VI SEMESTER

20IT6301-CLOUD COMPUTING

Course Category:		Program Core	Credits:	3
Course Type:		Theory	Lecture-Tutorial-Practice:	2-0-2
Prerequisites:		Computer networks	Continuous Evaluation:	30
			Semester end Evaluation:	70
			Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:		
	CO1	Interpret the concepts of cloud computing and its standards.		
	CO2	Analyze cloud models, security and storage accessibility in different cloud ecosystems		
	CO3	Illustrate cloud services offered by various cloud vendors for an enterprise		
	CO4	Implement cloud environment for various real time applications.		

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	1	2											1		2	1.5.1, 2.1.2
CO2		2									2				1	4	2.2.4, 11.3.1
CO3		1			3						2		2	1	2	2.1.2, 5.2.1, 11.3.1
CO4		2			2								3		3	2.1.2 5.2.1

Course Content	UNIT I: **Cloud Computing Basics:** Cloud Computing Overview – Cloud Components, Infrastructure, Cloud Services, and Applications – Storage, Database services. **Organizing the Cloud computing:** When You can use Cloud Computing, Benefits, Limitations and Security Concerns. **Hardware and Infrastructure:** Clients, Security, Network.
	UNIT II: **Accessing the Cloud:** Platforms, Web Applications, Web APIs, and Web Browsers. **Cloud Storage:** Overview, Cloud Storage Providers – Amazon S3, Google Bigtable Datastore, MobileMe, LiveMesh. **Standards**: Application, Client, Infrastructure, Service.
	UNIT III: **Software as a service :** Overview, Advantages, Driving Forces, Company Offerings – Intuit, Google, Microsoft **Software plus services :** Overview, Pros, Cons, Vendors, Mobile Device Integration, Providers-Adobe AIR, Microsoft Online **Developing Applications:** Google, Microsoft
	UNIT IV: **Local clouds and Thin Clients:** Virtualization in an organization, Server Solutions- Microsoft HyperV, VMWare, **Cloud Applications**: Scientific applications: Healthcare, Business and consumer applications: CRM, Salesforce.com, Productivity: Drop box

	and icloud, Social Networking: Facebook. **Fundamental Cloud Security:** Basic Terms and Concepts, Threat Agents, Cloud Security Threats, Cloud Security Mechanisms - Encryption, Hashing, Digital Signature, IAM, SSO
Text books and Reference books	**Text Book(s):** [1]. Velte T. Antony, Velte J. Toby., Elsenpeter Robert, "Cloud Computing: A Practical Approach", Tata McGraw- Hill , 2010 [2] Thomas Erl and RicardoPuttini Cloud Computing-Concepts, Technology andArchitecture, Pearson, 2013. **Reference Books:** [1]. Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishers, 2012 [2]. Miller Michael, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Que Publishing, 2008.
E-resources and other digital material	[1].John R Williams, Abel Sanchez , MIT Professional Education, "Cloud DevOps", 2022 https://professional.mit.edu/course-catalog/cloud-devops-continuous-transformation [2]. Courseera, "Cloud Application Security", 2021, https://www.mooc-list.com/course/cloud-application-security-coursera [3].Suresh S, Udemy, "Server Virtualization", 2021 https://www.udemy.com/tutorial/cloud-computing-the-technical-essentials/basics-of-virtualization/ [4] Prof.SowmyaKantiGhosh,IITKharagpur, "Cloud Computing"2022 https://nptel.ac.in/courses/106/105/106105167/

20IT5302–MACHINE LEARNING

Course Category:	ProgrammeCore	Credits:	4
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-2
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the fundamental concepts of machine learning
	CO2	Apply linear, distance based, and decision tree based models
	CO3	Analyze probabilistic, neural network models
	CO4	Design a suitable machine learning model for a given scenario

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low, 2-Medium, 3-High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1													1		2	
CO2	2	2											3	1	3	1.5.1, 2.1.2
CO3	2	2											3	1	4	1.5.1, 2.1.2
CO4	2	3											3	2	3	1.5.1, 2.1.2

Course Content	**UNIT I** **The ingredients of machine learning**: Tasks, Models, Features **Binary classification and related tasks**: Classification, Assessing classification performance, Visualizing classification performance **Beyond binary classification**: Multi-class classification, Regression, Unsupervised and descriptive learning
	UNIT II **Decision Tree learning** – Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Inductive bias in decision tree, Issues in decision tree learning. **Linear models**: The least-squares method, Multivariate linear regression, The perceptron, Support vector machines, Soft margin SVM, Going beyond linearity with kernel methods.
	UNIT III: **Distance Based Models:** Introduction, Neighbours and exemplars, Nearest Neighbours classification, K-Means algorithms, Clustering around medoids **Probabilistic Models:**Using Naïve Bayes Model for classification, Expectation Maximization, Gaussian Mixture models
	UNIT IV: **Artificial Neural Networks**: Introduction, Neural network representation, appropriate problems for neural network learning, Multilayer networks and the back propagation, Advanced topics in Artificial Neural Networks **Reinforcement Learning:** Introduction, Learning tasks, Q-learning.

Text books and Reference books	**Text Book(s):** [1]. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012 [2]. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education

	Reference Books: [1] AurélienGéron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition [2] Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014 [3] EthemAlpaydın, Introduction to machine learning, second edition, MIT press. [4] T. Hastie, R. Tibshirani and J. Friedman, "Elements of Statistical Learning", Springer Series , 2nd edition
E-resources and other digital material	[1]. Kevin Murphy,"MachineLearning:AProbabilisticPerspective" , MIT Press, 2012, https://www.cs.ubc.ca/~murphyk/MLbook/pml-intro-5nov11.pdf [2] Machine Learning by Andrew Ng, Stanford University https://www.coursera.org/learn/machine-learning **[3] Professor S. Sarkar IIT Kharagpur "Introduction to machine learning" ,** **https://www.youtube.com/playlist?list=PLYihddLF-CgYuWNL55Wg8ALkm6u8U7gps** [4] Professor Carl GustafJansson, KTH, Video Course on Machine Learning https://nptel.ac.in/noc/individual_course.php?id=noc19-cs35 [5]. Tom Mitchell, *"Machine Learning",* *http://www.cs.cmu.edu/~tom/10701_sp11/lectures.shtml*

20IT6303 - WEB PROGRAMMING AND DEVELOPMENT

Course Category:	Program core	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	2-0-2
Prerequisites:	20IT4302 Java Programming	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:	
	CO1	Understand features of Spring Boot, Spring Framework, Spring cloud and process involved to connect to Java Database Connectivity	
	CO2	Apply concepts of Servlets to develop server side applications	
	CO3	Design web applications with Spring Boot Annotations and connecting to JPA with Spring MVC and Spring Boot	
	CO4	Develop Representational State Transfer services in Spring Boot applications	

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1													1	1	2	
CO2	2			2									1		3	1.5.1, 5.2.1
CO3			3	2									2		3	3.2.2, 5.2.1
CO4			3	2									2		3	3.2.2, 5.2.1

Course Content	**UNIT I:** **JDBC**: The concept of JDBC,JDBC Driver Types, JDBC Packages, A Brief Overview Of The JDBC Process, Database Connection, Associating The JDBC/ODBC bridge with the Database, Statement objects, ResultSet. **Java Servlets :**Java Servlets and common gateway interface programming, benefits of using a java servlets, simple java servlet, anatomy of a java servlet, deployment descriptor, reading data from a client, sending data to a client, working the cookies and tracking sessions
	UNIT II: **Getting started with Spring Boot:** Structure, objectives, introduction, features, advantages of Spring Boot, Breaking the monolithic way of developing software, system requirements, setting up of the environment, the 12-factor app, Spring initializer **Developing Spring Boot Application**: Starting with Spring initializer, Build tools, understanding pom file, build.gradel understanding, building an application using Maven and Gradle, understanding the entry PInt class and SpringBootApplication, Bootstrap ApplicationContext
	UNIT III: **Spring Boot Starter Dependencies and Auto-Configuration**: Objectives, Spring Boot Starters, starter dependencies and their configurations, understanding auto-configuration. **Spring Boot Annotations**: Java Annotations, existence of spring annotations, Spring and Spring Boot annotations, Stereotype annotations, Spring Boot Annotations, Spring Task execution annotations, Spring profile annotations
	UNIT IV: **Working with Spring Data JPA**: Accessing relational data using JdbcTemplate and Spring data JPA in memory database, Spring data JPA with MySQL, Query methods in Spring data JPA **Micro services: Building RESTful Microservices:**Creating RESTful APIs, Consuming

	RESTful APIs. **Spring Cloud:** Introduction, Features of Spring cloud, Spring Cloud dataflow, features of spring cloud dataflow
	Case Study: Deploy Web application into a server using Servelt/Spring Technology
Text books and Reference books	**Text Book(s):** [1]. James Keogh, "J2Ee: The Complete Reference", 1st Edition, McGraw Hill Education, 2002 [2]. ShagunBakliwal, Hands-on Application Development using Spring Boot, BPB Publications, First Edition, 2022 **Reference Book(s):** [1]. Craig Walls, Spring in Action, Sixth Edition, MEAP Edition, Manning Early Access Program, Version 4, 2021 [2]. Mark Heckler, Spring Boot: Up and Running, O'Reilly Media,2021
E-resources and other digital material	[1]. RangaKaranam, Java Servlets and JSP - Build Java EE(JEE) app in 25 Steps, 04-06-2022 Available: https://www.udemy.com/course/learn-java-servlets-and-jsp-web-application-in-25-steps/ [2]. Spring-Official documentation, 04-06-2022 Available:https://spring.io/projects/spring-boot [3]. Advanced Java Programming by Infinite Skills, 04-06-2022 Available: https://www.udemy.com/advanced-java-programming/ [4]. Derek Parsons , Spring MVC, Spring Boot and Rest Controllers, Available: 04-06-2022, LearnQuest, https://www.coursera.org/learn/spring-mvc-rest-controller [5]. RangaKaranam, Spring Framework Master Class - Java Spring the Modern Way, Available: 04-06-2022 https://www.udemy.com/course/spring-tutorial-for-beginners/

20IT5404A -DATA VISUALIZATION

Course Category:	Program Elective - 1	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	-	Continuous Evaluation:	30
		Semester End Evaluation:	70
		Total Marks:	100

		Upon successful completion of the course, the student will be able to:												
Course Outcomes	CO1	Illustrate visualizations that represent the relationships contained in complex data sets and their interpretation.												
	CO2	Analyze data to create a visualization for a particular research application.												
	CO3	Identify appropriate visualization chart to present and represent design solutions.												
	CO4	Choose leading open source software packages to create and publish visualizations that enable clear interpretations of big, complex and real world data.												

