BACHELOR OF TECHNOLOGY IN

INFORMATION TECHNOLOGY

(As per National Education Policy 2020)

Scheme & Syllabus



G H RAISONI COLLEGE OF ENGINEERING AND MANAGEMENT

Department of Information Technology

Course Code	Name of Course	Course Category	Teaching Scheme				Credit	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-V													
23BTCSL301IT	Formal Languages and Automata	PCC6	3	-	-	3	3	10	15	50	-	-	75
23BTCSL304IT/ 23BTCSP304IT	Operating System	PCC7	3	-	2	5	4	10	15	50	25	25	125
23BTITL301CS/23 BTITP301CS	Computer Networks	PCC8	2	-	2	4	3	10	15	50	25		100
23BTITL311 / 23BTITP311 23BTITL312 / 23BTITP312 23BTITL313 / 23BTITP313	Program Elective Core1 1) Big Data Analytics 2) Artificial Neural Network 3)Unstructured Database Management	PEC1	3	-	2	5	**4**	10	15	50	25	-	100
23BTITL305 / 23BTITP305	Multi-DisciplinaryMinor : III (Backend programming)	MDM 3	3	-	2	5	**4**	10	15	50	25	-	100
23BTITL303	Open elective - III (Cyber Forensics)	OE III	2	-	-	2	**2**	10	15	50	-	-	75
23BTSHP301IT	Research Methodology	RM	-	-	4	4	**2**	-	-	-	25	-	25
TOTAL			**16**	-	**12**	**28**	**22**	**60**	**90**	**300**	**125**	**25**	**600**

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Course Title: **FORMAL LANGUAGES AND AUTOMATA**										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC6	3	-	-	3	10	15	50	-	-
Course Code	23BTCSL301IT									
Teaching Mode	Offline	3 Hrs			Total	75				
Duration of ESE	3 Hrs					75				

Course Objectives	To introduce the fundamental concepts of formal languages, grammars and automata theory.
	Classify machines by their power to recognize languages and use finite state machines to solve problems in computing.
	Use of Turing Machine and Pushdown Automata in Formal Language.
Course Outcomes	**CO1:** Understand the abstract machines and their power to recognize the valid Languages.
	CO2: Apply the knowledge of Automata Theory, Grammars & Regular Expressions for solving various problems
	CO3: Design context free grammars for formal languages.
	CO4: Analyze automata and their computational power to recognize languages.
	CO5: Solve the problems based on Turing Machine.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes:													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3		-	-	1	1		-	-	-	-	1	2	
CO2	-	3		3	2	2		-	-	-	-		3	3
CO3	-	3		3	2	-	-	-	-	-	-	1	3	3
CO4	-		3		2	1	-	-	-	-	-	-	3	
CO5	-		3		2	2	-	-	1	-	-	-	3	

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Course Contents:

Unit	Contents	Hours
I	Introduction Basic Mathematical Notation and techniques: Finite State systems Basic Definitions Finite Automaton DFA & NDFA Finite Automaton with €-moves, Regular Languages, Regular Expression Equivalence of NFA and DFA Equivalence of NDFA‟s with and without €-moves Equivalence of finite Automaton.	7
II	Regular Expressions: Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Properties of Regular Languages Pumping Lemma for Regular Languages, Applications of the Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages.	7
III	Context-Free Grammars: Chomsky hierarchy of languages. Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Forms, Parse Tress, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages.	7
IV	Push Down Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA‟s and CFG‟s, Deterministic Pushdown Automata.	7
V	Turing Machine: Definitions of Turing machines Models ,Computable languages and functions, Techniques for Turing machine construction, Multi head and Multi tape Turing Machines, The Halting problem.	7

Text Books	1.	Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
	2.	Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.
E--Books	1.	“Formal languages and automata theory” by K V N Sunitha; N Kalyani, Publisher: Chennai : Pearson, [2015] ©2015
Reference Books	1.	Introduction to Languages and The Theory of Computation, John C Martin, TMH.
	2	Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
	3	A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
	4.	Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.
Online TL Material	1.	NPTEL Course Formal Language and Automata, IIT Guwahati https://nptel.ac.in/courses/111/103/111103016/

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Course Title: **OPERATING SYSTEM**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC7	3	-	2	4	10	15	50	25	25
Course Code	23BTCSL304IT/ 23BTCSP304IT									
Teaching Mode	Offline	5 Hrs			Total	75			50	
Duration of ESE	3 Hrs					125				

