



# HANDBOOK

**COURSE STRUCTURE AND DETAILED SYLLABUS**

**M.Tech in Data Science**  
Batch 2020-22

**INSTITUTE OF ENGINEERING AND TECHNOLOGY**  
**JK LAKSHMIPAT UNIVERSITY**

Near Mahindra SEZ, Mahapura, Ajmer Road, Jaipur 302 026  
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## **Program Education Objectives**

The PG Programs at IET, JKLU are designed to prepare students for continued learning and successful careers. Our alumni are expected to:

PEO1: Apply their technical knowledge, complex problem solving and research skills in professional practice.

PEO2: Continue their intellectual development through critical thinking, self-study, apprenticeship, higher education, professional development courses, as well as participation in research groups and professional networks.

PEO3: Serve as ambassadors for engineering and sustainability by exhibiting high professional standards with a deep sense of civic responsibility.

PEO4: Effectively communicate about technical and related issues.

PEO5: Embrace roles of team members and leaders in their career.

## **Program Outcomes**

The graduates of PG Programs at IET, JKLU will have following competencies:

PO 1: *Life-long learning*: Demonstrate inquisitiveness, open mindedness, and the ability to engage in independent and life-long learning in the broadest context of technological, organizational, economic, and societal changes.

PO 2: Citizenship, Sustainability, and Professional ethics

PO 2a: Demonstrate knowledge of constitutional values of liberty, equity, justice, and fraternity with understanding of the impact of the engineering solutions in societal and environmental contexts as well as a sense of responsibility for sustainable development.

PO 2b: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, cultural, and environmental issues and the consequent responsibilities relevant to the professional engineering practice.

PO 2c: Demonstrate commitment for professional integrity and excellence and respect for ethics, responsibilities and norms as prescribed for the engineering practice.

PO 3: Engineering knowledge and Modern tool usage

PO 3a: Demonstrate clear conceptual understanding of fundamentals of engineering specialization and cognitive flexibility to appropriately 'transfer' what has been learned in a context, to different situations.

PO 3b: Apply engineering thinking, computational thinking, and the knowledge of mathematics, natural and social sciences, engineering fundamentals, information technology, engineering specialization, and engineering management to the solution of complex engineering problems.

PO 3c: Create, select, modify, and apply appropriate techniques, best practices, standards, resources, and modern engineering and IT tools including prediction and modelling to engineering and social activities with an understanding of the limitations.

PO 4: Complex problem solving, Design and Research

PO 4a: Identify, formulate, review research literature, and analyze complex engineering problems to arrive at substantiated conclusions using critical thinking along with principles of mathematics, computing, engineering as

well as natural and social sciences.

PO 4b: Use systems thinking and reflection to identify and consider underlying structures, patterns, volatility, uncertainties, complexities, ambiguities, complications, and risks to design and develop engineering solutions for complex problems to meet the specified and anticipated needs with appropriate concern for constraints, performance, sustainability, and professional ethics.

PO 4c: Use research-based knowledge and research methods including design of experiments, simulation, analysis and interpretation of data, and synthesis of the information to evaluate and improve the engineering solutions and practice.

PO 5: Individual & team work and Engineering management

PO 5a: Ability to work effectively as an individual and as a team member or leader in diverse and distributed teams, and in multidisciplinary settings.

PO 5b: Ability to apply engineering management principles to one's own and team's work to manage engineering projects and operations and in multidisciplinary environment.

PO 6: Communication: Ability to communicate effectively on complex engineering and technology activities, situations, problems, and solutions using verbal, textual, and pictorial elements with the colleagues, engineering community, users, clients, policy makers, and society at large with intellectual honesty, clarity, empathy, and compassion.

PO 7: Innovation and entrepreneurship:

PO 7a: Demonstrate enthusiasm and understanding to identify opportunities and translate research in engineering and other disciplines to conceive and design innovative engineering solutions for business, industry, and societal problems.

PO 7b: Demonstrate enthusiasm and understanding to conceive and plan technology based new ventures either as independent start-up businesses or within existing corporate structures.

## **Program Specific Outcomes**

### **M.Tech. (Data Science)**

The data science graduates of JKLU will be able to:

DSPSO1: Identify, extract, and pull together available and pertinent heterogeneous data and use appropriate computational principles, platforms and techniques to discover new relations and deliver insights into research problem or

organizational processes and support decision-making.

**DSPSO2:** Conceive, design, implement, and manage data analytics, data management and information systems, services, and processes by using principles of computer science, data management, machine learning, computational statistics, software engineering, and state of the art platforms, components and tools.

**DSPSO3:** Serve in the areas of data analytics, data science, or business analytics in business, consultancy, industry, government, healthcare, education, research, etc.