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low, 2-Medium, 3-High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	2	1	2								1		1	1	2	1.5.1, 2.1.2, 3.2.2
CO2	1	1	2								1		1	1	3	1.5.1, 2.1.2, 3.2.2
CO3		2											1	2	2	2.2.4
CO4	1		1		2								2	1	4	1.5.1, 3.2.2, 5.2.1

Course Content	**UNIT I:** **The Context of Data Visualization**: Visualization as a discovery tool, The bedrock of visualization knowledge, Defining data visualization, Visualization skills for the masses, the data visualization methodology. **Setting the Purpose and Identifying Key Factors:** Establishing intent – the visualization's function, Establishing intent – the visualization's tone, Key factors surrounding a visualization project, The " eight hats" of data visualization design
	UNIT II: **Conceiving and Reasoning Visualization Design Options:** Data visualization design is all about choices, The visualization anatomy – data representation, The visualization anatomy – data presentation **Taxonomy of Data Visualization Methods:** Data visualization methods, Choosing the appropriate chart type, Assessing hierarchies and part-to-whole relationships
	UNIT III: **Constructing and Evaluating Your Design Solution:** For constructing visualizations, technology matters, The construction process, Approaching the finishing linePost-launch evaluation. Case Studies on real-time applications.
	UNIT IV: **An Introduction to Connecting to Data:** An Introduction to Connecting to Data in Tableau, Shaping Data for Use with Tableau, Getting a Lay of the Land: Tableau Terminology, View the Underlying Data, View the Number of Records, Dimension Versus Measure, What Is a Measure? What Is a Dimension? Discrete Versus Continuous **Five Ways to Make a Bar Chart/An Introduction to Aggregation**: Five Ways to Create a

	Bar Chart in Tableau An Introduction to Aggregation in Tableau, Line Graphs, Independent Axes, and Date Hierarchies, How to Make a Line Graph in Tableau, Independent Axes in Tableau, Date Hierarchies in Tableau, Marks Cards, Encoding, and Level of Detail, An Explanation of Level of Detail, An Introduction to Encoding, Label and Tooltip Marks Cards.
Text books and Reference books	**Text Book(s):** [1] Andy Kirk, "Data Visualization: a successful design process", Packt Publishing (26 December 2012) [2] Ryan Sleeper, Practical Tableau, O'Reilly Media, Inc. April 2018. **Reference Books:** [3]. Chakrabarti, S,"Mining the web: Discovering knowledge from hypertext data ",Morgan Kaufman Publishers, 2003. [4]. Fry, Vi‖isualizing data, Sebastopo,O'Reily, 2007.
E-resources and other digital material	[9]. Dr. GauravDixit,Department of Management Studies, Indian Institute of Technology, Roorkee: https://nptel.ac.in/courses/110107092/7,2017 [10]. P Adam Marcus, and Eugene Wu. RES.6-009 How to Process, Analyze and Visualize Data. January IAP 2012. Massachusetts Institute of Technology: MIT Open Courseware, https://ocw.mit.edu.,2012 [3] Prof.ShankarNarasimhan,Ragunathan, Rengasamy,IIT Madras Data Visualization in R Basic graphics, https://nptel.ac.in/courses/106106179/11,2016 [4] Statistics and Visualization for Data Analysis and Inference, Dr. Ed Vul, Dr. Mike Frank, Massachusetts Institute of Technology, https://ocw.mit.edu/resources/res-9-0002-statistics-and-visualization-for-data-_analysis-and-inference-january-iap-2009/, 2009.

20IT6404B – BIGDATA

Course Category:	Program Elective-2	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	20IT4304: Database Management Systems	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand Big data characteristics, Hadoop, Hive, HDFS and Map Reduce architectures.
	CO2	Use Nosql Databases to process different varieties of Data.
	CO3	Apply Pig Latin, Hive Scripts and Map Reduce programming on real time applications.
	CO4	Develop In-Memory Data Analytics with Spark and Spark Streaming.

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1															2	
CO2	2	2			2								3		3	1.5.1, 2.1.2, 5.2.1
CO3	2		3		3								3	2	3	1.5.1, 3.2.2, 5.2.1
CO4	1		2		2								2		3	1.5.1, 3.2.2, 5.2.1

Course Content	**UNIT I** **Introduction to Big Data:** Big Data-definition, Characteristics of Big Data (Volume, Variety, Velocity), Data in the Warehouse and Data in Hadoop, Importance of Big Data and Patterns for Big Data Development. **Introduction to Hadoop:** Data, Data Storage and Analysis, Comparison with Other Systems: RDBMS, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases.
	UNIT II **Hadoop Distributed File System:** The Design of HDFS, HDFS Concepts, Blocks, Namenodes and Datanodes, Basic Filesystem Operations, HadoopFilesystems, Interfaces, The Java Interface, Reading Data from a HadoopURL, Data Flow, Anatomy of a File Read and Anatomy of a File Write. **Map Reduce–**A Weather Dataset, Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Map and Reduce, Java Map Reduce, Scaling Out, Hadoop Streaming, Hadoop Pipes.
	UNIT III: **NoSQL:** Introduction to NOSQL, Types of NoSQL Databases, Advantages of NoSQL databases, SQL versus NoSql. **NoSQL databases:** Introduction to MongoDB, Data types in MongoDB, MongoDB query language. **Pig-**Installation and Running of Pig, Execution Types, Running Pig Programs, Pig Latin Editors, Comparison with databases, Pig Latin, Functions, Data Processing Operators.

	UNIT IV: **Hive-**Installing Hive, An Example, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data. **Spark:** Introduction to data analytics with Spark, Spark Stack, Programming with RDDS, Working with key/value pairs and Spark SQL.
Text books and Reference books	**Text Book(s):** [1] Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data" 1st Edition, TMH, 2012. [2] Tom White, Hadoop, "The Definitive Guide", 3rd Edition, O'Reilly Publications, 2012. [3] SeemaAcharya, SubhashiniChellappan, Big Data and Analytics, Wiley Publishers. **Reference Books:** [1] Holden Karau, Andy Konwinski, Patrick Wendell, MateiZaharia, "Learning Spark: Lightning-Fast Big Data Analysis", O'Reilly Media, Inc.
E-resources and other digital material	[1]. https://www.tutorialsPInt.com/hive/hive_introduction.htm [2]. Alexey Grishchenko, Hadoopvs MPP, https://0x0fff.com/hadoop-vs-mpp/ [3].Random notes on bigdata- SlideShare: Available www.slideshare.net/yiranpang/random-notes-on-big-data-26439474

20IT6404C - INTERNET OFTHINGS

Course Category:		Programme Elective 2	Credits:	3
Course Type:		Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:		20IT5301 – Computer Networks	Continuous Evaluation:	30
			Semester end Evaluation:	70
			Total Marks:	100
Course Outcomes		Upon successful completion of the course, the student will be able to:		
	CO1	Analyze various protocols, privacy and security of Internet of Things.		
	CO2	Apply the methods of data acquiring, organizing and analytics using Cloud platform for IoT applications.		
	CO3	Design portable IoT system using Rasperry Pi and Arduino.		
	CO4	Apply the steps of the design methodology in developingIoT applications.		

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium,3-High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	1		3		1		2					2	1		2	1.5.1, 3.2.2, 5.2.1, 7.1.2
CO2	1		2		2		2						1	2	3	1.5.1, 3.2.2, 5.2.1, 7.1.2
CO3	1		2		2		3						1		3	1.5.1, 3.2.2, 5.2.1, 7.1.2
CO4	1		2		2		3					2	1	2		1.5.1, 3.2.2, 5.2.1, 7.1.2

Course Content	**UNIT I:** **Introduction to Internet of things:** Introduction, Physical design of IoT, Logical Design of IoT, IoT Enabling technologies, IoT levels & Deployment templates. **Domain Specific IoTs:** Home Automation, Cities **IoT and M2M:** Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT
	UNIT II: **Internet Connectivity Principles:** Introduction, Internet Connectivity, Internet-Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols-HTTP, HTTPS, FTP, Telnet and others. **Data Acquiring, Organizing, Processing and Analytics:** Introduction, Data Acquiring and Storage, Organizing the Data, Transactions, Business, Processes, Integration and Enterprise Systems, Analytics. **Data Collection, Storage and Computing Using a Cloud Platform:** Introduction, Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud Service Models.