Course Objectives	1. Introduces general idea, structure and functions of operating system
	2. Making students aware of basic mechanisms used to handle processes, memory, storage devices and files.
	Recent trends in the operating system
Course Outcomes	**CO1**: Understand basic structure and purpose of operating system.
	CO2: Interpret the concepts of process and illustrate various CPU scheduling algorithms.
	CO3: Apply the concepts of inter process communication.
	CO4: Schematize Deadlock & File System security mechanisms in operating systems.
	CO5: Analyze different memory management techniques with advantages and disadvantages.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	--	--	--	2	2	--	--	--	--	--	--	2	--
CO2	1	3	3	2	--	--	--	--	--	--	--	--	3	--
CO3	1	--	3	3	--	--	--	--	--	--	--	--	--	3
CO4	2	--	--	--	3	--	--	--	--	--	--	--	2	--
CO5	--	2	--	--	2	3	--	--	--	--	--	--	2	--

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Course Contents:

Unit	Contents	Hours
I	**Introduction About OS:** Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, system design and implementation.	7
II	**Process & Scheduling** Process concept, process control block, Types of scheduler- FCFS, SJF, LJF, Priority Scheduling, Round Robin, SRTF,LRTF, context switch, threads, multithreading model, goals of scheduling and different scheduling algorithms,	7
III	**Process management and synchronization**: Concurrency conditions, Critical section problem, software and hardware solution, semaphores, conditional critical regions and monitors, classical inter process communication problems	7
IV	**Deadlock & File System:** definitions, Prevention, Avoidance, detection and Recovery, Goals of Protection, access matrix, Deadlock implementation, File concept, Access methods space allocation strategies, disk arm scheduling strategies.	7
V	**Memory Management**: Contiguous allocation, Relocation, Paging, Segmentation, Segmentation with paging, demand paging, Virtual Memory Concepts, page faults and instruction restart, page replacement algorithms, working sets, Locality of reference, Thrashing, Garbage Collection.	7

Text Books	1.	Operating System concepts – Silberchatz; Galvin, Addison Wesley, 6thEdn.
	2.	Modern Operating Systems – Tanenbaum, Pearson Edn. 2nd edn
	3.	Operating Systems: Internals and Design Principles -- William Stallings
E--Books	1.	https://ebooks.lpude.in/computer_application/mca/term_1/DCAP403_OPERATING_SYSTEM.pdf
Reference Books	1.	Operating Systems – S R Sathe, Macmillan Publishers, India, 2008
	2.	Operating System –Milan Milenkovik, McGraw-Hill, 1987
	3.	Operating Systems - 3 rd Edition by Gary Nutt, Pearson Education.
On-line TL Material	1.	https://nptel.ac.in/courses/106/108/106108101/

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Sr. No	Name of Experiment	CO Mapping
1	Perform a case study by installing and exploring various types of operating systems on a physical or logical (virtual) machine. (Linux Installation).	**CO1**
2	Implement of different types of system calls.	**CO1**
3	Write a program to implement FCFS,SJF and priority based Algorithm.	**CO2**
4	Write a program to implement Round Robin Algorithm.	**CO2**
5	Write a program to implement Producer Consumer Problem.	**CO3**
6	Write a program to implement Dining-Philosophers Problem.	**CO3**
7	Write a program to implement Bankers algorithm.	**CO4**
8	Write a program to implement Page Replacement.	**CO4**
9	Write a program to implement Memory management algorithm.	**CO5**
10	Write a program to implement Disk Scheduling algorithms.	**CO5**
Open Ended Practical List		
11	Write C programs to simulate Intra & Inter – Process Communication (IPC) techniques: Pipes, Messages, Queues and Shared Memory.	
12	Write C program to Perform Shell Programming.	

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Course Title: **Computer Network**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC7	2	-	2	3	10	15	50	25	--
Course Code	23BTITL301CS/23BTITP301CS									
Teaching Mode	Offline	4 Hrs.			Total	75			25	
Duration of ESE	3 Hrs.					100				

Course Objectives	To understand the computer network architectures.
	To make aware of design and performance perspective of network architectures.
	To discuss current trends in communication
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Analyze the need for OSI reference model in computer networking
	CO2: Studying the various transmission medium used in physical layer
	CO3: Analyzing different Elementary protocols for communication and Identify IEEE standards employed in computer networking
	CO4: Solve and apply various Routing Algorithm and Protocols
	CO5: Use techniques involved in developing transport and application layer of computer networking.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	--	3	--	--	--	--	--	--	--	--	--	--	3	2	--
CO2	--	--	3	--	--	--	--	--	--	--	--	--	3	--	--
CO3	--	--	--	--	3	--	--	--	--	--	--	--	2	3	--
CO4	--	--	3	--	--	--	--	--	--	--	--	--	3	2	--
CO5	--	--		3	--	--	--	--	--	--	--	--	2	3	--

