



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF CSE - DATA SCIENCE**

**COURSE STRUCTURE AND SYLLABUS**

**For UG – R20**

**B. Tech - COMPUTER SCIENCE AND ENGINEERING with Specialization**  
**DATA SCIENCE**

*(Applicable for batches admitted from 2020-2021)*



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<b>IV B. Tech –I Semester (Tentative)</b>						
S.No	Course Code	Course Title	Hours per week			Credits
			L	T	P	C
1	PE	<b>Professional Elective-III</b> 1. Reinforcement Learning 2. Nature Inspired Computing Techniques 3. Social Media Analytics 4. Block Chain Technologies	3	0	0	3
2	PE	<b>Professional Elective-IV</b> 1. SnowFlake Cloud Analytics 2. Cloud Computing 3. Information Retrieval Systems 4. NOSQL Databases	3	0	0	3
3	PE	<b>Professional Elective-V</b> 1. Social Network Analysis 2. Recommender Systems 3. AI Chatbots 4. Data Visualization	3	0	0	3
4	Open Elective /Job Oriented	<b>Open Elective-III</b> Open Electives offered by other departments/ API and Microservices (Job Oriented Course)	3	0	0	3
5	Open Elective /Job Oriented	<b>Open Elective-IV</b> Open Electives offered by other departments/ Secure Coding Techniques (Job Oriented Course)	3	0	0	3
6	HS	Universal Human Values 2: Understanding Harmony	3	0	0	3
7	SO	1. Machine Learning with Go (Infosys Spring Board) <b>OR</b> 2. MEAN Stack Technologies-Module II- Angular JS and MongoDB	0	0	4	2
8	PR	<b>Industrial/Research Internship 2 months (Mandatory) after third year (to be evaluated during VII semester)</b>	0	0	0	3
<b>Total credits</b>						<b>23</b>
9	Minor	Data Wrangling in Data Science <sup>\$</sup>	4	0	0	4
<b>Minor courses through SWAYAM</b>						<b>2</b>

\$- Integrated Course



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IV B. Tech –II Semester						
S.No	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1	Project	Major Project Work, Seminar Internship	-	-	-	12
<b>Total credits</b>						<b>12</b>

**SUGGESTED COURSES FOR MINOR ENGINEERING IN B.TECH. CSE- DS**

**Note:**

1. TWO, NPTEL courses of EIGHT week duration covering a total of 4 credits (offered by CSE Department only), Student can register at any time after the completion of II B.Tech. I Sem.

**Eligibility for Minor in CSE-DS:-**

S.No.	Subject Title	Credits
1	Fundamentals of Data Science	4
2	Data Warehousing and Data Mining	4
3	Data Science Applications	4
4	Data Wrangling in Data Science	4
5	MOOCS Courses **	4
	1. Cloud Computing (NPTEL) ( <a href="https://nptel.ac.in/courses/106105167">https://nptel.ac.in/courses/106105167</a> )	
	2. Scalable Data Science (NPTEL) ( <a href="https://nptel.ac.in/courses/106105186">https://nptel.ac.in/courses/106105186</a> )	
	3. Distributed Systems (NPTEL) ( <a href="https://nptel.ac.in/courses/106106168">https://nptel.ac.in/courses/106106168</a> )	
	4. Big Data Computing (NPTEL) ( <a href="https://nptel.ac.in/courses/106104189">https://nptel.ac.in/courses/106104189</a> )	
<b>Total</b>		<b>20</b>

**\*\*Choose 02 MOOCS courses @ 2credits each from SWAYAM/NPTEL**



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Reinforcement Learning (Professional Elective-III)</b>					

**Course Objective:**

- Learn various approaches to solve decision problems with functional models and algorithms for task formulation, Tabular based solutions, Function approximation solutions, policy gradients and model based reinforcement learning.

**Course Outcomes:**

By completing the course the students will be able to:

- Understand basic concepts of Reinforcement learning
- Identifying appropriate learning tasks for Reinforcement learning techniques
- Understand various methods and applications of reinforcement learning

**UNIT I:**

**Introduction:** Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe

**Multi-armed Bandits:** A k-armed Bandit Problem, Action-value methods, The 10-armed Testbed, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper – Confidence-Bound Action Selection, Gradient Bandit Algorithm

**UNIT II:**

**Finite Markov Decision Process:** The Agent-Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions,

**Dynamic Programming:** Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming

**UNIT III:**

**Monte Carlo Methods:** Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Discontinuing-aware Importance Sampling, Per-decision Importance Sampling

**n-step Bootstrapping:** n-step TD Prediction, n-step Sarsa, n-step Off-policy Learning, Per-decision methods with Control Variables, A Unifying Algorithm: n-step Q( $\sigma$ )

**UNIT IV:**

**Off-policy Methods with Approximation:** Semi-gradient Methods, Examples of Off-policy Divergence, The Deadly Triad, Linear Value-function Geometry, Gradient Descent in the Bellman Error, The Bellman Error is not Learnable, Gradient-TD methods, Emphatic-TD methods, Reducing Variance

**Eligibility Traces:** The  $\lambda$ -return, TD( $\lambda$ ), n-step Truncated  $\lambda$ -return methods, Online  $\lambda$  –return Algorithm, True Online TD( $\lambda$ ), Dutch Traces in Monte Carlo Learning, Sarsa( $\lambda$ ), Variable  $\lambda$  and  $\gamma$ , Off-policy Traces with Control Variables, Watkins’s Q( $\lambda$ ) to Tree-Backup( $\lambda$ )

**UNIT V:**

**Policy Gradient Methods:** Policy Approximation and its Advantages, The Policy Gradient Theorem, REINFORCE: Monte Carlo Policy Gradient, REINFORCE with Baseline, Actor-Critic Methods, Policy Gradient for Continuing Problems, Policy Parameterization for Continuous Actions



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**Applications and Case Studies:** TD-Gammon, Samuel's Checkers Player, Watson's Daily Double Wagering, Optimizing Memory Control, Personalized Web Services

**Text Books:**

1. R. S. Sutton and A. G. Bart., "Reinforcement Learning - An Introduction," MIT Press, 2018.

**References:**

1. Szepesvári, Csaba, "Algorithms for Reinforcement Learning," United States: Morgan & Claypool, 2010.
2. Puterman, Martin L., "Markov Decision Processes: Discrete Stochastic Dynamic Programming," Germany: Wiley, 2014.

**Web References:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_cs74/preview](https://onlinecourses.nptel.ac.in/noc20_cs74/preview)
2. <https://www.coursera.org/learn/fundamentals-of-reinforcement-learning>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Nature Inspired Computing Techniques (Professional Elective-III)</b>					

**Course Objective:**

- Learn the theoretical foundations of Nature Inspired Computing techniques, how they can be used to solve problems, and in which areas are most useful and effective.

**Course Outcomes:**

By completing the course the students will be able to:

- Understand the strengths, weaknesses and appropriateness of nature-inspired algorithms.
- Apply nature-inspired algorithms to optimization, design and learning problems.