	UNIT III: **Sensors, Participatory Sensing, RFIDs and Wireless Sensor Networks:** Introduction, Sensor Technology, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology. **IoT physical devices & EndPInts: IoT Device,** Raspberry Pi Board, Raspberry Pi interfaces, Programming Raspberry pi with python.
	UNIT IV: **IoT Platforms Design Methodology:** Introduction, IoT Design Methodology, Case Study on IoT System for Weather Monitoring**.** **IoT Privacy, Security and Vulnerabilities Solutions:** Vulnerabilities, Security Requirements and Threat Analysis, IoT Security Tomography and Layered Attacker Model.
Text books and Reference books	**Text Book(s):** [1] Vijay Madisetti and ArshdeepBahga, **"Internet of Things (A Hands- on-Approach)",** 1st Edition, University Press Private Limited,2017 [2] Raj Kamal, "**Internet of Things, Architecture and Design Principles**" 1st Edition, McGraw Hill Education Private Limited, 2017. **Reference Books:** [1] Francis daCosta, **"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",** 1st Edition, Apress Publications,2013 [2] Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
E-resources and other digital material	[1] Prof SudipMisra, IIT, Kharagpur, "Introduction to Internet of Things",2017 https://www.youtube.com/watch?v=WUYAjxnwjU4 [2] IoT Tutorial for Beginners | Internet of Things (IoT) | Edureka,2017 https://www.youtube.com/watch?v=UrwbeOIlc68,

20IT6404D -INFORMATION RETRIEVAL SYSTEM

Course Category:	Program Elective - 2		Credits:		3
Course Type:	Theory		Lecture-Tutorial-Practice:		3-0-0
Prerequisites:	Data Visualization		Continuous Evaluation:		30
			Semester end Evaluation:		70
			Total Marks:		100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the basic concepts and techniques in Information Retrieval
	CO2	Evaluate information retrieval system performance and queries formulation
	CO3	Infer relevance feedback and query operations on a text database
	CO4	Analyze the web characterization and digital libraries implications

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1															2	
CO2	1	1			2								1	1	4	1.5.1, 2.1.2, 5.2.1
CO3	1	2	2		3								1	1	3	1.5.1, 2.1.2, 3.2.2, 5.2.1
CO4	1	2	2		3								2	2	4	1.5.1, 2.1.2, 3.2.2, 5.2.1

Course Content	**UNIT I** **Introduction:** Motivation,Information versus Data Retrieval, Information Retrieval at the Center of the Stage. **Basic Concepts:** The User Task, Logical View of the Documents. Past, Present, and Future: Early Developments, Information Retrieval in the Library, The Web and Digital Libraries,The Retrieval Process. **Modeling:**Introduction, A Taxonomy of Information Retrieval Models, Retrieval: Ad Hoc and Filtering, A Formal Characterization of IR Models, Classic information retrieval.
	UNIT II **Retrieval Evaluation**: Introduction, Retrieval Performance Evaluation : Recall and Precision, Alternative Measures ,Reference Collections : The TREC Collection **Query Languages:** Keyword-Based Querying, Pattern Matching, Structural Queries, Query Protocols.
	UNIT III **Query Operations :** User Relevance Feedback,Query Expansion and Term Reweighting for the Vector Model, Term Reweighting for the Probabilistic Model, A Variant of Probabilistic Term Reweighting, Evaluation of Relevance Feedback Strategies **Text Operations :** Introduction ,Document Preprocessing **Indexing and Searching :** Introduction,Inverted Files,Boolean Queries,Sequential Searching : Brute Force,Knuth-Morris-Pratt
	UNIT IV **Searching the Web** : Introduction,Challenges,Characterizing the Web,Search Engines,Browsing

	Digital Libraries : Introduction,Definitions,Architectural Issues,Document Models, Representations, and Access Case Studies: Page ranking , Retrieval evaluation of Web Search Engines
Text books and Reference books	**Text Books:** [1] Ricardo Baeza-Yaets and BerthierRibeiro-Neto, Modern Information Retrieval: The Concept and Technology behind Search, 2nd Edition, Pearson, 2020. **Reference Books:** [1] G. G. Chowdhurry,Introduction to Modern Information Retrieval, Neal-Schuman Publishers; Third edition , 2019 [2] Christopher D. Manning, PrabhakarRaghavan and HinrichSchütze, *Introduction to Information Retrieval*, Cambridge University Press. 2008..
E-resources and other digital material	[1] Information Retrieval,Prof.PabitraMitra,IITKharagpur, http://cse.iitkgp.ac.in/~pabitra/course/ir06/ir06.html [2] Information Retrieval,Prof.PawanGoyal,IITKharagpur, http://cse.iitkgp.ac.in/~pawang/courses/IR16/lec1.html [3] Natural Language Processing by Prof. Pushpak Bhattacharyya, Department of Computer science &Engineering,IIT Bombay, https://www.youtube.com/watch?v=m0oiAOgSQFw [4] Introduction to Information Retrieval ,University of South Carolina, https://www.youtube.com/watch?v=yluvahNq3wk

20IT6205A - AGILE SOFTWARE DEVELOPMENT

Course Category:	Open Elective	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	20IT5302 : Software Engineering	Continuous Evaluation:	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Apply software development methods for time management of agile projects.
	CO2	Analyze agile software development processes, quality and team work in learning.
	CO3	Evaluate measures that suit agile software development environments to process and product quality which delves into the details of TDD implementation.
	CO4	Build teams to establish a professional software development that promotes team members accountability and responsibility.

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	3										2		3		3	1.5.1, 11.3.1
CO2		3									2		1		4	2.1.2, 11.3.1
CO3				3							1		1	1	4	4.1.2,11.3.1
CO4					3				1				1	1	3	5.2.1, 9.1.2

Course Content	**UNIT I:** **Agile and Scrum Principles-**Three Perspectives on Software Engineering, Agile Manifesto, Definition of Scrum, Uses of Scrum, Scrum Theory, Scrum Values, The Scrum Team, Scrum Events, Scrum Artifacts. **Teamwork-** Objectives, A Role Scheme in Agile Teams, Dilemmas in Teamwork, Teamwork in Learning Environments,
	UNIT II: **Customers and Users-**Objectives, The Customer, The User, Customers and Users in Learning Environments **Time-** Objectives, Time-Related Problems in Software Projects, Tightness of Software Development Methods, Sustainable Pace, Time Management of Agile Projects, Time in Learning Environments,
	UNIT III: **Measures-** Objectives, Importance of Measures, Case Study- Monitoring a Large-Scale Project by Measures, Measures in Learning Environments. **Quality-** Overview, Objectives, The Agile Approach to Quality Assurance, Test-Driven Development, Measured TDD, Quality in Learning Environments.
	UNIT IV:

	Learning- Objectives, How Does Agile Software Development Support Learning Processes, Learning in Learning Environments **Abstraction-** Objectives, Abstraction Levels in Agile Software Development, Abstraction in Learning Environments **Trust-**, Objectives, Software Intangibility and Process Transparency, Game Theory Perspective in Software Development, Ethics in Agile Teams, Diversity, Trust in Learning Environments,
Text books and Reference books	**Text Book(s):** [1] Hazza and Dubinsky, ―Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009. [2] Scrum creators: Ken Schwaber and Jeff Sutherland, The Scrum Guide- The Definitive Guide to Scrum: The Rules of the Game, November 2017. **Reference Books:** [1]. Craig Larman, ―Agile and Iterative Development: A Managers Guide, Addison-Wesley, 2004. [2]. Kevin C. Desouza, ―Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.
E-resources and other digital material	[1] Praveen Mittal, Adjunct Professor, University of Minnesota [2] https://www.coursera.org/learn/agile-software-development **Prof. Rajib Mall, CSE IIT Kharagpur, Course name: Agile model https://archive.nptel.ac.in/courses/106/105/106105182/** [3] Nate Dinet, Author & Co-founder of Conquer Life & Enterprise Agile Coach Course name: An overview of agile methodologies https://www.udemy.com/course/agile-methodologies-overview/ [4] Bertrand Meyer : Agile methods are one of the most important developments https://learning.edx.org/course/course-v1:ETHx+ASD.1x+2T2020/home

20IT6205B- AUTOMATA AND COMPILER DESIGN

Course Category:	Open Elective	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	-	Continuous Evaluation:	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Analyze the concepts of abstract machines, compiler design, language classes & grammar relationships and variants of syntax trees.
	CO2	Apply code generation and code optimization techniques, top down and bottom up parsing techniques on context free grammars
	CO3	Construct finite state machines, Parsing Tables and regular expressions for modeling and solving computation problems.
	CO4	Design Context free grammars, Pushdown Automata and Turing machines for the formal languages.

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	2	2	2												2	1.5.1, 2.1.2, 3.2.2
CO2	3		2										1		3	1.5.1, 3.2.2
CO3	2		3										1	1	3	1.5.1, 3.2.2
CO4	2		3											2	3	1.5.1, 3.2.2

Course Content	
	UNIT I:
	Finite Automata: Deterministic Finite Automata-Definition of DFA, How a DFA processes strings, Simpler Notations for DFA's, Extending the Transition Function to Strings, The Language of DFA, Nondeterministic Finite Automata – Definition of NFA, Extended Transition Function, Language of NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Finite automata with Epsilon –Transitions – Uses of €-Translations, Formal notation for an €-NFA, Epsilon-Closures, Extended Transitions and Languages for €-NFA's, Eliminating €-Transitions.
	Regular Expressions and Languages: Regular expressions – Operators of Regular Expressions, Building Regular Expressions, Finite Automata and Regular Expressions - Converting DFA's to Regular expressions by eliminating states, Converting regular expressions to automata.
	UNIT II:
	Introduction: Structure of a compiler **Lexical Analysis** – Role of Lexical Analyzer – Lexical Analysis Vs. Parsing, Token, patterns and Lexemes, Lexical Errors
	Simple Syntax Directed Translator: Syntax definition – Definition of Grammars, Derivations, Parse Trees, Ambiguity, Parsing-Top-Down Parsing, Predictive Parsing, When to use € Productions, Designing a Predictive Parser, Left Recursion
	Syntax Analysis : Introduction - Role of a parser, Context Free Grammars – definition of CFG, Derivations, Parse Trees and Derivations, Ambiguity, Top Down Parsing-Recursive-Descent Parsing, FIRST and FOLLOW, LL(1) Grammars, Nonrecursive Predictive Parsing, Bottom Up

	Parsing – Reductions, Handle Pruning, Shift Reduce Parsing, Introduction to LR Parsing – Why LR Parsers, Items and the LR(0)Automaton, LR-Parsing Algorithm, Construction of SLR-Parsing Tables, More Powerful LR Parsers- Canonical LR(1) Items, Constructing LR(1) Sets of Items, Canonical LR(1) Parsing Tables, Constructing LALR Parsing Tables
	UNIT III: **Syntax Directed Translation**: Syntax Directed definition, Evaluation orders for SDD's, Applications of Syntax Directed Translation **Intermediate Code Generation** : Variants of Syntax Trees, Three Address Code, Type Checking- Rules for Type Checking, Type Conversions **Code generation:** Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Simple code Generator, Peephole Optimization.
	UNIT IV: **Pushdown Automata**: Definition of the Pushdown automata, The languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Push Down Automata. **Turing Machines**: Introduction, The Turing Machine – Notations, Descriptions, Transition diagrams, Language of a Turing Machine, Turing Machines and Halting.

