, Policy Improvement, Policy Iteration, Policy Optimization for Dynamic Programming (DP), Temporal Difference Learning (TD), Linear Function Approximation	6
IV	Adaption of Reinforcement Learning: Reinforcement Learning with Deep Neural Networks, Deep Q learning, Extension to Deep Q-Learning and Monte Carlo Learning (MC)	6
V	Policy Gradient and Actor Critic: Policy Gradient Methods: Advantages and Disadvantages, Likelihood Ratio Methods, Variance Reduction, Actor Critic	6
Course Outcomes as per Bloom's Taxonomy		
CO1	Explain the basics of reinforcement learning (RL) and specification of reinforcement learning (RL)	
CO2	Analyze the bandit framework and Markov decision process	
CO3	Explain the basics of Dynamic Programming (DP) and Temporal Difference Learning (TD).	
CO4	Adapt to Reinforcement Learning with Deep Neural Networks and Monte Carlo Learning (MC)	
CO5	Analyze Policy Gradient and Actor Critic	
Text Book	<ul style="list-style-type: none"> • Barto, R. S. S. a. A. G., 2018. Reinforcement learning : an introduction. 2nd ed. Cambridge, Massachusetts : The MIT Press. 	
Reference Books	<ul style="list-style-type: none"> • Abhishek Nandy, M. B., 2018. Reinforcement learning : with Open AI, TensorFlow and Keras using Python. 1st ed. Berkeley, Calif: Apress. • Ian Goodfellow, Y. B. a. A. C., 2016. Deep learning. 1st ed. Cambridge, Massachusetts : The MIT Press 	