**UNIT I :**

**Analysis of Algorithms:** Analysis of Optimization Algorithms, Nature Inspired Algorithms, Parameter Tuning and Parameter Control: Parameter Tuning, Hyper optimization, Multi objective View, Parameter Control, Simulated Annealing: Algorithm, Basic Convergence Properties, Stochastic Tunneling

**UNIT II:**

**Genetic Algorithms:** Introduction, Role of Genetic Operators, Choice of Parameters, GA Variants, **Differential Evolution:** Introduction, Differential Evolution, Variants, Choice of Parameters, Convergence Analysis, **Particle Swarm Optimization:** Swarm Intelligence, PSO Algorithm, Accelerated PSO, Binary PSO

**UNIT III:**

**Firefly Algorithms:** Firefly Behavior, Standard Firefly Algorithm Variations of Light Intensity and Attractiveness, Controlling Randomization, Firefly Algorithms in Applications  
**Cuckoo Search:** Cuckoo Breeding Behavior, Levy Flights, Cuckoo Search: Special Cases of Cuckoo Search, Variants of Cuckoo Search, Global Convergence, Applications

**UNIT IV**

**Bat Algorithms:** Echolocation of Bats: Behavior of Microbats, Acoustics of Echolocation, Bat Algorithms: Movement of Virtual Bats, Loudness and Pulse Emission, Binary Bat Algorithm, Variants of the Bat Algorithm, Convergence Analysis, Applications: Continuous Optimization, Combinatorial Optimization and Scheduling, Inverse Problems and Parameter Estimation, Classifications, Clustering and Data Mining, Image Processing, Fuzzy Logic and Other Applications

**UNIT V:**

**Flower Pollination Algorithms:** Introduction, Characteristics of Flower Pollination, Flower Pollination Algorithms, Multi-Objective Flower Pollination Algorithms, Validation and Numerical Experiments: Single-Objective Test Functions, Multi-Objective Test Functions, Applications: Single-Objective Design Benchmarks, Multi-Objective Design Benchmarks

**Text Books:**

1. “Nature-Inspired Optimization Algorithms”, Yang, Xin-She, Elsevier Science, 2014.

**References:**



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3. “Nature-Inspired Computing and Optimization: Theory and Applications,” Germany: Springer International Publishing, 2017.



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Social Media Analytics (Professional Elective-III)</b>					

**Course Objective:**

- Understand and deal with any social media network, strategy, or campaign.

**Course Outcomes:**

By completing the course the students will be able to:

- Understand social media categories and types of social media analytics
- Understand the impact of social media analytics integration with and affects other areas of business.

**UNIT I :**

**Introduction:** Foundation for Analytics, Evolution of Data and the Digital Gap, Social Media Data Sources: Offline and Online, Definition of Social Media, Data Sources in Social Media Channels, Estimated vs. Factual Data Sources, Public and Private Data, Data Gathering in Social Media Analytics, Social Media Network Support of Data Collection, API: Application Programming Interface, Web Crawling or Scraping,

**UNIT II:**

**From Data to Insights:** Example of a Single Metric Giving Actionable Insight, An Example of a Metric Leading to New Questions, Creating a Plan to Shape Data into Insights, The Planning Stage: Projecting Possible Insights, Analysis of a Social Media Post, The process of Comparison, Data Aggregation, Calculations and Display, Data Display, Social Media and Big Data, Potential Challenges

**UNIT III:**

**Analytics in Social Media:** Types of Analytics in Social Media, Analytics or Channel Analytics, Social Media Listening: Keyword and Mention-Based Analysis, Demographics, Interests and Sentiment, Advertising Analytics: Focus on Conversions and ROI of Paid Social Media Campaigns, Conversions: The Key to Digital and Social Advertising, CMS Analytics: Measuring the Performance of the Content Management Team, CRM Analytics: Customer Support and Sales via Social Media

**UNIT IV:**

**Dedicated vs. Hybrid Tools :** Common to all Tools, Dedicated Tools, Advantages of Dedicated Tools, Disadvantages of Dedicated tools, Hybrid Tools, Dedicated Tools with Hybrid Features, Advantages of Hybrid Tools, Disadvantages of Hybrid Tools, Data Integration Tools, Advantages of Data Integration Tools, Disadvantages of Data Integration Tools.

**UNIT V:**

**Social Network Landscape:** Concept and UX on Social Networks, Features and Their Strategic Value, Interactivity: How Social is the Network, Content Flow on Social Network

**The Analytics Process:** Analysis is Comparison, Investigation beyond Social Analytics, Shaping a Method: The End Game for an Analyst, The Analysis Circle, Dynamic Cycles, The Analyst Mindset: Making the Right Questions and Running the Right Experiments

**Text Books:**

1. Alex Goncalves, “Social Media Analytics Strategy-Using Data to Optimize Business Performance,” Apress, 2017.

**References:**





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1. Qiu, Liangfei., Kumar, Subodha, “Social Media Analytics and Practical Applications: The Change to the Competition Landscape,” United States: CRC Press, 2021.
2. Sponder, Marshall, “Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics,” United Kingdom: McGraw-Hill Education, 2011.

**Web References:**

1. <https://www.coursera.org/learn/social-media-analytics-introduction>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Block Chain Technologies (Professional Elective-III)</b>					

**Course Objectives:**

To understand block chain technology and Cryptocurrency works

**Course Outcomes:**

After the completion of the course, student will be able to

- Demonstrate the block chain basics, Crypto currency
- To compare and contrast the use of different private vs. public block chain and use cases
- Design an innovative Bit coin Block chain and scripts, Block chain Science on varies coins
- Classify Permission Block chain and use cases – Hyper ledger, Corda
- Make Use of Block-chain in E-Governance, Land Registration, Medical Information Systems and others

**UNIT I:**

**Introduction:** Introduction, basic ideas behind block chain, how it is changing the landscape of digitalization, introduction to cryptographic concepts required, Block chain or distributed trust, Currency, Cryptocurrency, How a Cryptocurrency works, Financial services, Bitcoin prediction markets.

**UNIT II:**

Hashing, public key cryptosystems, private vs public block chain and use cases, HashPuzzles, Extensibility of Block chain concepts, Digital Identity verification, Block chain Neutrality, Digital art, Block chain Environment

**UNIT III:**

**Introduction to Bitcoin :** Bitcoin Block chain and scripts, Use cases of BitcoinBlockchain scripting language in micropayment, escrow etc Downside of Bit coin mining, Block chain Science: Grid coin, Folding coin, Block chain Genomics, Bit coin MOOCs.

**UNIT IV:**

Ethereum continued, IOTA, The real need for mining, consensus, Byzantine Generals Problem, and Consensus as a distributed coordination problem, Coming to private or permissioned block chains, Introduction to Hyper ledger, Currency, Token, Campus coin, Coin drop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency

**UNIT V:**

Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations, Uses of Block chain in E-Governance, Land Registration, Medical Information Systems.

**Text Books:**

1. Blockchain Blue print for Economy by Melanie Swan

**Reference Books:**

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st Edition, by Daniel Drescher



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>SnowFlake Cloud Analytics (Professional Elective-IV)</b>					

**Course Objectives:**

The main objective of the course is to master data warehousing on cloud using Snowflake

**Course Outcomes:**

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

- load & transform data in Snowflake
- scale virtual warehouses for performance and concurrency
- share data and work with semi-structured data
- gain a thorough knowledge of query constructs, DDL & DML operations, managing and monitoring Snowflake accounts and Snowflake's continuous data protection methods.