Text books and Reference books	**Text Book(s):**
	    [1] John E..Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, " Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2011
	    [2] Daniela Witten, Trevor Hatie, RoberstTibhirani , "Compilers Principles, Techniques and Tools", Pearson Education, Second Edition, 2009.
	 Reference Books:
	 [1]. Michael Sipser, Introduction to the Theory of Computation, PWS
	    Publishing.
	 [2] Lewis H.P. & Papadimitriou C.H , "Elements of Theory of
	Computation", Second edition, Pearson /PHI.
	 [3]. K.L.P.Mishra and N. Chandrashekaran, "Theory of computation" , 2^{nd}edition, PHI

E-resources and other digital material	[1]. Prof.KamalaKrithivasan, IIT, Madras, "Theory of Automata, Formal Languages and Computation" , 2011, https://nptel.ac.in/courses/106106049/http://dev.tutorialsPInt.com/automata_theory/index.htm [2]. Neso Academy, "Introduction to Theory of Computation", Dec 2016. https://www.youtube.com/watch?v=58N2N7zJGrQhttp://www.nptelvideos.in/2012/11/theory-of-computation.html [3]. Prof. SouravMukhopadhyay, Department of Mathematics, IIT, Kharagpur, ntroduction to Automata, Languages and Computation, NPTEL, 2021. https://nptel.ac.in/courses/106105196 [4]. Compiler design, learning material https://www.tutorialsPInt.com/compiler_design/compiler_design_useful_resources.htm

20IT6205C–INTRODUCTION TO DATA STRUCTURES

Course Category:	Open Elective		Credits:		3
Course Type:	Theory		Lecture-Tutorial-Practice:		3-0-0
Prerequisites:	20ES1103 : Programming for Problem Solving		Continuous Evaluation:		30
			Semester end Evaluation:		70
			Total Marks:		100

		Upon successful completion of the course, the student will be able to:
Course Outcomes	CO1	Apply linear data structures to solve different applications.
	CO2	Develop algorithms to solve a given problem using appropriate data structure.
	CO3	Implement operations on binary trees, binary search trees and sorting.
	CO4	Solve problems using algorithm design methods such as the divide and conquer,greedy method and dynamic programming.

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	1	2											2	1	3	1.5.1, 2.1.2
CO2	1												1		3	1.5.1
CO3		1										1	2	2	3	2.1.2, 12.2.1
CO4				1					1			1			3	4.1.2, 9.1.2

Course Content	**UNIT I** **Introduction:** Basic Terminology, Classification of Data Structures, Operations on Data Structures, Abstract Data Type, Algorithms, Different Approaches to Designing an Algorithm, Control Structures Used in Algorithms, Time and Space Complexity. **Searching:** Linear Search and Binary Search Techniques **Stacks:** Introduction to Stacks, Array Representation of Stacks, Operations on a Stack, Linked Representation of Stacks, Operations on a Linked Stack, Applications of Stacks- Evaluation of Arithmetic Expressions, Recursion.
	UNIT II **Queues:** Introduction to Queues, Array Representation of Queues, Linked Representation of Queue, Types of Queues-Circular Queues, Deques, Priority Queues, Multiple Queues, Applications of Queues **Linked list**: Introduction, Singly linked lists-Traversing, Searching, Inserting, Deleting a Node from a linked list **Doubly linked list:** Inserting and deleting a Node from a Doubly linked list.
	UNIT III: **Trees**–Introduction, Binary trees, Creating a Binary Tree from a General Tree, Traversing a Binary Tree

	Efficient Binary Trees– Binary search tree, Operations on Binary Search Trees- Searching, Inserting and Deleting a node **Sorting:** Bubble sort, Insertion sort, Selection sort, Merge sort and Quick sort
	UNIT IV: **Divide and Conquer:** General Method, Binary Search, Finding Minimum and Maximum **Greedy Algorithm:** General Method, Knapsack Problem, Single-Source Shortest Paths **Dynamic Programming:** General Method, Multistage Graph, All Pairs Shortest Paths, The Traveling salesperson Problem
Text books and Reference books	**Text Book(s):** [1]. Reema Thareja "Data structures using C" 2nd edition Oxford University press,2014 [2]. Ellis Horowitz, SartajSahni,SanguthevarRajasekharan" Computer Algoithms", Computer Science Press **Reference Books:** [1]. Thomas H Corman, E Leiserson, Ron Rivest, "Introduction to Algorithms" , MIT Press, 2nd Edition, Jan 2001. [2]. Alfred V Aho, J D Ullman, J E Hopcroft, "Data Structures and Algorithms" , Addison Wesley Longman, 1983. [3]. Mark Allen Weiss, "Data Structures in C++", Addison Wesley Longman, 2nd Edition, 1998. [4]. Horowitz E and Sahni S, " Fundamentals of Computer Algorithms", Computer Science Press, 1984.
E-resources and other digital material	[1]. SudarshanIyengar: IIT Ropar (12, August, 2018). Data Structures and Algorithms[NPTEL]. Available: http://nptel.ac.in/ [2]. Erik Demaine, (12, may, 2018). Advanced Data Structures [MIT-OpenCourseWare]. Available: http://ocw.mit.edu/ [3]. https://www.coursera.org/learn/data-structures [4]. https://www.coursera.org/specializations/data-structures-algorithms

20IT6351 - WEB PROGRAMMING AND DEVELOPMENT LAB

Course Category:	Program Core Lab	Credits:	2
Course Type:	Laboratory	Lecture-Tutorial-Practice:	0-0-2
Prerequisites:	20IT4302 Java Programming	Continuous Evaluation:	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Implement Java Database Connectivity Application Programming Interface to connect to relational databases
	CO2	Build server side applications to interact with server using Java Servlets
	CO3	Design Web applications that interact with server as well as the relational databases
	CO4	Implement dependency injection and inversion of control to solve problems in Spring Boot
	CO5	Apply Spring Boot annotations to provide solutions to real world problems
	CO6	Create Spring Boot applications that uses Representational State Transfer services

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low, 2- Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1		2			2										3	2.1.2, 5.2.1
CO2	3				2										3	1.5.1, 5.2.1
CO3			3		2								2	2	3	3.2.2, 5.2.1
CO4	2				3								1		3	5.2.1
CO5	3				2								2	2	3	5.2.1
CO6			3		3								2	2	6	3.2.2,5.2.1

Course Content	**Week 1:** Create JDBC programs to connect to relational databases
	Week 2: Connect to a database using different type of Statement Interfaces and process the results using ResultSet a. Implementation of CRUD operations on a relational database
	Week 3: Create server side applications using Java Servlets

	Week 4: Servlet programs on sessional tracking using
	    a. Cookies
	    b. Sessions

	Week 5: Creation of Spring programs via SpringBootApplication and Spring Initializerin Spring
	Week 6: Implementation of 12-factor App in Spring Boot
	Week 7: Implement dependency injection into a program in Spring Boot
	Week 8: Use of annotations in developing applications in Spring Boot

	Week 9: Accessing of relational databases via JDBC and JPA
	Week 10: Implement RESTFul Services in Spring Boot
	Week 11&12:Case Studies- 1. Develop web applications using Java Servlets 2. Web applications that handles the sessions via session tracking 3. Develop Spring Boot applications to real world problems 4. Make use of Representational State Transfer in building applications in Spring Boot
Text books and Reference books	**Text Book(s):** [1].James Keogh, "J2Ee: The Complete Reference", 1st Edition, McGraw Hill Education, 2002 [2].ShagunBakliwal, Hands-on Application Development using Spring Boot, BPB Publications, First Edition, 2022 **Reference Book(s):** [1].Craig Walls, Spring in Action, Sixth Edition, MEAP Edition, Manning Early Access Program, Version 4, 2021 [2].Mark Heckler, Spring Boot: Up and Running, O'Reilly Media,2021
E-resources and other digital material	[1].RangaKaranam, Java Servlets and JSP - Build Java EE(JEE) app in 25 Steps, 04-06-2022 Available: https://www.udemy.com/course/learn-java-servlets-and-jsp-web-application-in-25-steps/ [2].Spring-Official documentation, 04-06-2022Available:https://spring.io/projects/spring-boot [3].Advanced Java Programming by Infinite Skills, 04-06-2022 Available: https://www.udemy.com/advanced-java-programming/ [4].Derek Parsons , Spring MVC, Spring Boot and Rest Controllers, Available: 04-06-2022, LearnQuest, https://www.coursera.org/learn/spring-mvc-rest-controller [5].RangaKaranam, Spring Framework Master Class - Java Spring the Modern Way, Available: 04-06-2022 https://www.udemy.com/course/spring-tutorial-for-beginners/

20IT6352A -DATA VISUALIZATION LAB

Course Category:	Program Elective 2	Credits:		1.5
Course Type:	Laboratory	Lecture-Tutorial-Practice:		0-0-3
Prerequisites:		Continuous Evaluation:		30
		Semester end Evaluation:		70
		Total Marks:		100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the visualization pipeline with its relationship to other data
	CO2	Design considerations for the components of the good visualization
	CO3	Construct visualizations for effective data analysis
	CO4	Build interactive dashboards for better decision making

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1															2	
CO2	1	1	2								1			2	3	1.5.1, 2.1.2, 3.2.2
CO3		2												3	3	2.1.2
CO4	1		1								1		3		3	1.5.1, 3.2.2

Course Content	**Week 1:** Implement Pie chart, Area Chart and Bubble plot on real-time data
	Week 2: Implement visualization techniques on textual data
	Week 3 & 4: Implementing data visualization using R 1. Find the data distributions using box and scatter plot. 2. Find the outliers using plot. **3.** Plot the histogram, bar chart and pie chart on sample data.
	Week 5 & 6: Implementing basic operations in Tableau to get accustomed to its interface and Emphasizing the Results and Map View [1] Tableau Workspace, Connecting to a Data Source, Creating a view and Refining the view [2] Adding Filters to the view, Adding Colors to the view and Key Findings [3] Building a Map View, Getting into details and Identifying the Key PInts
	Week 7: Creating a dashboard and building story to showcase stories in presentation mode [1] Creating a dashboard and Adding Interactiveness [2] Building a Story and Making a Conclusion
	Week 8: Tracking Twitter data to see how fast information spreads online: Create a data visualization to understand the spread of information and miss information insights of individual tweets online.