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Course Contents:

Unit	Contents	Hours
I	**Introduction** The use of computer networks. Network hardware. LAN's, Man's, WAN's,internet works, Network software, protocol hierarchies, design issues for layers, interfaces and services, Connectionless oriented and connectionless services, service primitives, relationship of Services to protocols, the OSI reference model, TCP/IP reference model, comparison of OSI and TCP/IP reference model	8
II	**Physical Layer:** The theoretical basis for data communication-Fourier analysis, bandwidth-limited signals, Maximum data rate of a channel, transmission media-magnetic media, and twisted pair coaxial Cable, fiber optics. Wireless transmission, microwave transmission. Multiplexing, switching, Narrow and ISDN - services, architecture, interface, perspective on N-ISDN, broadband ISDN & ATM- virtual circuits versus circuit switching, transmission in ATM networks, ATM Switches.	8
III	**Data Link Layer:** Design issues - services provided to the network Layer, framing, error control, flow control, Error correcting & detecting codes, elementary data link protocols, simplex stop and wait Simplex protocols for noisy channel, sliding window protocols-one bit protocol, go back Protocol, selective repeat protocol. The medium access sub layer - static and dynamic channel Allocation in LANs and MANs, Multiple access protocols - ALOHA. CSMA, collision free Protocols, limited contention protocols, IEEE 802.11 wireless LAN protocols, IEEE Standards 802 for LAN and MANs-802.3 & Ethernet, token bus. Token ring,	8
IV	**The Network Layer:** Design issues, services provided to the transport layer, internal organization, comparison of Virtual circuit and datagram subnets, routing algorithms. Optimality principle, shortest path Routing, flooding, flow-based routing, distance vector routing, link state routing, hierarchical Routing, broadcast & multicast routing, congestion control algorithms, general principles Prevention policies, traffic shaping. flow specifications, congestion control in virtual circuit Subnets. choke packets, load shedding, jitter control. IP protocol, IP address. Subnets, internet Control protocols, OSPF. BGP.	8
V	**Transport and Application Layer:** Transport and Application Layer - services provided to the upper layer, Quality of Service, Transport service primitives, elements of transport protocols, addressing, establishing a Connection, releasing a connection, flow control & buffering, multiplexing, crash recovery	8

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Text Books	1.	Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Fifth Edition, Pearson
	2.	Data Communication And Networking, Behrouz A. Forouzam, Fourth Edition, McGraw Hil
E-Books	1.	Fayez Gebali, Analysis of Computer and Communication Networks, First Edition, Springer
Reference Books	1.	Jean Walrand , Pravin Varaiya, High-Performance Communication Networks (The Morgan Kaufmann Series in Networking), Second Edition, Morgan Kaufmann Publishers
	2.	V.S.Bagad, I.A.Dhotre, Computer Communication Networks, Third Edition, Technical Publications, Illustrated
	3.	Norman Abramson, Franklin F. Kuo, Computer-communication networks, Fourth Edition, Prentice-Hall, 1973, Illustrated

List of Experiments:

Experiment No.	Title of Experiments	CO
1	Study of Networks and layered communications, understanding of Network equipment, wiring in details	CO1
2	Study of basic network command and Network configuration commands	CO1, CO2
3	Install and configure Network Devices: HUB, Switch and Routers.	CO2
4	Introduction to Packet Tracer, creating of a LAN and connectivity test in the LAN	CO3
5	Configure a Network topology using packet tracer software	CO3
6	Overview of IP Addressing and sub-net masking.	CO4
7	Study of Basic Router Configuration, Static Routing Implementation.	CO4
8	Observing Static and Dynamic Routing	CO4
9	Packet capture and header analysis by wire-shark (TCP,UDP,IP)	CO5
10	Configuring a Cisco Router as a DHCP Server	CO5
11	Configuring RIP	CO5

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Course Title: Big Data Analytics										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC1	3	--	2	4	10	15	50	25	-
Course Code	23BTITL311/ 23BTITP311									
Teaching Mode	Offline	5 Hrs			Total	75 Marks			25 Marks	
Duration of ESE	3 Hrs.					100 Marks				