**UNIT I:**

Snowflake Architecture - Unlocking Business Value, Business Agility Is More Important Than Ever, All Hail the Cloud! , Snowflake Architecture, Database Storage, Micro Partitions, Benefit of Micro Partitioning, Data Clustering, Virtual Warehouses, Caching, Result Cache, Local Disk Cache (Text Book 1)

Getting Started with Cloud Analytics - Key Cloud Computing Concepts (Text Book 2)

Getting Started with Snowflake – Planning, Deciding on a Snowflake Edition, Choosing a Cloud Provider and Region, Examining Snowflake's Pricing Model, Other Pricing Considerations, Examining Types of Snowflake Tools, Creating a Snowflake Account, Connecting to Snowflake (Text Book 2)

**UNIT II:**

Building a Virtual Warehouse - Overview of Snowflake Virtual Warehouses, Warehouse Sizes and Features, Multicluster Virtual Warehouses, Virtual Warehouse Considerations, Building a Snowflake Virtual Warehouse

(Text Book 2)

Getting Started with SnowSQL - Installing SnowSQL, Configuring SnowSQL, SnowSQL Commands, Multiple Connection Names (Text Book 2)

**UNIT III:**

Data Movement – Stages, External Stages, External Tables and Data Lakes, Internal Stages (Text Book 1)

Loading Bulk Data into Snowflake - Overview of Bulk Data Loading, Bulk Data Loading Recommendations, Bulk Loading with the Snowflake Web Interface, Data Loading with SnowSQL (Text Book 2)

Continuous Data Loading with Snowpipe - Loading Data Continuously, Snowpipe Auto-Ingest, Building a Data Pipeline Using the Snowpipe Auto-Ingest Option (Text Book 2)

**UNIT IV:**

Snowflake Administration - Administering Roles and Users, Administering Resource Consumption, Administering Databases and Warehouses, Administering Account Parameters, Administering Database Objects, Administering Data Shares, Administering Clustered Tables, Snowflake Materialized Views (Text



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Book 2)

Snowflake Security Overview – Snowflake security reference architecture, Network and site access, Account and user authentication, Object security, Data security, Security validations, Snowflake Audit and Logging(Text Book 2)

Business Continuity and Disaster Recovery - Regions and Availability Zones, Data Replication, Failover, and Failback, Business Continuity Process Flow, Bringing It All Together (Text Book 1)

**Unit V:**

Working with Semistructured Data- Supported File Formats, Advanced Data Types, Working with XML, Working with JSON, Working with AVRO, Working with Parquet (Text Book 2)

Secure Data Sharing - Secure Data Sharing, Secure Table Sharing, Data Sharing Using a Secure View (Text Book 2)

Time Travel (pr book 2) (Text Book 2)

Advanced Performance Tuning - Designing Tables for High Performance, Designing High-Performance Queries Optimizing Queries, Optimizing Warehouse Utilization, Monitoring Resources and Account Usage Resource Monitors (Text Book 1)

**Text Books:**

1. Mastering Snowflake Solution Supporting Analytics and Data Sharing, Apress
2. Jumpstart Snowflake A Step-by-Step Guide to modern cloud analytics, Apress

**Reference Books:**

1. Snowflake Essentials Getting Started with Big Data in the Cloud, Apress
2. Snowflake Cookbook: Techniques for building modern cloud data warehousing solutions
3. Snowflake: The Definitive Guide Architecting, Designing, and Deploying on the Snowflake Data Cloud – ORIELLY
4. <https://docs.snowflake.com/en/>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Cloud Computing (Professional Elective-IV)</b>					

**Course Objectives:**

- To explain the evolving computer model caned cloud computing.
- To introduce the various levels of services that can be achieved by cloud.
- To describe the security aspects in cloud.
- To motivate students to do programming and experiment with the various cloud computing environments.

**Course Outcomes:** At the end of the course, student will be able to

- Illustrate the key dimensions of the challenge of Cloud Computing
- Classify the Levels of Virtualization and mechanism of tools.
- Analyze Cloud infrastructure including Google Cloud and Amazon Cloud.
- Create Combinatorial Auctions for cloud resource and design scheduling algorithms for computing cloud
- Assess control storage systems and cloud security, the risks involved its impact and develop cloud application

**UNITI:**

**Systems Modeling, Clustering and Virtualization:** Scalable Computing over the Internet-The Age of Internet Computing, Scalable computing over the internet, Technologies for Network Based Systems, System models for Distributed and Cloud Computing, , Performance, Security and Energy Efficiency

**UNITII:**

**Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structures/ Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

**UNITIII:**

**Cloud Platform Architecture:** Cloud Computing and Service Models, Public Cloud Platforms, Service Oriented Architecture, Programming on Amazon AWS and Microsoft Azure

**UNIT IV:**

**Cloud Resource Management and Scheduling:** Policies and Mechanisms for Resource Management, Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds-Fair Queuing, Start Time Fair Queuing.

**UNITV:**

**Storage Systems:** Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system.

**Text Books:**

1. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.



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**Reference Books:**

1. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madisetti, University Press
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
3. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Information Retrieval Systems (Professional Elective-IV)</b>					

**Course Objectives:**

- To provide the foundation knowledge in information retrieval.
- To equip students with sound skills to solve computational search problems.
- To appreciate how to evaluate search engines.
- To appreciate the different applications of information retrieval techniques in the Internet or Web environment.
- To provide hands-on experience in building search engines and/or hands-on experience in evaluating search engines.

**Course Outcomes:**

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

- Identify basic theories in information retrieval systems
- Classify the analysis tools as they apply to information retrieval systems.
- Illustrate the problems solved in current IR systems.
- Discuss the advantages of current IR systems
- Summarize the difficulty of representing and retrieving documents.
- Translate the latest technologies for linking, describing and searching the web

**UNIT-I:**

**Introduction to Information Storage and Retrieval System:** Introduction, Domain Analysis of IR systems and other types of Information Systems, IR System Evaluation. Introduction to Data Structures and Algorithms related to Information Retrieval: Basic Concepts, Data structures, Algorithms

**UNIT-II:**

**Inverted Files:** Introduction, Structures used in Inverted Files, Building Inverted file using a sorted array, Modifications to Basic Techniques.

**UNIT-III:**

**Signature Files:** Introduction, Concepts of Signature Files, Compression, Vertical Partitioning, Horizontal Partitioning.

**UNIT-IV:**

**New Indices for Text:** PAT Trees and PAT Arrays: Introduction, PAT Tree structure, algorithms on the PAT Trees, Building PAT trees as PATRICA Trees, PAT representation as arrays.

**UNIT-V:**

**Stemming Algorithms:** Introduction, Types of Stemming Algorithms, Experimental Evaluations of Stemming to Compress Inverted Files

**Thesaurus Construction:** Introduction, Features of Thesauri, Thesaurus Construction, Thesaurus construction from Texts, Merging existing Thesauri

**Text Books:**

1. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992.



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2. Modern Information Retrieval by Yates Pearson Education.
3. Information Storage & Retrieval by Robert Korfhage – John Wiley & Sons.

**Reference Books:**

1. Kowalski, Gerald, Mark T Maybury: Information Retrieval Systems: Theory and Implementation, Kluwer Academic Press, 1997.
2. Information retrieval Algorithms and Heuristics, 2ed, Springer





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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>NOSQL Databases (Professional Elective-IV)</b>					

**Course Objective:** The student will be able to

- Define, compare and use the four types of NoSQL Databases (Document-oriented, Key-Value Pairs, Column-oriented and Graph).
- Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
- Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.

**Course Outcomes:** At the end of the course, student will be able to

- Discuss about Aggregate Data Models
- Explain about Master-Slave Replication, Peer-to-Peer Replication
- Describe the Structure of Data, Scaling, Suitable Use Cases
- Make use of Complex Transactions Spanning Different Operations
- Identify Routing, Dispatch and Location-Based Services

**UNIT I:**

Why NoSQL, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate-Oriented Databases. More Details on Data Models; Relationships, Graph Databases, Schema less Databases, Materialized Views, Modelling for Data Access,

**UNIT II:**

**Distribution Models:** Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication. Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums. Version Stamps, Business and System Transactions, Version Stamps on Multiple Nodes

**UNIT III:**

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, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets.