	Week 9: Loan risk analysis : Create visualization to analyze bank loan data to assess the risk of loan defaulters.
	Week 10: Motivate sales teams by modelling commission rates: Create a visualization to explore the relationships between compensation type, commission for sales people to motivate them.
Text books and Reference books	**Text Book(s):** [1] Andy Kirk, "Data Visualization: a successful design process", Packt Publishing (26 December 2012) [2] Ryan Sleeper, Practical Tableau, O'Reilly Media, Inc. April 2018. **Reference Books:** [1]. Chakrabarti, S,"Mining the web: Discovering knowledge from hypertext data ", Morgan Kaufman Publishers, 2003. Fry ,Vi‖isualizing data, Sebastopo, O'Reily, 2007.
E-resources and other digital material	[1]. Dr. GauravDixit,Department of Management Studies, Indian Institute of Technology, Roorkee: https://nptel.ac.in/courses/110107092/7,2017 [2]. P Adam Marcus, and Eugene Wu. RES.6-009 How to Process, Analyze and Visualize Data. January IAP 2012. Massachusetts Institute of Technology: MIT Open Courseware, https://ocw.mit.edu.,2012 [3] Data Visualization in R Basic graphics, Prof.ShankarNarasimhan, RagunathanRengasamy,IIT Madras, https://nptel.ac.in/courses/106106179/11,2016 [4] Statistics and Visualization for Data Analysis and Inference, Dr. Ed Vul, Dr. Mike Frank, Massachusetts Institute of Technology, https://ocw.mit.edu/resources/res-9-0002-statistics-and-visualization-for-data-analysis-and-inference-january-iap-2009/, 2009.

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20IT6352B - BIG DATA LAB

Course Category:	Program Elective- 2	Credits:	1.5
Course Type:	Lab	Lecture-Tutorial-Practice:	0-0-3
Prerequisites:	20IT4352: Database Management Systems Lab	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Implement Map Reduce programming on real time applications.
	CO2	Apply NOSQL Concepts on real time applications.
	CO3	Apply Pig Latin and Hive Script programming on real time applications.
	CO4	Solve various business applications using Big data concepts.

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	2		3		3								3	2	3	1.05.1, 3.3.1, 5.2.1
CO2	2	2			3								3	2	3	1.5.1, 2.1.2, 5.2.1
CO3	2		3		3								3	2	3	1.5.1, 3.2.2, 5.2.1
CO4	2		3		3								3	3	3	1.5.1, 3.2.2, 5.2.1

Course Content	**Week 1** • Introduction, Applications, Tools related to Big data and NOSQL.
	Week 2 NOSQL: Mangodb installation and querying in Mangodb
	Week 3 Querying in Mangodb • Create Database • Drop Database • Create collection • Drop collection • Indexing • Aggregation
	Week 4 Installation of Cloudera
	Week 5 Exploring HDFS and Listing of files.
	Week 6 HDFS Operations using various commands
	Week 7 HiveQL • Create Database

	• Drop Database • Create table • Alter table • Drop table • Partitioning • Built-in operators • Built-in functions • Views and indexes
	Week 8 HiveQl • Select where • Order by • Group by • Joins
	Week 9 Map Reduce Applications • Mapper code • Reducer code • Combiner code
	Week 10 Pig Latin Scripts • Operators • Load & Store • Diagnostic • Grouping and Joining • Combining and Splitting • Filtering • Sorting
	Week 11 **Spark SQL**
	Week 12 Case Study on Hive and Pig from kaggle
	Week 13 Case Study on Map reduce
Text books and reference books	**Text Book(s):** [1]. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data" 1st Edition, TMH,2012. [2]. Tom White, Hadoop, "The Definitive Guide", 3rd Edition, O'Reilly Publications, 2012.

	Reference Books: [1]. SeemaAcharya, SubhashiniChellappan, Big Data and Analytics, Wiley Publishers. [2]. Holden Karau, Andy Konwinski, Patrick Wendell, MateiZaharia, "Learning Spark: Lightning-Fast Big Data Analysis", O'Reilly Media, Inc.
E-resources and other digital material	[1]. https://www.tutorialsPInt.com/hive/index.htm [2]. https://www.tutorialsPInt.com/apache_pig/index.htm [3]. https://www.tutorialsPInt.com/mongodb/index.htm [4]. https://www.tutorialsPInt.com/map_reduce/index.htm

20IT6352C–INTERNET OF THINGS LAB

Course Category:	ProgramElective-II	**Credits:**	1
Course Type:	Lab	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	Computer Networks	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course ,the student will be able to:
	CO1	Understanding of IoT value chain structure (device, data cloud), application areas and technologies involved.
	CO2	Choose the right sensors and actuators for an application.
	CO3	Test and experiment different sensors for application development.
	CO4	Develop IoT applications using Arduino/Raspberry Pi/open platform.
	CO5	Develop smart IoT Applications using smart sensor devices and cloud systems.
	CO6	Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low,2-Medium,3-High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	1		1									3		1	2	1.5.1, 3.2.2, 12.2.1
CO2	1		1									3	1		4	1.5.1, 3.2.2, 12.2.1
CO3				2	2							3	2	2	5	4.1.3, 5.2.1, 12.2.1
CO4				2	2							3	1	2	3	4.1.3, 5.2.1, 12.2.1
CO5			1	2											3	3.2.2, 4.1.3
CO6			1	2											3	3.2.2, 4.1.3

CourseContent	**Week1&2:** • Selectanyone development board(ExArduino,NodeMCU,Raspberry Pi)andcontrolLEDusingtheboard. • ByusingtheArduino/RaspberryPi boardreaddatafromasensor.Experimentwithbothanaloganddigitalsensor. • WriteanArduinoprogramtocontrolanLEDlightusingpushbuttonandprintthe statusofbuttonandLEDonserialmonitor.

	Week3 • WriteanArduinoprogramforinterfacingtheArduinoboardwiththeLDRsenso randprintoutputonSerialmonitor. • Arduinoboardinterfacingwiththetemperatureandhumiditysensorandprints theoutputonLCD/serialmonitor
	Week4 • Control any two actuators which are connected to development board using Bluetooth • Write an Arduino program for interfacing the Arduino board with the LDR sensor and activate the LED based on threshold value and print on LCD.
	Week5: • WriteanArduinoprogramforactivatingthebuzzerwhenmotionisdetectedusi ngrelay • Write an Arduino program for interfacing Arduino board with the Ultrasonic sound sensor and print the output on Serial monitor
	Week6: • WriteanArduinoprogramforinterfacingArduinoboard withtheIRsensorandprintoutputonSerialmonitor • WriteanArduino programforinterfacing ArduinoboardwiththeGassensorandactivatethebuzzerifthevalueisgreaterth anthresholdvalue andprint outputonSerialmonitor
	Week7: • WriteaPythonprogramtocontrolanLEDlightusingswitchwithRaspberryPib oard • Write a PythonprogramtoblinkanLED usingRaspberryPiboard
	Week8: • Write a Pythonprogramtointerface LDR sensorwithRaspberryPiboard. • WriteaPythonprogramtointerfaceIRsensorwithRaspberryPiboardanddispl aythedistanceoftheobject.
	Week9: Write aPython program tointerfaceUltrasonicsensorwith Raspberry Piboardanddisplaythevalues ofthesensor DevelopaPythonprogramtointerfacetemperatureandhumiditysensorwithR aspberryPiboardanddisplaythe DHTvalues onLCD
	Week10:Case Study • Create any cloud platform account. Explore IoT Services. Register a thing in the platform and push the sensor data to cloud using MQTT protocol
Text books and Reference books	**TextBook(s):** [1] VijayMadisettiandArshdeepBahga,**"InternetofThings(AHands-on-** **Approach)",** 1stEdition, VPT,2014. [2] CharalamposDoukas"BuildingInternetofThingswiththeArduino"

	ReferenceBooks: [1]FrancisdaCosta,**"RethinkingtheInternetofThings:AScalableApproachto** ConnectingEverything",1stEdition,ApressPublications,2013 [2]JanHoller,VlasiosTsiatsis,CatherineMulligan,StefanAvesand, StamatisKarnouskos,DavidBoyle,**"FromMachine-to-MachinetotheInternetof** Things:Introductiontoa NewAge ofIntelligence",1st Edition,AcademicPress,2014.

E-resources and other digital material	[1].Raspberryt Pi3 Tutorial, Edureka,
	             Decemberhttps://www.youtube.com/watch?v=QlApoE
	    KGfU4
	[2].SudipMishra, IIT,Kharagpur, "IntroductiontoIoT",
	    NPTEL,https://nptel.ac.in/courses/106105166/2017.