Course Objectives	1. Introduction of basic concepts and techniques of Big data. 2. To Learn Hadoop Distributed File System (HDFS) & its applications 3. Understand MapReduce and its qualities and retain advanced MapReduce thoughts.
Course Outcomes	Upon successful completion of this course, student will be able to: **CO 1.** Acquire basic concepts and techniques of Hadoop and Big data computing. **CO 2**. Develop skills for implementation of various Hadoop ecosystem component. **CO 3.** Shall able to apply ecosystem knowledge to real time problems of moderate complexity. **CO 4.** Implement and Design different Big Data framework. **CO 5.** Implementing data science and big data analysis in various pplications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		2	3	-	3	-	-	-	-	-	-	-	-	2	2
CO2		2	3	-	3	-	-	-	-	-	-	-	-	3	2
CO3		3	3	-	3	-	-	-	-	-	-	-		2	3
CO4		3	3	-	3	-	-	-	-	-	-	-		3	3
CO5		3	3	-	3	-	-	-	-	-	-	-	-	3	2

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Course Contents:

Unit	Contents	Hours
I	**Unit I: Big data and Hadoop** Introduction to Hadoop and Big Data, Big data, challenges for processing big data, technologies support big data, History of Hadoop, Use cases of Hadoop, RDBMS vsHadoop When to use and when not to use Hadoop.	8
II	**Unit II: HDFS** Hadoop Distributed File System, Significance of HDFS in Hadoop, Features of HDFS,Data Storage in HDFS: Introduction about Blocks, Data replication. Accessing HDFS:CLI (Command Line Interface) and admin commands, Java Based Approach, Fault tolerance. Download Hadoop, Installation and set-up of Hadoop., Start-up & Shut down process	8
III	**Unit III: Map Reduce** Map Reduce: Map Reduce Story, Map Reduce Architecture, How Map Reduce works, Developing Map Reduce, Map Reduce Programming Model, Different phases of Map Reduce Algorithm, Different Data types in Map Reduce	8
IV	**Unit IV: Pig And HIVE** Introduction to Apache Pig, Map Reduce Vs. Apache Pig, Modes of Execution in Pig, Loading data, Exploring Pig Latin commands, HIVE: Hive introduction, Hive architecture, Data types and schemas, Partitions and buckets, Concept of HBASE.	8
V	**Unit V: Spark** Spark Shell, Spark Application, Flume, SQOOP introduction and application.	8

Text Books	1.	Tom White, "Hadoop: The Definitive Guide", 3rd edition, O'Reilly Media.
	2.	Big Data (Black Book), Wiley
E-Books	1.	BigData Now current perspective from O'Reilly Media
	2.	Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer
Reference Books	1.	V. Ankam, Big Data Analytics, Packt Pub Ltd.
	2.	N. Dasgupta, Practical Big Data Analytics, Packt Pub Ltd.
	3.	
on line TL Material	1.	https://www.udemy.com/big-data-hadoop-the-complete-course/
	2.	https://www.cloudera.com/more/training/certification.html
	3.	https://www.edureka.co/big-data-and-hadoop https://www.simplilearn.com/big-data-and-analytics/big-data-and-hadoop-training

List of Practical:

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Sr. No.	Name of the Experiments	Course Outcomes
1	To install Hadoop framework, configure it and setup a single node cluster. Use web based tools to monitor your Hadoop setup	CO1
2	To implement file management tasks in Hadoop HDFS like adding, retrieving and deleting files	CO1
3	To implement a word count application using the MapReduce API.	CO2
4	Creating the HDFS tables and loading them in Hive	CO2
5	To create HDFS tables and load them in Hive and implement joining of tables in Hive.	CO3
6	To install, deploy & configure Apache Spark Cluster. To Select the fields from the dataset using Spark SQL. To explore Spark shell and read from HDFS	CO3
7	To install and run Pig and then write Pig Latin scripts to sort, group, join, project, and filter your data.	CO4
8	To perform Graph analytics and visualization using Tableau.	CO4
9	To implement basic functions and commands in R Programming. better visualization than a data table.	CO5
10	To use following platforms for solving any big data analytic problem of your choice. (1) Amazon web services,(2) Microsoft Azure, (3)Google App engine	CO5

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Course Title: **Artificial Neural Network**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC1	3	-	2	4	10	15	50	25	-
Course Code	23BTITL312 / 23BTITP312									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	3 Hrs.					100				