**UNIT IV:**

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, Ecommerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure

**UNIT V:**

Graph Databases, What Is a Graph Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch and Location-Based Services,



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Recommendation Engines, When Not to Use

**Text Books:**

1. Sadalage, P. & Fowler, No SQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addison Wesley, 2012

**Reference Books:**

1. Dan Sullivan, "NoSQLFor Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN13: 978-9332557338)
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022)
3. Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O'Reilly Publications, 2013. (ISBN-13: 978-9351102694)



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Social Network Analysis (Professional Elective-V)</b>					

**Course Objectives:**

- Formalize different types of entities and relationships as nodes and edges and represent this information as relational data
- Plan and execute network analytical computations
- Use advanced network analysis software to generate visualizations and perform empirical investigation of network data
- Interpret and synthesize the meaning of the results with respect to a question, goal or task
- Collect network data in different ways and from different sources while adhering to legal standards and ethics standards

**Course Outcomes:**

After completing the course students should:

- Know basic notation and terminology used in network science
- Be able to visualize, summarize and compare networks
- Illustrate basic principles behind network analysis algorithms
- Develop practical skills of network analysis in R programming language
- Be capable of analyzing real world networks

**UNIT I:**

Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily.

**UNIT II:**

Random graph models: Random graphs and alternative models, Models of network growth, Navigation in social Networks, Cohesive subgroups, Multidimensional Scaling, Structural equivalence, roles and positions.

**UNIT III:**

Network topology and diffusion, Contagion in Networks, Complex contagion, Percolation and information, Navigation in Networks Revisited.

**UNIT IV:**

Small world experiments, small world models, origins of small world, Heavy tails, Small Diameter, Clustering of connectivity, The Erdos Renyi Model, Clustering Models.

**UNIT V:**

Network structure - Important vertices and page rank algorithm, towards rational dynamics in networks, basics of game theory, Coloring and consensus, biased voting, network formation games, network structure and equilibrium, behavioral experiments, Spatial and agent-based models.

**Text Books:**

1. S. Wasserman and K. Faust. "Social Network Analysis: Methods and Applications", Cambridge University Press.
2. D. Easley and J. Kleinberg, "Networks, Crowds and Markets: Reasoning about a highly connected world", C



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Cambridge University Press, 1<sup>st</sup> edition, 2010

**Reference Books:**

1. Maarten van Steen. "Graph Theory and Complex Networks. An Introduction", 2010.
2. Reza Zafarani, Mohammed Ali Abbasi, Huan Liu. "Social Media Mining: An Introduction". Cambridge University Press 2014.
3. Maksim Tsvetovat and Alexander Kouznetsov. "Social Network Analysis for Startups". O'Reilly Media, 2011.

**e-Resources:**

- 1) <https://www.classcentral.com/course/edx-social-network-analysis-sna-9134>
- 2) <https://www.coursera.org/learn/social-network-analysis>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Recommender Systems (Professional Elective-V)</b>					

**Course Objective:**

To develop state-of-the-art recommender systems that automates a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations

**Course Outcomes:**

By completing the course the students will be able to:

- Understand the basic concepts of recommender systems
- Carry out performance evaluation of recommender systems based on various metrics
- Implement machine-learning and data-mining algorithms in recommender systems data sets.
- Design and implement a simple recommender system.

**UNIT I :**

An Introduction to Recommender Systems: Goals of Recommender Systems, Basic Models of Recommender Systems, Collaborative Filtering Models, Content-Based Recommender Systems, Knowledge-Based Recommender Systems, Domain-Specific Challenges in Recommender Systems, Advanced Topics and Applications.

**UNIT II:**

Neighborhood-Based Collaborative Filtering: Key Properties of Ratings Matrices, Predicting Ratings with Neighborhood-Based Methods, Clustering and Neighborhood-Based Methods, Dimensionality Reduction and Neighborhood Methods, A Regression Modeling View of Neighborhood Methods, Graph Models for Neighborhood-Based Methods

**UNIT III:**

Model-Based Collaborative Filtering: Decision and Regression Trees, Rule-Based Collaborative Filtering, Naïve Bayes Collaborative Filtering, Latent Factor Models, Integrating Factorization and Neighborhood Models

**UNIT IV:**

Content-Based Recommender Systems: Basic Components of Content-Based Systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations

Knowledge-Based Recommender Systems: Constraint-Based Recommender Systems, Case-Based Recommenders, Persistent Personalization in Knowledge-Based Systems.

**UNIT V:**

Evaluating Recommender Systems: Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures

**Text Books:**

1. Charu .C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.



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**Reference Books:**

4. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed.
5. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1<sup>st</sup> ed.
6. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1<sup>st</sup> ed.
7. J. Leskovec, A. Rajaraman and J. Ullman, Mining of massive datasets, 2<sup>nd</sup> Ed., Cambridge, 2012



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>AI Chatbots (Professional Elective-V)</b>					

**Course Objectives:**

- Learn how artificial intelligence powers chatbots, get an overview of the bot ecosystem and bot anatomy, and study different types of bots and use cases.
- Identify best practices for defining a chatbot use case, and use a rapid prototyping framework to develop a use case for a personalized chatbot.

**Course Outcomes:**

- Develop an in-depth understanding of conversation design, including onboarding, flows, utterances, entities, and personality.
- Design, build, test, and iterate a fully-functional, interactive chatbot using a commercial platform.
- Deploy the finished chatbot for public use and interaction.

**UNIT I:**

Introduction: Benefits from Chatbots for a Business, A Customer-Centric Approach in Financial Services, Chatbots in the Insurance Industry, Conversational Chatbot Landscape, Identifying the Sources of Data: Chatbot Conversations, Training Chatbots for Conversations, Personal Data in Chatbots, Introduction to the General Data Protection Regulation (GDPR)

**UNIT II:**

Chatbot Development Essentials: Customer Service-Centric Chatbots, Chatbot Development Approaches, Rules-Based Approach, AI-Based Approach, Conversational Flow, Key Terms in Chatbots, Utterance, Intent, Entity, Channel, Human Takeover, Use Case: 24x7 Insurance Agent

**UNIT III:**

Building a Chatbot Solution: Business Considerations, Chatbots Vs Apps, Growth of Messenger Applications, Direct Contact Vs Chat, Business Benefits of Chatbots, Success Metrics, Customer Satisfaction Index, Completion Rate, Bounce Rate, Managing Risks in Chatbots Service, Generic Solution Architecture for Private Chatbots

**UNIT IV:**

Natural Language Processing, Understanding, and Generation: Chatbot Architecture, Popular Open Source NLP and NLU Tools, Natural Language Processing, Natural Language Understanding, Natural Language Generation, Applications.

**UNIT V:**

Introduction to Microsoft Bot, RASA, and Google Dialog flow: Microsoft Bot Framework, Introduction to QnA Maker, Introduction to LUIS, Introduction to RASA, RASA Core, RASA NLU, Introduction to Dialog flow  
 Chatbot Integration Mechanism: Integration with Third-Party APIs, Connecting to an Enterprise Data Store, Integration Module

**Text Books:**



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1. Abhishek Singh, KarthikRamasubramanian, ShreyShivam, “Building an Enterprise Chatbot: Work with Protected Enterprise Data Using Open Source Frameworks”, ISBN 978-1-4842-5034-1, Apress,2019

**Reference Books:**

1. Janarthanam and Srinu, Hands-on chatbots and conversational UI development: Build chatbots and voice user interfaces with C (1 ed.), Packt Publishing Ltd, 2017. ISBN 978-1788294669.
2. Galitsky, Boris., Developing Enterprise Chatbots (1 ed.), Springer International Publishing, 2019. ISBN 978-303004298
3. Kelly III, John E. and Steve Hamm, Smart machines: IBM's Watson and the era of cognitive computing (1 ed.), Columbia University Press, 2013. ISBN 978- 0231168564.
4. Abhishek Singh, KarthikRamasubramanian and ShreyShivam, Building an Enterprise Chatbot (1 ed.), Springer, 2019. ISBN 978-1484250334.