20IT6352D - INFORMATION RETRIEVAL SYSTEM LAB

Course Category:		Program Core	Credits:		1.5
Course Type:		Lab	Lecture-Tutorial-Practice:		0-0-3
Prerequisites:		Data Mining lab	Continuous Evaluation:		30
			Semester end Evaluation:		70
			Total Marks:		100

Course Outcomes		Upon successful completion of the course, the student will be able to:				
	CO1	Demonstrate genesis and diversity of information retrieval situations for text and hypermedia.				
	CO2	Interpret different types of algorithms to provide better search results				
	CO3	Analyze the functions of web search engines.				
	CO4	Apply techniques for compressing dictionaries and inverted indexes				

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low,2-medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	1		1									3		1	2	1.5.1,2.1.2, 3.2.2, 11.3.1
CO2	1		1									3	1		4	1.5.1,2.1.2, 3.2.2, 11.3.1
CO3			2	2								3	2	2	5	2.2.4, 5.2.1
CO4			2	2								3	1	2	3	1.5.1, 3.2.2, 5.2.1, 11.3.1

Course Content	**Week 1 :** Implement text processing using given text
	Week 2 : Perform lemmatization and Stemming on given text
	Week 3 : Create a inverted index for given text file Implement program to search for words and patterns in a given text file using inverted index
	Week 4 : Implement token normalization of a given text Perform count word frequency in a given text file
	Week 5 : Measure the rank of the specific word for its relevancy with in the text document using IDF Implement document ranking using vector space model
	Week 6 : Compute Similarity between two text documents Implement a basic IR system using Lucene
	Week 7: Extract data using web scraping and web crawling with python
	Week 8 : Build a corpus of language data and analyze this text, and visualize the results.
	Week 9 : Implementation of Retrieval evaluation of Web Search Engines

	Week 10 : Represent the likelihood of randomly clicking on links of a particular page using PageRank algorithm to output probability distribution.
	Week 11&12 : Case studies on Sentiment Analysis, image query processing
Text books **Reference books**	**Text Book(s):** [1]Stefan Buttcher , Charles L. A. Clarke , Gordon V. Cormack ,Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2016. **Reference Books:** [1] Gerald J Kowalski, Mark T Maybury Information Storage and Retrieval Systems: Theory and Implementation, Springer, 2004. [2] SoumenChakrabarti, Mining the Web : Discovering Knowledge from Hypertext Data, Morgan – Kaufmann Publishers, 2002. [3] Christopher D Manning, PrabhakarRaghavan, HinrichSchutze, An Introduction to Information Retrieval By Cambridge University Press, England, 2009
E-resources and other digital material	[1]PabitraMitra , Professor,CSEDepartment,IITKhargapur,Information Retrieval,https://cse.iitkgp.ac.in/~pabitra/course/ir06/ir06.html [2] ShehzaadDhuliawalaMaulikachhani,Information Retrieval,http://www.cfilt.iitb.ac.in/viva_workshop/Day4-Information_Retrieval-ShehzaadDhuliawala

20IT6353 - ADVANCED PROGRAMMING LAB – III

Course Category:	Programming Core	Credits:										1.5			
Course Type:	Lab	Lecture-Tutorial-Practice:										0-0-3			
Prerequisites:	20IT3353: Object Oriented Programming using C++ Lab 20IT5352- Advanced Programming Lab - II	Continuous Evaluation:										30			
		Semester end Evaluation:										70			
		Total Marks:										100			

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the basic concepts such as Stacks, Queues, Linked Lists and Hashing Techniques in the programming language.
	CO2	Demonstrate the use of stacks, queues and sequences in solving real world scenarios.
	CO3	Apply tries and trees in solving network related scenarios.
	CO4	Solve the problems with given test cases.
	CO5	Analyze the solutions for the problemsusing algorithm analysis concepts
	CO6	Apply programing skills for optimized code and derive the solutions according to the provided constraints.

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low,2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1													1		2	
CO2	2				2								2		3	1.5.1, 5.2.1
CO3	2												2		3	1.5.1
CO4		2			2								1		3	2.1.2,2.3.1, 5.2.1
CO5		2											2		4	2.3.1
CO6	2	2											1		3	1.5.1, 2.3.1

Course Content	**Course Content:** Solving the programs under "Easy / Medium" category in Leetcode, Topcoders, Codewars, CodeChef, HackerEarth, Hackerrank etc., Students must solve 100 problems from any of the online platforms. Students shall perform minimum of one contest for a month, with the support of online judges. Problems to be solved using either Python, C++, etc., Students should solve the problems on the following list of topics • Stacks • Queues, Sequences • Dynamic Programming • Tries

	- Trees - Decomposition - Strings - Collections - Sequences - Computational Geometry Results of regular contests can be considered as day-to-day assessment of the laboratory. Monthly one such evaluation. Different problems should be solved by the students in the lab slot & at their homes with minimum of 15 problems per week.
Text books and Reference books	**Text Book(s):** [1]. Halim, Steven and Halim, Felix, Competitive Programming 1, 2013 [2]. ReemaThareja,"Python ProgrammingUsing Problem Solving Approach", Oxford University Press, 2019. **Reference Books:** [1]. AnttiLaaksonen, "Guide to Competitive Programming", 1st edition, Springer International Publishing, 2017 [2]. Ahmed ShamsulArefin, Art of Programming Contest, ACMSolver, Second Edition, 2012 [3]. Zed Shah, "Learn PythonThe Hard Way", Third edition, Addison-Wesley, 2013. [4]. John V. Guttag, "Introduction to Computation and Programming Using Python", The MIT Press, 2013
E-resources and other digital material	[1]. FilippRukhovich, Competitive Programming for beginners, [COURSERA]. (11-12-2021), Available: https://www.coursera.org/learn/competitive-programming-for-beginners [2]. Prof Neeldhara, IIT Gandhinagar, Getting Started with Competitive Programming,[NPTEL],(11-12-2021),Available :https://onlinecourses.nptel.ac.in/noc21_cs99/preview [3]. Prof. Erik Demaine,Prof. Ronald Rivest,Prof. SriniDevadas MIT Open Courseware, Introduction to Algorithms, Getting Started with Competitive Programming,[MIT], (11-12-2021),Available:https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-spring-2008/index.htm [4]. Erik Demaine, Prof. Ronald Rivest, Prof. SriniDevadas, Lecture notes by EE & CSE of MIThttps://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-854j-advanced-algorithms-fall-2005/lecture-notes/ [5]. Hacker Rank, 11-12-2021 Available https://www.hackerrank.com/ [6]. Leet Code, 11-12-2021Availablehttps://leetcode.com/ [7]. Hacker Earth, 11-12-2021Available https://www.hackerearth.com/ [8]. Topcoder, 11-12-2021Available https://www.topcoder.com/challenges/ [9]. Coder Byte, 11-12-2021Available https://www.coderbyte.com/ [10]. Code wars, 11-12-2021Available https://www.codewars.com/ [11]. Code Signals, 11-12-2021Available https://codesignal.com/ [12].Code Chef, 11-12-2021 Available https://www.codechef.com/

20IT7251 - MINI PROJECT

Course Category:	Project			Credits:		2
Course Type:	Practical			Lecture-Tutorial-Practice:		0-0-4
Prerequisites:	-			Continuous Evaluation:		30
				Semester end Evaluation:		70
				Total Marks:		100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Identify the problem, define objectives and scope of the project.
	CO2	Analyze the problem from state of the art for arriving at feasible solutions.
	CO3	Prepare an organized report employing elements of technical writing & critical thinking.
	CO4	Summarize and communicate the content to audience in an effective manner.

Contribution of Course Outcomes towards achievement of Program Outcomes(1-Low, 2-Medium, 3-High)

CO	PO												PSO			PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	BTL	
CO1	2	1					2	3	2		1	1		1	2	
CO2		3	2	2							2	2	2	2	4	
CO3						3	2	3	2	2	2	1	1	2	3	
CO4						1	2	2	3	3		2	1	1	2	

Course Content	Mini Project could be done in group of students; involves working under a faculty member and carrying out a detailed feasibility study, literature survey and preparing a work plan for major project

20MC6107A - INNOVATION, IPR AND ENTREPRENEURSHIP

Course Category:	Mandatory Course		Credits:	0
Course Type:	Theory		Lecture - Tutorial - Practice:	2-0-0
Prerequisites:	--		Continuous Evaluation:	100
			Semester end Evaluation:	
			Total Marks:	100

	Upon successful completion of the course, the student will have:
	CO1	Learn the innovation concepts related to business organizations.
	CO2	Understand the importance of innovation in new start-ups.
	CO3	Know fundamental aspects of Intellectual property Rights.
	CO4	Learn the basic concepts of entrepreneurship and its benefits.

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2- Medium, 3-High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1		1						2	2		2				2	
CO2		2						1	2		2				2	
CO3		2						2	3		3				2	
CO4		1						3	2		2				2	

Course Content	**UNIT – I Innovation Management: Introduction** Innovation: Definition, Importance – The need to view innovation in an organizational context – Different types of innovation - Innovation and Invention – Popular views of innovation – Innovation as a management process.
	UNIT – II Innovation: New Product Development (NPD) Innovation Management and New Product Development – Considerations when developing as NPD strategy - NPD as a strategy for growth – What is new product? – Classification of new products – NPD as an industry innovation cycle.
	UNIT – III – Intellectual Property Rights (IPR) Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development.
	UNIT – IV - Entrepreneurship Concept and need of entrepreneurship - Characteristics and Types of Entrepreneurship - Entrepreneurship as a career - Entrepreneurship as a style of Management - The changing role of the entrepreneur - Entrepreneurial traits, factors affecting entrepreneurs.