Course Objectives	Provide a sound and comprehensive understanding of artificial neural networks
	Solve practical problems via implementation of these techniques via simulation;
	Promote further independent learning on the topics of artificial neural networks and machine learning;
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the basics of Artificial Neural Networks
	CO2: Identify different neural network architectures, algorithms, applications and their limitations
	CO3: Understand appropriate learning paradigms and its applications rules for each of the architectures and learn several neural network
	CO4: Develop different single layer/multiple layer Perception learning algorithms
	CO5: Reveal different applications of these models to solve engineering and other problems.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**											**3**		
CO2		**3**	**2**											
CO3			**3**	**2**										
CO4			**2**	**3**	**3**								**3**	**3**
CO5			**3**	**3**	**3**	**2**						**3**	**3**	**3**

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Course Contents:

Unit	Contents	Hours
I	Introduction to Artificial Neural Networks, Artificial Neuron Model and Linear Regression, Gradient Descent Algorithm, Nonlinear Activation Units and Learning Mechanisms, Learning Mechanisms-Hebbian,Competitive,Boltzmann	6
II	Associative Memory Model, Condition for Perfect Recall in Associative Memory, Statistical Aspects of Learning, V.C. Dimensions: Typical Examples Importance of V.C. Dimensions Structural Risk Minimization	6
III	Single-Layer Perceptions, Unconstrained Optimization: Gauss-Newton's Method, Linear Least Squares Filters, Least Mean Squares Algorithm, Perceptron Convergence Theorem, Bayes Classifier & Perceptron: An Analogy Bayes Classifier for Gaussian Distribution, Back Propagation Algorithm	8
IV	Solution of Non-Linearly Separable Problems Using MLP, Heuristics For Back-Propagation, Multi-Class Classification Using Multi-layered Perceptrons, Radial Basis Function Networks: Cover's Theorem, Regularization Networks and Generalized RBFComparison Between MLP and RBF, Learning Mechanisms in RBF	8
V	Introduction to Principal Components and Analysis, Dimensionality reduction Using PCA, Hebbian-Based Principal Component Analysis, Introduction to Self Organizing Maps, Cooperative and Adaptive Processes in SOM	8

Text Book	1.	Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications By S. Rajasekaran, G. A. Vijayalakshmi Pai. EEE
	2.	Simon O. Haykin, Neural Networks and Learning Machines, Pearson Education https://cours.etsmtl.ca/sys843/REFS/Books/ebook_Haykin09.pdf
E-Books	1.	Kevin Gurney, An Introduction to Artificial Neural Networks, UCL Press Ltd. https://www.inf.ed.ac.uk/teaching/courses/nlu/assets/reading/Gurney_et_al.pdf
	2.	Michael Nielsen, Neural Networks and Deep Learning https://static.latexstudio.net/article/2018/0912/neuralnetworksanddeeplearning.pdf
Reference Books	1.	Deep Learning, by Ian Goodfellow and Yoshua Bengio, The MIT Press, 2016.
	2.	C. Bishop, Neural Networks and Machine Learning, Springer, 1998.
Online Material:	1.	https://nptel.ac.in/courses/117/105/117105084/

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List of Practicals:

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Implement a single artificial neuron to perform linear regression. Train the neuron using gradient descent and visualize the loss reduction.
2	Implement gradient descent with different learning rates to minimize a quadratic loss function. Explore the behavior of nonlinear activation functions (ReLU, sigmoid, tanh) on a simple neural network.
3	Simulate Hebbian learning for a basic associative memory model. Implement a competitive learning algorithm to cluster data into distinct groups.
4	Create an associative memory model using Hopfield networks. Test conditions for perfect recall and analyze the stability of stored patterns.
5	Implement a single-layer perceptron for binary classification.
6	Implement the backpropagation algorithm for a multi-layer perceptron (MLP). Solve a non-linearly separable problem (e.g., XOR) and visualize the decision boundaries.
7	Implement a radial basis function (RBF) network to solve a classification problem.
8	Perform PCA on a high-dimensional dataset for dimensionality reduction.
9	Implement a self-organizing map to cluster a dataset (e.g., Iris or MNIST).
Open Ended Experiments / New Experiments	
10	Implement Bayes classifier for Gaussian-distributed data and visualize decision boundaries.
Details of on line Laboratory Resource Material Instruction / Operating Manuals	
1.	ANN Virtual Lab URL: https://cse22-iiith.vlabs.ac.in/List%20of%20experiments.html

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Course Title: **UNSTRUCTURED DATABASE MANAGEMENT**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC1	3	-	2	4	10	15	50	25	-
Course Code	23BTITL313 / 23BTITP313									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	3 Hrs					100				