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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Data Visualization (Professional Elective-V)</b>					

**Course Outcomes:**

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

- Understand basics of Data Visualization
- Implement visualization of distributions
- Write programs on visualization of time series, proportions & associations
- Apply visualization on Trends and uncertainty
- Explain principles of proportions

**UNIT I:**

**INTRODUCTION TO VISUALIZATION:** Visualizing Data-Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes- Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales-Color as a Tool to Distinguish, Color to Represent Data Values, Color as a Tool to Highlight, Directory of Visualizations- Amounts, Distributions, Proportions, x–y relationships, Geospatial Data

**UNIT II:**

**VISUALIZING DISTRIBUTIONS:** Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heatmaps, Visualizing Distributions: Histograms and Density Plots- Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time, Visualizing Distributions: Empirical Cumulative Distribution Functions and Q-Q Plots-Empirical Cumulative Distribution Functions, Highly Skewed Distributions, Quantile Plots, Visualizing Many Distributions at Once-Visualizing Distributions Along the Vertical Axis, Visualizing Distributions Along the Horizontal Axis

**UNIT III:**

**VISUALIZING ASSOCIATIONS & TIME SERIES:** Visualizing Proportions-A Case for Pie Charts, A Case for Side-by-Side Bars, A Case for Stacked Bars and Stacked Densities, Visualizing Proportions Separately as Parts of the Total ,Visualizing Nested Proportions- Nested Proportions Gone Wrong, Mosaic Plots and Treemaps, Nested Pies ,Parallel Sets. Visualizing Associations Among Two or More Quantitative Variables-Scatterplots, Correlograms, Dimension Reduction, Paired Data. Visualizing Time Series and Other Functions of an Independent Variable-Individual Time Series , Multiple Time Series and Dose–Response Curves, Time Series of Two or More Response Variables

**UNIT IV:**

**VISUALIZING UNCERTIANITY:** Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition, Visualizing Geospatial Data-Projections, Layers, Choropleth Mapping, Cartograms, Visualizing Uncertainty-Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots

**UNIT V:**

**PRINCIPLE OF PROPORTIONAL INK:** The Principle of Proportional Ink-Visualizations Along Linear Axes, Visualizations Along Logarithmic Axes, Direct Area Visualizations, Handling Overlapping Points-Partial Transparency and Jittering, 2D Histograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information ,Using Nonmonotonic Color Scales to Encode Data Values, Not



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Designing for Color-Vision Deficiency

**Text Books:**

1. Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 1st edition, O’Reilly Media Inc, 2019.
2. OssamaEmbarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Apress, 2018

**Reference Books:**

1. Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization, O’Reilly, 2016



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>API and Microservices (Job Oriented Course)</b>					

**Course Outcomes:**

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

- Develop a Spring Data JPA application with Spring Boot
- Implement CRUD operations using Spring Data JPA
- Implement pagination and sorting mechanism using Spring Data JPA
- Implement query methods for querying the database using Spring Data JPA
- Implement a custom repository to customize a querying mechanism using Spring Data JPA
- Understand update operation using query approaches in Spring Data JPA
- Implement Spring Transaction using Spring Data JPA
- Develop RESTful endpoints using Spring REST Processing URI parameters
- Write RESTful services using Spring REST that consumes and produces data in different formats
- Handle exceptions and errors in Spring REST endpoints
- Write Spring based REST clients to consume RESTful services programmatically
- Create secure RESTful endpoints using Spring Security Document and version the Spring REST endpoints Implement CORS in a Spring REST application

**UNIT I:**

**Spring 5 Basics :** Why Spring, What is Spring Framework, Spring Framework - Modules, Configuring IoC container using Java-based configuration, Introduction To Dependency Injection, Constructor Injection, Setter Injection, What is AutoScanning

**UNIT II:**

**Spring Boot:** Creating a Spring Boot Application, Spring Boot Application Annotation, What is Autowiring , Scope of a bean, Logger, Introduction to Spring AOP, Implementing AOP advices, Best Practices : Spring Boot Application

**UNIT III:**

**Spring Data JPA with Boot:** Limitations of JDBC API, Why Spring Data JPA, Spring Data JPA with Spring Boot, Spring Data JPA Configuration, Pagination and Sorting, Query Approaches, Named Queries and Query, Why Spring Transaction, Spring Declarative Transaction, Update Operation in Spring Data JPA, Custom Repository Implementation, Best Practices - Spring Data JPA

**UNIT IV:**

**Web Services:** Why Web services, SOA - Service Oriented Architecture, What are Web Services, Types of Web Services, SOAP based Web Services, RESTful Web Services, How to create RESTful Services

**UNIT V:**

**Spring REST:** Spring REST - An Introduction, Creating a Spring REST Controller, @RequestBody and ResponseEntity, Parameter Injection, Usage of @PathVariable, @RequestParam and @MatrixVariable, Exception Handling, Data Validation, Creating a REST Client, Versioning a Spring REST endpoint, Enabling CORS in Spring REST, Securing Spring REST endpoints

**Hardware and software configuration**



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- 4 or 8 GB RAM/126 GB ROM
- Swagger tool suite(opensource)
- OpenJDK 17 or Java 11,Maven 3.2 or above and MySQL 8.0 or above, Spring Tool suite, Postman

**Text Books:**

1. Spring in action, 5th Edition, Author: Craig Walls, Ryan Breidenbach, Manning books

**Web Links [Courses mapped to Infosys Springboard platform]:**

**Infosys Springboard courses:**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01296689056211763272\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01296689056211763272_shared/overview) [Spring 5 Basics with Spring Boot]
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_4313461831752789500\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_4313461831752789500_shared/overview) [Spring Data JPA with Boot]
3. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012731900963905536190\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012731900963905536190_shared/overview) [Spring REST]

**Web references:**

1. <a href="#">Dependency Injection in spring - javatpoint</a>
2. <a href="#">Autowiring in Spring - javatpoint</a>
3. <a href="https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-springbootapplication-annotation.html">https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-springbootapplication-annotation.html</a>
4. <a href="#">Autowiring in Spring - javatpoint</a> , <a href="https://www.baeldung.com/spring-bean-scopes">https://www.baeldung.com/spring-bean-scopes</a>
5. <a href="#">Spring Boot Logging   How does logging works in spring boot with example (educba.com)</a>
6. <a href="#">Spring AOP Tutorial   Aspect Oriented Programming - javatpoint</a>
7. <a href="#">Spring Boot Best Practices (javaguides.net)</a>
8. <a href="#">Introduction to Spring Data JPA   SpringHow</a>
9. <a href="https://asbnotebook.com/spring-data-jpa-crud-example/">https://asbnotebook.com/spring-data-jpa-crud-example/</a> , <a href="https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/">https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/</a>
10. <a href="#">Pagination and Sorting using Spring Data JPA - PagingAndSortingRepository (javaguides.net)</a>
11. <a href="https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html">https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html</a> , <a href="https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html">https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html</a>
12. <a href="https://javadeveloperzone.com/spring/spring-declarative-transaction-management/">https://javadeveloperzone.com/spring/spring-declarative-transaction-management/</a>
13. <a href="https://javadeveloperzone.com/spring/spring-declarative-transaction-management/">https://javadeveloperzone.com/spring/spring-declarative-transaction-management/</a>
14. <a href="https://javabeat.net/spring-data-custom-repository/">https://javabeat.net/spring-data-custom-repository/</a>
15. <a href="https://www.jrebel.com/blog/jpa-application-performance-best-practices">https://www.jrebel.com/blog/jpa-application-performance-best-practices</a>
16. <a href="https://www.javatpoint.com/service-oriented-architecture">https://www.javatpoint.com/service-oriented-architecture</a> , <a href="https://www.javatpoint.com/web-services-tutorial">https://www.javatpoint.com/web-services-tutorial</a>
17. <a href="https://www.javatpoint.com/soap-web-services">https://www.javatpoint.com/soap-web-services</a> , <a href="https://www.javatpoint.com/restful-web-services">https://www.javatpoint.com/restful-web-services</a>
18. <a href="#">RESTful Web Services - javatpoint</a>
19. <a href="https://www.javatpoint.com/restful-web-services-spring-boot">https://www.javatpoint.com/restful-web-services-spring-boot</a>
20. <a href="https://www.javatpoint.com/restful-web-services-spring-boothttps://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spri">https://www.javatpoint.com/restful-web-services-spring-boothttps://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spri</a>