Text Books	[1] Paul Trott, Innovation Management and New Product Development, Pearson Education Limited, UK, 2017. [2] Nithyananda, K V., Intellectual Property Rights: Protection and Management, Cengage Learning India Private Limited, 2019. [3] Dr.S S Khanka, Entrepreneurial Development, S Chand, New Delhi, 2020.
Reference Books	[1] Managing innovation: Integrating Technological, Market and Organizational Change, Joe Tidd, John Besant, 2018. [2] Neeraj, P., &Khusdeep, D, Intellectual Property Rights. PHI learning Private Limited, India, 2019. [3] Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, India, 2022.
E-resources and other digital material	https://edisciplinas.usp.br/pluginfile.php/5553082/mod_folder/content/0/Trott%20-%202017%20-%20%20roz%20Innovation-Management-and-New-Product-Development.pdf?forcedownload=1

DEPARTMENT OF INFORMATION TECHNOLOGY

HONORS DEGREE

SCHEME OF INSTRUCTIONS & SYLLABUS

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

DEPARTMENT OF INFORMATION TECHNOLOGY

HONOR DEGREE IN INFORMATION TECHNOLGY

COURSES OFFERED UNDER HONOR DEGREE IN IT

COMMENCING FROM ACADEMIC YEAR 2021-2022

TRACK 1: AI & DATA SCIENCE

S.No	Course code	Course Name	Offered in Semester	L	T	P	Credits
1	20ITH48A01	Data Analytics	IV	4	0	0	4
2	20ITH58A02	Web and Text Mining	V	4	0	0	4
3	20ITH68A03	Social Network Anal;ysis	VI	4	0	0	4
4	20ITH78A04	Health Analytics	VII	4	0	0	4
(MOOCs - Self Learning)							
5	20ITH58A11	Advanced Data Science	V	-	-	-	2
6	20ITH78A12	Machine Learning Engineering for Production	VII	-	-	-	2

20ITH48A01–DATA ANALYTICS

Course Category:		Honors		Credits:	4
Course Type:		Theory		Lecture-Tutorial-Practice:	4-0-0
Prerequisites:				Continuous Evaluation:	30
				Semester end Evaluation:	70
				Total Marks:	100
Course Outcomes		Upon successful completion of the course, the student will be able to:			
	CO1	Understand the basics and Life cycle of Data Analytics			
	CO2	Apply probability and Sampling distributions for data modeling.			
	CO3	Develop forecasting and Monte Carlo simulation models			
	CO4	Solve linear optimization and Decision problems			

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2- Medium, 3-High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1	1	1											1		2	1.5.1, 2.1.2
CO2	2	2		1									1	1	3	1.5.1, 2.2.4, 4.1.2
CO3	1	2		1									2	1	3	1.5.1, 2.2.4, 4.1.2
CO4	2	2		2									2	1	3	1.5.1, 2.2.4, 4.1.2

Course Content	
	UNIT I:
	Introduction to Data Analytics
	Introduction to Big Data Analytics: Big Data Overview, Data Structures,Analyst perspective on Data Repositories,State of the PracticeinAnalytics, Current AnalyticalArchitecture, Emerging Big Data ecosystemandaNewApproach toAnalytics
	Data Analytic Life Cycle: Overview, phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6- Operationalize
	UNIT II:
	Descriptive Analytics
	Probability Distributions and Data Modeling: Basic concepts of probability, Random variables and probability distribution, Discrete Probability Distributions, Continuous Probability Distributions.
	Sampling and Estimation: Statistical Sampling, Estimating Population parameters, Sampling Error, Sampling Distributions, Interval Estimates, Confidence Intervals, Using confidence intervals for decision making, Prediction intervals, Confidence intervals and sample size
	UNIT III:
	Predictive Analytics
	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality,

	Selecting appropriate Time-Series-Based Forecasting models **Monte Carlo Simulation and Risk Analysis**: Spreadsheet Models with Random Variables, New-Product Development Model, Newsvendor Model
	UNIT IV: **Prescriptive Analytics** **Linear Optimization**: Building Linear Optimization Models **Applications of Linear Optimization**: Types of constraints in Optimization models, Process Selection Models, Blending Models, Portfolio Investment Models, Transportation Models **Decision Analysis:** Formulating Decision Problems, Decision Strategies without Outcome Probabilities, Decision Strategies with Outcome Probabilities, Decision trees, The value of information, Utility and decision making
Text books and Reference books	**Text Book(s):** [1]. EMC Education Services (Editor),"Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley, March 2015. [2]. James Evans, "Business Analytics, Second Edition, Pearson Publications, 2017. **Reference Books:** [1]. Hastie, Trevor, et al. "The elements of statistical learning." Vol. 2. No. 1. New York: springer, 2009 [2]. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010. [3]. SeemaAcharya R N Prasad, "Fundamentals of Business Analytics", 2nd Edition, Wiley Publications, 2016
E-resources and other digital material	[1]Ingo Mierswa, CTO & Co-Founder at RapidMiner, "From Predictive to Prescriptive Analytics", Jan 26, 2016 https://www.youtube.com/watch?v=lXdCnOQCCAE [2]Rahul, CEO, Treasury Consulting LLP, "Data Analytics - Descriptive , PredictiveandPrescriptiveAnalytics",Dec3,2018 https://www.youtube.com/watch?v=qYdNFqWHKQA

20ITH58A02 :WEB AND TEXT MINING

Course Category:	Honors		Credits:		4
Course Type:	Theory		Lecture-Tutorial-Practice:		4-0-0
Prerequisites:	---		Continuous Evaluation:		30
			Semester end Evaluation:		70
			Total Marks:		100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the fundamental concepts of text mining and web mining
	CO2	Apply various clustering approaches to web mining and text mining
	CO3	Apply various classification approaches to web mining and text mining
	CO4	Design a suitable clustering or classification approach for a given scenario

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1															2	
CO2	2	2											3	1	3	1.5.1, 2.1.2
CO3	2	2											3	1	3	1.5.1, 2.1.2
CO4	2	3											3	2	3	1.5.1, 2.1.2

Course Content	**UNIT I** **Introduction to web mining:** The Web Challenges,Web Search Engines, Topic Directories, Semantic Web, Web Mining, Web content mining, Web usage mining
	UNIT II **Information Retrieval and Web Search:** Crawling the Web, Indexing and keyword search, Document representation, Relevance Ranking, Vector space model (TF, IDF, TFIDF), Euclidian distance, cosine similarity, Relevance feedback, Advanced text search, Using the HTML structure in keyword search, Evaluating search quality, Similarity search
	UNIT III Hyperlink Based Ranking, Clustering approaches for web mining, Evaluating Clustering
	UNIT IV: **Classification approaches for Web Mining:** General setting and evaluatiion techniques, Nearest Neighbor, Feature Selection, Bayesian approaches, Numeric approaches, Relational Learning

Text books and Reference books	**Text Book(s):** [1]. Zdravko Markov and Daniel T. Larose. Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage, Wiley, 2007, ISBN: 978-0-471-66655-4. **Reference Books:** [1]. Ian H. Witten and Eibe Frank. Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Morgan Kaufmann, 2005, ISBN: 0-12-088407-0. [2]. T. Hastie, R. Tibshirani and J. Friedman, "Elements of Statistical Learning", Springer Series , 2nd edition
E-resources and other digital material	[1]Web mining by Dr. Zdravko Markov, Stanford University https://cs.ccsu.edu/~markov/ccsu_courses/WebMining.html [2]Text Mining Course by coursera https://www.coursera.org/learn/text-mining [3] Web Search and Mining by Soumen Chakrabarti https://www.cse.iitb.ac.in/~soumen/teach/2013.2A.CS635/ [4] Professor Carl Gustaf Jansson, KTH, Video Course on Machine Learning https://nptel.ac.in/noc/individual_course.php?id=noc19-cs35

20ITH68A03: SOCIAL NETWORK ANALYSIS

Course Category:	Honors		Credits:	4
CourseType:	Theory		Lecture-Tutorial-Practice:	4-0-0
Prerequisites:			ContinuousEvaluation:	30
			Semester	70
			Total Marks:	100

Course Outcomes	Upon successfulcompletion ofthe course, the student will be able to:	
	CO1	Understand the basic notation and terminology used in social network
	CO2	Analyze the structure and balance of the social network
	CO3	Derive the similarities of people in the society and find the communities in the society.
	CO4	Generate recommendations, social recommendations and evaluate recommendations.

Contribution of Course Outcomes towards achievementof Program Outcomes (1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1															2	
CO2	1		2	1									1	2	4	1.5.1, 3.2.2, 4.1.2
CO3	1	2	3	2		2							2	2	3	1.5.1, 2.1.2, 3.2.2, 4.1.2, 6.2.1
CO4	2	2	3	2		2							2	2	3	1.5.1, 2.1.2, 3.2.2, 4.1.2, 6.2.1

Course Content	**UNIT I:** **Overview:**Introduction to Social Network Analysis. **Graph Essentials:** Graph basic definitions, Paths and connectivity, Distance and Breadth-first search, Network Datasets. **Strong and Weak Ties :** Triadic closure, The strength of weak Ties, Tie strength and network structures in large scale data, tie strength, social media and passive engagement, closure, structural holes and social capital.

	UNIT II **Networks in Their Surrounding Contexts:** Homophily,Mechanisms Underlying Homophily: Selection and Social Influence,Affiliation. **Positive and Negative Relationships:** Structural Balance,Characterizing the Structure of Balanced Networks, Applications of Structural Balance.
	UNIT III: **Community analysis**: Community Detection, Node degree, Node Reachability, Social Communities, Community Detection Algorithms, Member Based Community Detection **Group Based Community Detection Algorithms:** Balanced Communities, Robust Communities, Modular Communities, Dense Communities and Hierarchical communities.
	UNITIV: **Recommendation in Social Media:** Recommendation System challenges, classical recommendation algorithms, Content-based methods, collaborative filtering, User-based collaborative filtering, item-based collaborative filtering,**Recommendation using social context:** Recommendation using social context alone, recommendation constrained by social context, Evaluating Recommendations.
Textbooks and Referencebooks	**Text Book(s):** [1]."Networks, Crowds, and Markets Reasoning about a Highly Connected World", David Easley, Cornell University, New York, Jon Kleinberg, Cornell University, New York, 2010. [2] Reza Zafarani, Mohammad Ali Abbasi , Huan Liu Social Media Mining: An Introduction **Reference Books:** [1]. Charu c. aggarwal "Social network data analytics" Springer [2] M. E. J. Newman Hardback "Networks: An Introduction by M. E. J. Newman, a college-level textbook about the science of networks.", Oxford University Press, 2010.
E-resources and Other digital materials	[1].Dr Bernie Hoganhttps://www.youtube.com/watch?v=2zhuj8ubinmSocial network analysis - Introduction to structural thinking:, University of Oxford, 2018. [2].S.R.S. Lyengarhttps://www.youtube.com/watch?v=b7Ug1h6EGNk "Introduction to Social Networks, 2017.