Course Objectives	To explore the emergence, requirements and benefits of a NoSQL database
	To site principles behind the NoSQL databases, such as modern distributed database theory, P2P indexing or the Map Reduce programming model;
	To understand the basic architecture and data models of a NoSQL database (key-value stores, document databases, column-family stores, graph databases);
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: To Differentiate between a relational database and a non-relational (NoSQL) database
	CO2: To Perform CRUD operations (create, read, update and delete) on data in NoSQL environment
	CO3: To Define, compare and use the four types of NoSQL Databases (Document-oriented, Key Value Pairs, Column-oriented and Graph).
	CO4: To Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
	CO5: To implement the advanced unstructured database management techniques

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	--	--	3	1	--	--	--	--	3	2	--	2
CO2	2	--	3	--	3	1	--	--	--	--	3	2	--	1
CO3	2	--	--	3	3	1	--	--	--	--	3	2	--	2
CO4	2	--	3	--	3	1	--	--	--	--	3	2	--	2
CO5	2	--	3	--	3	1	--	--	--	--	3	2	--	2

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Course Contents:

Unit	Contents	Hours
I	Introduction: Overview, and History of NoSQL Databases Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points	6
II	Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases, Replication and sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication	8
III	NoSQL Key/Value databases using MongoDB, Document Databases, What Is a Document Database? Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.	8
IV	Column- oriented NoSQL databases using Apache HBASE, Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, What Is a Column-Family Data Store? Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage, When Not to Use, Introduction to Bigdata and hadoop	6
V	NoSQL Key/Value databases using Riak, Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets, Any case study.	8

Text Books	1.	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence , Author: Sadalage, P. & Fowler, Publication: Pearson Education
	2.	Shashank Tiwari. Professional NoSQL. John Wiley and Sons. ISBN: 978-0-470-94224-6.
	3	Peter Membrey, David How, Eelco Plugge, MongoDB Basics, Apress, 2014
	4	Shakuntala Gupta, Edward Sabharwal, Practical Mongo DB, Apress, 2015
	5	Jean Isson, Unstructured Data Analytics, Wiley, 2018
	6	Ben Smith, Beginning JSON, Apress,2015
E-Books	1.	Managing Multimedia and Unstructured Data in the Oracle Database: A revolutionary approach by Marcelle Kratochvil

		https://www.pdfdrive.com/managing-multimedia-and-unstructured-data-in-the-oracle-database-a-revolutionary-approach-to-understanding-managing- and-delivering-digital-objects-assets-and-all-types-of-data-e185839907.html

Reference Books	1.	Name: Redmond, E. &Wilson, Author: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement Edition: 1st Edition.
On line TL Material	1.	https://nptel.ac.in/courses/106/104/106104189/

Sr. No.	**Name of Practical (The practical's are divided into tools: MongoDB and Cassandra.)**
1	Installation and setup of MongoDB client and server
2	Create a database and collection using MongoDB environment. For example a document collection meant for analyzing Restaurant records can have fields like restaurant_id, restaurant_name, customer_name, locality, date, cuisine, grade, comments. etc. Create database using INSERT, UPDATE, UPSERTS, DELETE and INDEX. Practice writing simple MongoDB queries such as displaying all the records, display selected records with conditions
3	Experiment with MongoDB comparison and logical query operators - $gt, $gte, $lt, $lte, $in, #nin, $ne, $and, $or, $not
4	Practice exercise on element, array based and evaluation query operators -$exists, $type, $mod, $regex
5	Exercise on MongoDB shell commands and user management
6	Installation and configuration of Cassandra. Find out two use cases where Cassandra is preferred over MongoDB
7	Create database in Casandra using – Create, Alter and Drop. Add records using Inset, Update, Delete and Truncate.
8	Exercise based on Cassandra Query Language i.e. selecting records, select records with specific conditions
9	Mini-project

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Course Title: **BACKEND PROGRAMMING**										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MDM3	3	-	2	4	10	15	50	25	-
Course Code	23BTITL305									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	3 Hrs.					100				

Course Objectives	To gain the knowledge of both Python and Java allows you to work on a wide range of platforms and projects, from web applications and services to enterprise solutions
	To develop skills that are in high demand across various industries.
	To get hand on in Python and Java, as well as in frameworks like Django, Flask, and Spring, can significantly enhance your prospects in the software development field.
Course Outcomes	**CO1**: Understand Python's syntax and essential programming constructs, enabling the creation of basic scripts and applications.
	CO2: Implement Python syntax and control structures to create basic programs and develop simple web applications using Django and Flask
	CO3: Analyze Python libraries like Pandas and NumPy for effective data analysis, preparing for data-driven backend development
	CO4: Design and implement robust backend services with Spring, using dependency injection and the MVC pattern for structured web development
	CO5: Create a sample enterprise application using Java EE components and architecture