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21. <a href="https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful">https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful</a>
22. <a href="https://www.baeldung.com/exception-handling-for-rest-with-spring">https://www.baeldung.com/exception-handling-for-rest-with-spring</a>
23. <a href="https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/">https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/</a>
24. <a href="https://www.javatpoint.com/restful-web-services-versioning">https://www.javatpoint.com/restful-web-services-versioning</a>
25. <a href="https://spring.io/guides/gs/rest-service-cors/">https://spring.io/guides/gs/rest-service-cors/</a>
26. <a href="https://www.javatpoint.com/restful-web-services-basic-authentication-with-spring-security">https://www.javatpoint.com/restful-web-services-basic-authentication-with-spring-security</a>
27. <a href="https://www.springboottutorial.com/rest-api-best-practices-with-java-and-spring">https://www.springboottutorial.com/rest-api-best-practices-with-java-and-spring</a>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Secure Coding Techniques (Job Oriented Course)</b>					

**Course Outcomes:**

At the end of the Course, student will be able to:

- Differentiate the objectives of information security
- Understand the trend, reasons and impact of the recent Cyber attacks
- Understand OWASP design principles while designing a web application
- Understand Threat modelling
- Importance of security in all phases of SDLC
- Write secure coding using some of the practices in C/C++/Java and Python programming languages

**UNIT I:**

**Network and Information security Fundamentals:** Network Basics, Network Components, Network Types, Network Communication Types, Introduction to Networking Models, Cyber Security Objectives and Services, Other Terms of Cyber Security, Myths Around Cyber Security, Myths Around Cyber Security, Recent Cyber Attacks, Generic Conclusion about Attacks, Why and What is Cyber Security, Categories of Attack

**UNIT II:**

**Introduction to Cyber security:** Introduction to OWASP Top 10, A1 Injection, A1 Injection Risks Root Causes and its Mitigation, A1 Injection, A2 Broken Authentication and Session Management, A7 Cross Site Scripting XSS, A3 Sensitive Data Exposure, A5 Broken Access Control, A4 XML External Entity (XEE), A6 Security Misconfiguration, A7 Missing Function Level Access Control, A8 Cross Site Request Forgery CSRF, A8 Insecure Deserialization, A9 Using Components With Known Vulnerabilities, A10 Unvalidated Redirects and Forwards, A10 Insufficient Logging and Monitoring, Secure Coding Practices, Secure Design Principles, Threat Modelling, Microsoft SDL Tool

**UNIT III:**

**Secure coding practices and OWASP Top 10:** Declarative Security, Programmatic Security, Concurrency, Configuration, Cryptography, Input and Output Sanitization, Error Handling, Input Validation, Logging and auditing, Session Management, Exception Management, Safe APIs, Type Safety, Memory Management, Tokenizing, Sandboxing, Static and dynamic testing, vulnerability scanning and penetration testing

**UNIT IV**

**Secure coding practices in C/C++ and Java:** Potential Software Risks in C/C++, Defensive coding, Preventative Planning, Clean Code, Iterative Design, Assertions, Pre Post Conditions, Low level design inspections, Unit Tests

Java- Managing Denial of Service, Securing Information, Data Integrity, Accessibility and Extensibility, Securing Objects, Serialization Security

**UNIT V**

**Secure coding in Python:** Interactive Python Scripting, Python Variables, Conditionals, Loops, Functions, External Modules, File operations, Web requests





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**Text Books:**

1. Networking Fundamentals, 2019 edition, Packt, Author: Gordon Davies
2. Principles of Information Security, Authors: Michael E. Whitman and Herbert J. Mattord, Course technology incorp.
3. CSSLP SECURE SOFTWARE LIFECYCLE PROFESSIONAL ALL-IN-ONE EXAM GUIDE, Third Edition, 3rd Edition, Authors: Wm. Arthur Conklin, Daniel Paul Shoemaker, Released February 2022, Publisher(s): McGraw-Hill, ISBN: 9781264258215
4. OCP Oracle Certified Professional Java SE 11 Programmer II Study Guide: Exam 1Z0-816 and Exam 1Z0-817 Paperback – 6 August 2020, Authors: Scott Selikoff , Jeanne Boyarsky
5. OWASP 2017 Handbook,  
[https://owasp.org/www-pdf-archive/OWASP\\_Top\\_10\\_2017\\_RC2\\_Final.pdf](https://owasp.org/www-pdf-archive/OWASP_Top_10_2017_RC2_Final.pdf)

**Web Links:**

**Infosys Springboard courses**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012683751296065536354\\_shared/content](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012683751296065536354_shared/content) [Network Fundamentals]
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_3388902307073574000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_3388902307073574000_shared/overview) [Introduction to cybersecurity]
3. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_0135015696571596809160](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_0135015696571596809160) [Certified Secure Software Lifecycle Professional (CSSLP) 2019: Secure Coding Practices]
4. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_0135015689927557129660](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_0135015689927557129660) [OWASP Top 10: Web Application Security]
5. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_01350159304097792013093](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01350159304097792013093) [Defensive coding fundamentals in C and C++]
6. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_01350159172969267213125](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01350159172969267213125) [Java SE 11 Programmer II: Secure Coding in Java SE 11 Applications]
7. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01350158164493107211192/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01350158164493107211192/overview) [Security Programming: Python Scripting Essentials]

**Web references:**

1. <https://www.stealthlabs.com/blog/infographic-top-15-cybersecurity-myths-vs-reality/>
2. <https://microage.ca/cybersecurity-layering-approach/>
3. <https://www.synopsys.com/glossary/what-is-threat-modeling.html#:~:text=Threat%20modeling%20is%20a%20structured,An%20abstraction%20of%20the%20system>
4. <https://www.microsoft.com/en-us/securityengineering/sdl/threatmodeling>
5. <https://www.checkpoint.com/cyber-hub/threat-prevention/what-is-sandboxing/>
6. <https://www.skillsoft.com/course/defensive-coding-fundamentals-for-cc-f44c02f9-1bcc-11e7-b15b-0242c0a80b07#:~:text=Defensive%20Programming%20is%20a%20methodology,%2C%20testing%2C%20and%20input%20validation.>
7. <https://www.oracle.com/java/technologies/javase/seccodeguide.html>
8. <https://www.skillsoft.com/course/security-programming-python-scripting-essentials-be99adad-1f65-47a8-a4b5-6b5346072b8e>



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**DEPARTMENT OF CSE - DATA SCIENCE**