20ITH78A04 : HEALTH ANALYTICS

Course Category:	Honors		Credits:	4
Course Type:	Theory		Lecture-Tutorial-Practice:	4-0-0
Prerequisites:			Continuous Evaluation:	30
			Semester End Evaluation:	70
			Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO 1	Understand how data is organized to facilitate analysis in the healthcare setting.
	CO 2	Evaluate data from varying sources to create meaningful presentations.
	CO 3	Understand and select appropriate data visualization techniques to effectively communicate results.
	CO 4	Apply business intelligence techniques to solve specific business problems within the context of the rapidly changing healthcare environment.

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1															2	
CO2	3									2	2		1	2	4	1.5.1, 10.2.1, 11.3.1
CO3		3									2		2	1	2	2.1.2, 11.3.1
CO4				3							1		1	1	3	4.1.2, 11.3.1

Course Content	**UNIT I:** **Introduction:** Introduction to Health Care Data Analytics, Electronic Health Records (EHR)- Components of EHR, Coding Systems, Benefits of EHR, Barrier to adopting EHR, Challenges, Phenotyping Algorithms.
	UNIT II: **Image Analysis:** Biomedical Image Analysis, Mining of Sensor Data in Healthcare, Biomedical Signal Analysis, Genomic Data Analysis for Personalized Medicine. **Data Analytics:** Natural Language Processing and Data Mining for Clinical Text, Mining the Biomedical Social Media Analytics for Healthcare.
	UNIT III: **Advanced Data Analytics:** Advanced Data Analytics for Healthcare – Review of Clinical Prediction Models, Temporal Data Mining for Health-care Data, Visual Analytics for Health-care, Predictive 53 models for Integrating Clinical and Geonomic Data, Information Retrieval for Health-care, Data Publishing Methods in Healthcare.

	UNIT IV: **Applications:** Applications and Practical Systems for Healthcare – Data Analytics for Pervasive Health, Fraud Detection in Healthcare, Data Analytics for Pharmaceutical Discoveries, Clinical Decision Support Systems, Computer Assisted Medical Image Analysis Systems, Mobile Imaging and Analytics for Biomedical Data.

Text books and Reference books	**Text Book(s):**
	   d) Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis 2015.
	Reference Books:
	   [1]. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement" , Wiley, 2016.

E-resources and other digital material	*1.* *[1]. Prof. Doug Berman, Director, Data Acquisition and Architecture,* *2.* *University of California, Davis* https://www.coursera.org/learn/healthcare-data-models d) [2]. Dr. Rita Kukafka, Associate Professor, Columbia University **1.** **HI-FIVE: Health Informatics For Innovation, Value & Enrichment (Clinical** **2.** **Perspective)https://www.coursera.org/learn/hi-five-clinical** *2.* *[3]. Brian Paciotti, Healthcare Data Scientist, University of California, Davis* ***3.*** *Analytical Solutions to Common Healthcare Problems* https://www.coursera.org/learn/analytical-solutions-common-healthcare-problems#instructors

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE
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COURSES OFFERED UNDER HONOR DEGREE IN IT

COMMENCING FROM ACADEMIC YEAR 2021-2022

TRACK 2: CYBER SECURITY

S.No	Course Code	Title of the course	Offered in Semester	L	T	P	Credits
1	20ITH48B01	Data Privacy	IV	4	0	0	4
2	20ITH58B02	Blockchain Security and Performance	V	4	0	0	4
3	20ITH68B03	Cyber Physical Systems	VI	4	0	0	4
4	20ITH78B04	Data Analytics for Fraud Detection / Cloud Security	VII	4	0	0	4
MOOCs - SELF LEARNING COURSES							
1	20ITH58B11	Information Security and Cyber Forensics	V	-	-	-	2
2	20ITH78B12	Online privacy	VII	-	-	-	2

- MOOC courses must be of minimum 8/12 weeks in duration.

- Attendance will not be monitored for MOOC courses.

- Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 2 credits.

- If the MOOC course does not specify grade then, the grade will be assigned by the College Academic Council.

20ITH48B01: DATA PRIVACY

Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture-Tutorial-Practice:	4-0-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the need for sharing and protecting data
	CO2	Characterize basic rules and principles for protecting privacy and personal information.
	CO3	Design enhanced privacy protection methods by envisioning the basic attacks to happen.
	CO4	Formulate data that supports useful statistical inference while minimizing the disclosure of sensitive information

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, Medium-1, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1															2	
CO2		1													2	2.1.2
CO3			3										1	1	3	3.2.2
CO4		2	2										2		2	2.1.2, 3.2.2

Course Content	**UNIT I** **Data Privacy and its Importance**: Need for Sharing Data, Methods of Protecting Data, Importance of Balancing Data Privacy and Utility, Disclosure, Tabular Data, Micro data, Approaches to Statistical disclosure control, Ethics, principles, guidelines and regulations **Microdata** : Disclosure, Disclosure risk, Estimating re-identification risk, Non-Perturbative microdata masking, Perturbative microdata masking, Information loss in microdata
	UNIT II **Static Data Anonymization on Multidimensional Data**: Privacy Preserving Methods, Classification of Data in a Multidimensional Data Set **Static Data Anonymization on Complex Data Structures:** Privacy Preserving Graph Data, Privacy Preserving Time Series Data, Time Series Data Protection Methods, Privacy Preservation of Longitudinal Data, Privacy Preservation of Trans- action Data.
	UNIT III **Data Anonymization Threats**: Threats to Anonymized Data, Threats to Data Structures, Threats by Anonymization Techniques, Randomization, k- Anonymization, l-Diversity, t-Closeness. Dynamic Data Protection: Tokenization, Understanding Tokenization, Use Cases for Dynamic Data Protection, Benefits of Tokenization Compared to Other Methods, Components for Tokenization **Privacy Preserving Data Mining**: Key Functional Areas of Multidimensional Data for

	privacy preservation , Association Rule Mining, Clustering algorithms for privacy preservation
	UNIT IV **Privacy Preserving Test Data Generation**: Test Data Fundamentals, Utility of Test Data: Test Coverage, Privacy Preservation of Test Data,
Text books and Reference books	**Text Book(s):** 1.NatarajVenkataramanan, AshwinShriram, Data Privacy: Principles and Practice, Taylor Francis, 2016. (ISBN No.: 978-1-49-872104-2). 2.Anco Hundepool, Josep Domingo-Ferrer, Luisa Franconi, Sarah Giessing, Eric Schulte Nordholt, Keith Spicer, Peter-Paul de Wolf, Statistical Disclosure Control, Wiley, 2012. (ISBN No.: 978- 1-11-997815-2) Reference Books : 1. George T. Duncan. Mark Elliot, Juan-Jose Salazar-GonZalez, Statistical Confidentiality: Principle and Practice. Springer, 2011. (ISBN No.: 978-1-44-197801-1). 2. Aggarwal, Charu C., Yu, Philip S., Privacy-Preserving Data Mining : Models and Algorithms, Springer, 2010. (ISBN No.: 978-0-38-770991-8).
E-resources and other digital material	**[1]** Prof. PonnurangamKumaraguru **IIT Delhi** ,Privacy and Security in Online Social Media Jan 2021 https://onlinecourses.nptel.ac.in/noc21_cs28/preview [2] Giovanni Campagna, Rakesh Ramesh , December 2021,**Standford University** https://oval.cs.stanford.edu/ [3] BristenaOprisanu July 2018 https://www.turing.ac.uk/research/interest-groups/privacy-preserving-data-analysis

20ITH58B02 :BLOCKCHAIN SECURITY AND PERFORMANCE

Course Category:	Honors	Credits:		4
Course Type:	Theory	Lecture-Tutorial-Practice:		4-0-0
Prerequisites:	---	Continuous Evaluation:		30
		Semester end Evaluation:		70
		Total Marks:		100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the security and performance perspective of blockchain technology
	CO2	Apply security analysis and performance-enhancing techniques related to blockchain.
	CO3	Infer new approaches required for enhancing blockchain performance.
	CO4	Interpret the real-life applications of block chain technology and apply it to provide solutions to some real-life problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)

CO	PO												PSO		BTL	PI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO1								2							2	
CO2	1	1			2								1		3	1.5.1, 2.1.2, 5.2.1
CO3		1												1	2	3.2.2
CO4	2												3		3	1.5.1

Course Content	**UNIT I:** Security Issues: Blockchain Related Issues, Higher-Level Language (Solidity) Related Issues, EVM Bytecode Related Issues, Real-Life Attacks on Blockchain Applications/ Smart Contracts, Trusted Execution Environments
	UNIT II: Security Tools for Smart Contracts: Working, Advantages, And Disadvantages of Tools-Oyente, Securify, Maian, Manticore, Mythril, SmartCheck, Verx. Secure Key Management, Quantum Resilience Keys.
	UNIT III: Performance Related Issues: Transaction Speed, Transaction Fees, Network Size, Complexity, Interoperability Problems, Lack of Standardization. Lack of Supportive Regulations Related to Blockchain Applications
	UNIT IV: Performance Improvements: Off-Chain State Channels, Sidechains, Parallels Chains, Concurrent Smart Contract Transactions, Sharding Technique and Its Benefits, Atomic Swaps Between Smart Contracts.
Text books and Reference books	**Text Book(s):** Mastering Ethereum: Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O′Reilly Publisher
E-resources	[1] Prof. SandeepShuklaCSE, **IIT Kanpur** ,February 2020

and other digital material	,https://onlinecourses.nptel.ac.in/noc20_cs01/preview [2] Prof. SandipChakraborty, Department of Computer Science and Engineering, **IIT Kharagpur.** April 2018 http://www.infocobuild.com/education/audio-video-courses/computer-science/BlockchainArchitectureDesign-IIT-Kharagpur/lecture-02.html [3] Steven Pu ,Founder& CEO of Taraxa,**Stanford** Seminar - Practical Blockchain Applications May 2020https://www.youtube.com/watch?v=q6WEe4ws-pE