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO2	3	-	2	-	3	-	-	-	-	-	-	-	2	2
CO3	3	-	3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	3	-	3	-	-	-	2	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	-	2	2

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Course Contents:

Unit	Contents	Hours
I	Introduction to Backend Development: Overview of Backend Development: Importance, roles, and responsibilities of a backend developer. Introduction to Python and Java: History, strengths, and environments. Setting up Development Environment: Tools and IDEs for Python (PyCharm, Jupyter) and Java (Eclipse, IntelliJ IDEA).	5
II	Python for Backend Development: Python Basics: Syntax, data types, and control structures. Introduction to Django: Architecture and components, Building a simple web application. Introduction to Flask: Minimalist applications with Flask, Routing and templates	5
III	Advanced Python Frameworks and Applications: FastAPI, Building APIs with asynchronous support. Data Analysis with Python: Using libraries like Pandas and NumPy. Artificial Intelligence with Python: Overview of libraries like TensorFlow and PyTorch.	6
IV	Java for Backend Development: Java Basics: Syntax, data types, object-oriented programming. Introduction to Spring Framework: Dependency injection, MVC pattern, Building RESTful services with Spring Boot	5
V	Enterprise Applications with Java EE: Overview of Java EE components and architecture, Creating a sample enterprise application	4

Text Books	1.	Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming 2nd Edition by Eric Matthes
	2.	Java Programming,– 20 March 2018, by Joyce Farrell
Reference Books	1.	Spring in Action 5th Edition, by Craig Walls
	2.	Fluent Python: Clear, Concise, and Effective Programming 1st Edition, by Luciano Ramalho
Online TL Material	1.	https://www.udemy.com/course/software-developer-masterclass/?srsltid=AfmBOorZq6za5vyNF9wltGRxt3mNPjalquvxjJxjm5SvqtxBhcKRJobN&couponCode=BFCPSALE24
	2	https://www.udemy.com/course/fundamentals-of-backend-communications-and-protocols/?srsltid=AfmBOorLf6yYFeMvGu4quuUKbBs1qO7Mw7xzPEFHrkICQJBnZev9l0P7&couponCode=BFCPSALE24

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Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	Write and Execute a Python Script for Basic Data Operations	CO1
2	Develop a Simple Web Application Using Django	CO1
3	Design a Personal Blog Using Flask	CO2
4	Implement RESTful APIs with FastAPI for a Bookstore Application	CO2
5	Write Python Scripts for Data Analysis Using Pandas	CO3
6	Design a Basic Neural Network Using TensorFlow for Image Classification	CO3
7	Develop a Java Application Setup Environment Using IntelliJ IDEA	CO4
8	Design and Develop a Simple MVC Application with Spring Boot	CO4
9	Write and Deploy a Java EE Application for Employee Management	CO5
10	Develop a Capstone Project: End-to-End Backend System Using Chosen Technologies	CO5
	Open Ended Experiments / New Experiments	
1	Integrating Machine Learning Models into Backend Systems for Personalized Recommendations	
2	Optimizing Database Queries for a Social Media Application's Backend	

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Course Title: CYBER FORENSICS (OE-III)										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	OE3	2	-	-	2	10	15	50	-	-
Course Code	23BTITL303									
Teaching Mode	Offline	2 Hrs			**Total**	75				
Duration of ESE	3 Hrs					75				

Course Objectives	To introduce the fundamental concepts of cybercrime, cyber forensics, and digital evidence which are obtained from digital media.
	To learn and understand threats, risks and defensive techniques against cyber-attacks and cybercrime.
Course Outcomes	**CO1:** To understand fundamentals of Cyber Forensics.
	CO2: Prepare documents for the Forensics investigation.
	CO3: Analyze and validate the forensics data.
	CO4: To compare and work with different tools and techniques associated with Cyber Forensics.
	CO5: Solve digital media related cyber forensic problems.