<b>IV B Tech I Sem</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Universal Human Values 2: Understanding Harmony</b>					

### Human Values Courses

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as “H-102 Universal Human Values 2: Understanding Harmony” is designed which may be covered in their III or IV semester. During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

### Universal Human Values 2: Understanding Harmony

Course code: HSMC (H-102)

Credits: L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits

Pre-requisites: None. Universal Human Values 1 (desirable)

#### 1. Objective:

##### The objective of the course is four fold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

#### 2. Course Topics:

The course has 28 lectures and 14 practice sessions in 5 modules:

#### Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

5. Purpose and motivation for the course, recapitulation from Universal Human Values-I
6. Self-Exploration—what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation— as the process for self-exploration
7. Continuous Happiness and Prosperity- A look at basic Human Aspirations
8. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
9. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
10. Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

#### Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

11. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
12. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility
13. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
14. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’





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15. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
16. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

**Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

17. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
18. Understanding the meaning of Trust; Difference between intention and competence
19. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
20. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
21. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

**Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

22. Understanding the harmony in the Nature
23. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
24. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
25. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

**Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics**

26. Natural acceptance of human values
27. Definitiveness of Ethical Human Conduct
28. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
29. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
30. Case studies of typical holistic technologies, management models and production systems
31. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
32. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.



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**3. READINGS:**

**3.1 Text Book**

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

**3.2 Reference Books**

1. Jeevan Vidya: Ek Parichaya, ANagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

**4. MODE OF CONDUCT (L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits)**

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than "extraordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty. Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.



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**5. ASSESSMENT:**

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks

Self-assessment: 10 marks

Assessment by peers: 10 marks

Socially relevant project/Group Activities/Assignments: 20 marks

Semester End Examination: 50 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

**6. OUTCOME OF THE COURSE:**

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

- a) faculty-student or mentor-mentee programs throughout their time with the institution
- b) Higher level courses on human values in every aspect of living. E.g. as a professional



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		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>Machine Learning with Go (Skill Oriented Course)</b>					

**Course Objectives:**

- To turn the students into a productive, innovative data analyst who can leverage Go to build robust and valuable applications.
- To introduce the technical aspects of building predictive models in Go, but also helps you understand how machine learning workflows are applied in real-world scenarios.
- To understand how to gather, organize, and parse real-work data from a variety of sources.
- To develop a solid statistical toolkit that will allow you to quickly understand gain intuition about the content of a dataset.
- To implement essential machine learning techniques (regression, classification, clustering, and so on) with the relevant Go packages.

**Prerequisites:**

1. Bash Shell
2. Go-an editor

**List of Experiments:**

1. a) Write a Go program to read CSV file and find the maximum value in a particular column.  
b) Write a Go program to read iris dataset which is in csv format and demonstrate handling of unexpected fields, types and manipulating CSV data.
2. a) Demonstrate how JSON data can be parsed using Go.  
b) Demonstrate how to connect and Querying SQL like databases (Postgres MySQL, SQL Lite) using Go
3. Demonstrate how to cache data in memory using Go
4. a) Demonstrate how to represent matrices and vectors in Go  
b) Write a Go program to get statistical measures like mean, median, standard deviation and so on for any dataset.  
c) Write a Go program to visualize data distributions using Histogram, Box Plots.
5. a) Write a Go program to demonstrate Mean Squared Error(MSE), Mean Absolute Error (MAE) ,  $R^2$  (R Squared).  
b) Write a Go program to compute Accuracy, Precision , Recall, AUC (Area Under Cover)
6. a) Demonstrate how to build a linear regression model using Go.  
b) Demonstrate how to build a multiple linear regression model using Go.
7. Demonstrate how to build a logistic regression model using Go
8. Apply k-nearest neighbor classifier on iris dataset using Go
9. Build a decision tree on iris dataset using Go.
10. Demonstrate K-Means clustering method using Go.
11. Build auto regressive models for time series data using Go
12. Demonstrate how to build a simple neural network using Go

**References:**

1. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0130944292286873602383\\_share\\_d/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944292286873602383_share_d/overview)



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		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>MEAN Stack Technologies-Module II-Angular JS and MongoDB (Skill Oriented Course)</b>					

**Course Outcomes:**

- Build a component-based application using Angular components and enhance their functionality using directives.
- Utilize data binding for developing Angular forms and bind them with model data.
- Apply Angular built-in or custom pipes to format the rendered data.
- Develop a single page application by using synchronous or asynchronous Angular routing.
- Make use of MongoDB queries to perform CRUD operations on document database.

**List of Exercises:**

<b>1.a</b>	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Angular Application Setup</p> <p>Observe the link <a href="http://localhost:4200/welcome">http://localhost:4200/welcome</a> on which the mCart application is running. Perform the below activities to understand the features of the application.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24049616594198490000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24049616594198490000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a></p>
<b>1.b</b>	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Components and Modules</p> <p>Create a new component called hello and render Hello Angular on the page</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28217843279641040000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28217843279641040000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a></p>
<b>1.c</b>	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Elements of Template</p> <p>Add an event to the hello component template and when it is clicked, it should change the courseName.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19226434057992030000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19226434057992030000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a></p>
<b>1.d</b>	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Change Detection</p> <p>progressively building the PoolCarz application</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_25609816371207710000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_25609816371207710000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
<b>2.a</b>	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Structural Directives - ngIf</p> <p>Create a login form with username and password fields. If the user enters the correct credentials, it should render a "Welcome &lt;&lt;username&gt;&gt;" message otherwise it should render "Invalid Login!!! Please try again..." message</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-">https://infyspringboard.onwingspan.com/web/en/viewer/web-</a></p>





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	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637402260439042595_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">module/lex_auth_0127637402260439042595_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
2.b	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngFor
	Create a courses array and rendering it in the template using ngFor directive in a list format. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32795774277593590000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32795774277593590000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
2.c	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngSwitch
	Display the correct option based on the value passed to ngSwitch directive. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_23388127475984175000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_23388127475984175000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
2.d	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Custom Structural Directive
	Create a custom structural directive called 'repeat' which should repeat the element given a number of times. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24073319904331424000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24073319904331424000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
3.a	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Attribute Directives - ngStyle
	Apply multiple CSS properties to a paragraph in a component using ngStyle. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24037156998765367000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24037156998765367000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
3.b	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngClass
	Apply multiple CSS classes to the text using ngClass directive. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3459610297074182000_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3459610297074182000_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course</a>
3.c	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Custom Attribute Directive
	Create an attribute directive called 'showMessage' which should display the given message in a paragraph when a user clicks on it and should change the text color to red. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14783742359773809000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14783742359773809000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
4.a	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Property Binding
	Binding image with class property using property binding. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_8951964709153619000_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_8951964709153619000_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course</a>
4.b	<b>Course Name:</b> Angular JS



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	<p><b>Module Name:</b> Attribute Binding</p> <p>Binding colspan attribute of a table element to the class property.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7154252883180625000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7154252883180625000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
4.c	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Style and Event Binding</p> <p>Binding an element using inline style and user actions like entering text in input fields.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7417401021103822000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7417401021103822000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
5.a	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Built in Pipes</p> <p>Display the product code in lowercase and product name in uppercase using built-in pipes.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_11810543990912035000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_11810543990912035000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course</a></p>
5.b	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Passing Parameters to Pipes</p> <p>Apply built-in pipes with parameters to display product details.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21187073707540988000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21187073707540988000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course</a></p>
5.c	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Nested Components Basics</p> <p>Load CoursesListComponent in the root component when a user clicks on the View courses list button.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24231999287700136000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24231999287700136000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course</a></p>
6.a	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Passing data from Container Component to Child Component</p> <p>Create an AppComponent that displays a dropdown with a list of courses as values in it. Create another component called the CoursesList component and load it in AppComponent which should display the course details. When the user selects a course from the</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15758356947336235000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15758356947336235000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course</a></p>
6.b	<p><b>Course Name:</b> Angular JS</p> <p><b>Module Name:</b> Passing data from Child Component to ContainerComponent</p> <p>Create an AppComponent that loads another component called the CoursesList component. Create another component called CoursesListComponent which should display the courses list in a table along with a register .button in each row. When a user clicks on th</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2494980689916818400_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2494980689916818400_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>