Course Contents:

Unit	Contents	Hours
I	**Introduction of Cybercrime**: Basics of cyber forensics, types of Cybercrime, cyber forensics investigation processes, digital evidence, challenges in cyber forensics, skills required for cyber forensics expert, The Internet spawns crime: Warn Vs. Viruses, Computers' roles in crimes, Introduction to digital forensics, Introduction to Incident - Incident Response Methodology –Steps - Activities in Initial Response, Phase after detection of an incident.	6
II	**Initial Response and forensic duplication**: Initial Response & Volatile Data Collection from Windows system -Initial Response & Volatile Data Collection from Unix system – Forensic Duplication: Forensic duplication: Forensic Duplicates as Admissible Evidence, Forensic Duplication Tool	6

	Requirements, Creating a Forensic. Duplicate/Qualified Forensic Duplicate of a Hard Drive.	
III	**Forensics analysis and validation:** Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, performing remote acquisitions. Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project.	8
IV	**Current Forensic tools:** evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software.	6
V	**Cell phone and mobile device forensics:** Understanding mobile device forensics, understanding acquisition procedures for cell phones and mobile devices. **E-Mail Investigations:** Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.	6

Text Books	1.	Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGraw Hill, 2006.
	2.	Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
Reference Books	1	Computer Forensics and Investigations by Nelson, Phillips Enfinger, Steuart, CENGAGE Learning
	2	Real Digital Forensics by Keith J. Jones, Richard Bejtiich, Curtis W. Rose, Addison- Wesley Pearson Education
	3	Forensic Compiling, A Tractitioneris Guide by Tony Sammes and Brian Jenkinson, Springer International edition.

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Course Title: Research Methodology										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Odd	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	RM	-.	-	4	2	-	-	-	25	-
Course Code	23BTSHL301/ 23BTSHP301									
Teaching Mode	Offline	4 Hrs			Total	-			25	
Duration of ESE	-					25				

Course Objectives	1. To understand the role of research methodology in Engineering.
	2. To understand data collection methods and basic instrumentation.
	3. To learn various statistical tools for data analysis.
	4. To develop the ability to apply statistical tools and techniques.
	5. To provide knowledge on sampling design.
Course Outcomes	CO1: Understand the role of research methodology in Engineering
	CO2: Apply appropriate techniques for data collection
	CO3: Analyze collected data using editing, classification, coding, and quantitative methods
	CO4: Apply statistical methods for data analysis
	CO5: Evaluate sampling designs and apply suitable sampling techniques

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		3		3											
CO2		3		3	1										
CO3		3	3	3	2										
CO4				3	1										
CO5		3		3							2				

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Course Contents:

Unit	Contents	Hours
I	**Introduction to Research**: Definition of research, Characteristics of research, Types of research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Overview of research methodology in various areas, Introduction to problem solving, basic research terminology such as proof, hypothesis, lemma etc., Role of Information and Communication Technology(ICT) in research.	6
II	**Data Collection:** Primary Data: Meaning, Importance & limitations.,, Observation , Questionnaire, Interview, Interview Scheduled Social Survey, Case Study Secondary Data: Meaning, Importance& limitations. Sources Secondary Data.	6
III	**Data Analysis And Use Of Quantitative Method**: Editing, Classification and Coding. Categorization, Tabulation, Tables, Graphs, Illustrations. Use of quantitative method in research.	6
IV	**Data Analysis And Use Of Statistical Method:** Statistical Techniques: Measures of Central tendency, Dispersion, Skewness, Kurtosis & Moments, Correlation, Regression. Theory of Attributes & Association, chi squareTest & Distribution.	6
V	**Sampling Design:** Census and sample survey, Characteristics of good sample design, Implications of sample design, Sampling Techniques, Probability or random sampling, Non-probability sampling	6

Text Books	1	Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications Ltd., 2011.
	2	C.R. Kothari ,"Research Methodology: Methods and Trends", New Age International,2004
	3	Gupta S.C, Fundamentals of Statistics, Himalaya Publication House, Bombay Rajaram V. (1996),
E--Books	1	Wayoc C. Booth : The Craft of Research
	2	David Willinson : Research Tools Kits : A Complete Guide to Practitioner Research
Reference Books	1	Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction" JUTA and Company Ltd, 2004.
on line TL Material	1	http:// www.shodhaganga.inflibnet.ac.in
	2	http:// www.inflibnet.ac.in.
	3	http:// www.zotero.org

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List of Practicals

Sr. No.	Name of Experiments / Mini Projects/ Case Studies (Any 8)
1	Report writing explaining importance of research.(CO1)
2	To collect data using two different methods. (CO2)
3	Performing literature review, identifying gaps (CO3)
4	Design simple sampling method for survey(CO3)
5	Raw data coding and classification(CO3)
6	Formulation of hypothesis based on collected data (CO3)
7	Using bar graphs, pie charts for interpreting findings(CO4)
8	Project proposal that includes problem identification.(CO5)
9	Ethical consideration in research methodology.(CO5)