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6.c	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Shadow DOM
	Apply ShadowDOM and None encapsulation modes to components.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10312243404892470000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10312243404892470000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
6.d	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Component Life Cycle
	Override component life-cycle hooks and logging the corresponding messages to understand the flow.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10818939635948007000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10818939635948007000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
7.a	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Template Driven Forms
	Create a course registration form as a template-driven form.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2810668513603024400_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2810668513603024400_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
7.b	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Model Driven Forms or Reactive Forms
	Create an employee registration form as a reactive form.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33704702617536004000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33704702617536004000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
7.c	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Custom Validators in Reactive Forms
	Create a custom validator for an email field in the employee registration form ( reactive form)
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33728128192769250000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33728128192769250000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
8.a	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Custom Validators in Template Driven forms
	Create a custom validator for the email field in the course registration form.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_27688491925133280000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_27688491925133280000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
8.b	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Services Basics
	Create a Book Component which fetches book details like id, name and displays them on the page in a list format. Store the book details in an array and fetch the data using a custom service.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32584403823635940000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32584403823635940000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
8.c	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> RxJS Observables
	Create and use an observable in Angular.



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	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6209609363905256000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6209609363905256000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
9.a	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Server Communication using HttpClient
	Create an application for Server Communication using HttpClient
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637395317063682615_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637395317063682615_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
9.b	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Communicating with different backend services using Angular HttpClient
	Create a custom service called ProductService in which Http class is used to fetch data stored in the JSON files.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4266333361795059700_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4266333361795059700_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
10.a	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Routing Basics, Router Links
	Create multiple components and add routing to provide navigation between them.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3782024852517635000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3782024852517635000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
10.b	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Route Guards
	Considering the same example used for routing, add route guard to BooksComponent. Only after logging in, the user should be able to access BooksComponent. If the user tries to give the URL of Bookscomponent in another tab or window, or if the user tries
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30303325731876470000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30303325731876470000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
10.c	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Asynchronous Routing
	Apply lazy loading to BookComponent. If lazy loading is not added to the demo, it has loaded in 1.14 s. Observe the load time at the bottom of the browser console. Press F12 in the browser and click the Network tab and check the Load time
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9878739890118246000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9878739890118246000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
10.d	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Nested Routes
	Implement Child Routes to a submodule.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012768043900444672140_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012768043900444672140_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
11.a	<b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide
	<b>Module Name:</b> Installing MongoDB on the local computer, Create MongoDB Atlas Cluster
	Install MongoDB and configure ATLAS



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	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821437313024030083_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821437313024030083_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a>
<b>11.</b>	<b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide
<b>b</b>	<b>Module Name:</b> Introduction to the CRUD Operations
	Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821874166169630118_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821874166169630118_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a>
<b>12.</b>	<b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide
<b>a</b>	<b>Module Name:</b> Create and Delete Databases and Collections
	Write MongoDB queries to Create and drop databases and collections.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821654119219230121_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821654119219230121_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a>
<b>12.</b>	<b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide
<b>b</b>	<b>Module Name:</b> Introduction to MongoDB Queries
	Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate().
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_0132890816264519682505_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_0132890816264519682505_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a>

**Text Books:**

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, Elad Elrom, Apress O'Reilly.
3. Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1st edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.
4. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly

**Software configuration and installation:**

1. Angular  
Setup details: Angular Application Setup - Internal - Viewer Page | Infosys Springboard (onwingspan.com)
2. MongoDB  
TOC - MongoDB Essentials - A Complete MongoDB Guide | Infosys Springboard (onwingspan.com)

**Web Links:**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_20858515543254600000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_20858515543254600000_shared/overview) (Angular JS)
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_013177169294712832113\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview) (MongoDB)



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<b>IV B Tech I Sem</b>	<b>Minor</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>Data Wrangling in Data Science</b>					

**Course outcomes:**

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

- Identify and execute the basic data format.
- Perform the computations with Excel and pdf files
- Understand the concepts of data cleanup
- Explore and analyze the Image and video data
- Understand the concepts web scraping

**UNIT I:**

**INTRODUCTION TO DATA WRANGLING:** Data Wrangling, Importance of Data Wrangling, How is Data Wrangling performed, Tasks of Data Wrangling, Data Wrangling Tools, Introduction to Python, Python Basics, Data Meant to be Read by Machines, CSV Data, JSON Data, XML Data.

**UNIT II:**

**WORKING WITH EXCEL FILES AND PDFS:** Installing Python Packages, Parsing Excel Files, Parsing Excel Files, Getting Started with Parsing, PDFs and Problem Solving in Python, Programmatic Approaches to PDF Parsing, Converting PDF to Text, Parsing PDFs Using pdf miner, Acquiring and Storing Data-Databases: A Brief Introduction, Relational Databases: MySQL and PostgreSQL, Non-Relational Databases: NoSQL, When to Use a Simple File, Alternative Data Storage.

**UNIT III:**

**DATA CLEANUP:** Why Clean Data, Data Cleanup Basics, Identifying Values for Data Cleanup, Formatting Data, Finding Outliers and Bad Data, Finding Duplicates, Fuzzy Matching, RegEx Matching, Normalizing and Standardizing the Data, Saving the Data, Determining suitable Data Cleanup, Scripting the Cleanup Testing with New Data

**UNIT IV:**

**DATA EXPLORATION AND ANALYSIS:** Exploring Data, Importing Data, Exploring Table Functions, Joining Numerous Datasets, Identifying Correlations, Identifying Outliers, Creating Groupings, Analyzing Data, Separating and Focusing the Data Presenting Data, Visualizing the Data, Charts-Time-Related Data, Maps, Interactives, Words-Images, Video, and Illustrations, Presentation Tools, Publishing the Data, Open Source Platforms

**UNIT V:**

**WEB SCRAPING:** What to Scrape and How, Analyzing a Web Page, Network/Timeline, Interacting with JavaScript, In-Depth Analysis of a Page, Getting Pages, Reading a Web Page, Reading a Web Page with LXML, XPath-Advanced Web Scraping, Browser-Based Parsing, Screen Reading with Selenium, Screen Reading with Ghost.PySpidering the Web, Building a Spider with Scrapy, Crawling Whole Websites with Scrapy.

**Text Books:**

1. Data Wrangling with Python, Jacqueline Kazil & Katharine Jarmul, O'Reilly Media, Inc, 2016
2. Data Wrangling with Python: Creating actionable data from raw sources., Dr. Tirthajyoti Sarkar, Shubhadeep Packt Publishing Ltd, 2019



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**Reference Books;**

1. Hands-On Data Analysis with Pandas, Stefanie Molin, Packt Publishing Ltd,2019
2. Practical Data Wrangling, Allan Visochek, Packt Publishing Ltd,2017
3. Principles of Data Wrangling: Practical Techniques for Data Preparation, TyeRattenbury, Joseph M. Hellerstein, Jeffrey Heer, Sean Kandel, Connor Carreras, , O'Reilly Media, Inc,2017