**JK Lakshmipat University, Jaipur**  
**Institute of Engineering and Technology**  
**Course Structure for the M.Tech (Batch 2020-2022)**  
**Specializations: Data Science (DS)**

<b>Courses</b>							<b>Hours &amp; Credits</b>
<b>Semester I</b>							
Statistical Data Analysis-I  (3 0 4) 5	Cloud based Big Data System-I (3 0 2) 4	Machine Learning and Data Mining (3 0 4) 5	Elective-1 (3 0 0) 3	<b>Project- I/</b> Research Methodology-I (2 0 0) 2	CCC T (2 0 0) 2	Hours: 26 Credits: 21	
<b>Semester II</b>							
Statistical Data Analysis-II (3 0 4) 5	Cloud based Big Data System-II (3 0 2) 4	Advanced Machine Learning Algorithms (3 0 4) 5	Elective-2 (3 0 0) 3	<b>Project- II/</b> Research Methodology-II (2 0 0) 2	CCC T (2 0 0) 2	Hours: 26 Credits: 21	
<b>Internship (6- 8 weeks)</b>							4
<b>Exit Option with PG Diploma</b>							
<b>Semester III</b>							
Elective-3 (3 0 0) 3	Elective - 4 (3 0 0) 3	Dissertation/Industrial Project/Entrepreneurial Project 10				Hours: 6+ Credits: 16	
<b>Semester IV</b>							
Dissertation/Industrial Project/Entrepreneurial Project 16						Credits : 16	

**M.Tech Computer Science Engineering  
Specializations: Data Science (DS)  
(Batch: 2020-2022)**

<b>Course Code</b>	<b>Course Name</b>	<b>Page Number</b>
AS2101	Statistical Data Analysis-I	
CS2101	Cloud based Big Data System-I	
CS2102	Machine Learning and Data Mining	
CS2103	Robotic Process Automation	
PR2101	Project-I/ Research Methodology-I	
CC2171	Critical Thinking for Developing Perspectives	
	Statistical Data Analysis-II	
CS2103	Cloud based Big Data System-II	
CS2104	Advanced Machine Learning Algorithms	
PR2102	Project-II/ Research Methodology-II	
PR2103/ PR2104/ PR2105	Dissertation/Industrial Project/Entrepreneurial Project	

<b>Course Title and Code:</b> Statistical Data Analysis (AS2101)		
Hours per Week	<b>L-T-P: 3-0-4</b>	
Credits	<b>5</b>	
Students who can take	M.Tech. Semester-I (Batch: 2020-2022) <b>Core</b>	
<b>Course Objective:</b> This course aims to introduce basic concepts in descriptive and inferential statistics, as well as data exploration methods. Topics covered include probability distributions, hypothesis testing, frequency analysis, correlation, regression and design of experiments.		
<b>After course completion, the student will be able to:</b>		
<ol style="list-style-type: none"> <li>1. Frame real world analysis problems using statistical concepts and solve them using standard techniques.</li> <li>2. Use professional level tools to support the study of statistics.</li> <li>3. Communicate quantitative ideas to a range of audiences.</li> <li>4. Apply recommended practices for data analysis.</li> </ol>		
<b>Prerequisites</b>		
<b>Sr. No</b>	<b>Specifications</b>	<b>Marks</b>
1	Attendance	Nil
2	Assignment	Nil
3	Class Participation	10
4	Quiz	15
5	Theory Exam-I	Nil
6	Theory Exam-II	Nil
7	Theory Exam-III	30
8	Report-I	Nil
9	Report-II	Nil
10	Report-III	Nil
11	Project-I	25
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	20
15	Lab Evaluation-II	Nil
16	Course Portfolio	Nil
	<b>Total (100)</b>	Nil

## **SYLLABUS**

### **Theory:**

**Principles of Statistical Data Analysis:** Data Elements, Variables, and Data categorization, Levels of Measurement: Nominal, Ordinal, Interval, or Ratio, Data management and indexing, Tabular data, Measures of dispersions, Skewness – Karl Pearson and Bowley, Skewness – Kelly coefficient of Skewness and Kurtosis



**Probability Theory**, Mathematical expectation, moments, probability and moment generating function, Chebyshev's inequality, Mean and Variance of a Random Variable, product moments, independence of random variables, Joint, marginal and conditional distributions, Discrete and continuous distribution function, Introduction to statistical learning using R-Programming/Python

**Basic Statistical Techniques:** Sampling Theory and Distributions for Normal and Non-normal Populations, Central Limit Theorem, Point and Interval Estimates, Estimator and Estimates, Sample size calculations Sample Size for Estimating Means and Proportions, Maximum likelihood test, The Central Limit Theorem, p-values and power, Parametric and Non-Parametric test of Hypothesis, Goodness of fit, Analysis of contingency tables, Non-parametric tests of location and dispersion, Statistical inference using R/Python

**Analysis of Continuous and Categorical Data:** Estimation Using the Regression Line, Method of Least Squares, Standard Error of Estimate, Prediction Intervals, Multi Variate regression, generalized linear models, Logistic regression, Ordinal logistic regression, Proportional odds models, Multinomial logistic regression, Poisson regression, negative binomial regression, zero-inflated models, Log linear models for (paired) tables. Procedures for stepwise building of a regression model, Introduction to random intercept models, penalized linear regression methods, Graphical and formal diagnostic methods for the inspection of residuals, Correlation Analysis, autocorrelation and cross correlation, Regression and Correlation analysis using R/Python

**Design of experiments:** Basic principles of experimental designs, Analysis of variance: one-way, Two-way classifications, Latin square design, Two Factorial Design.

**Practical:** Solve the problems mentioned in theory classes using packages like Python, NumPy, Pandas, statistical package SciPy, Stats, scikit-learn, plotting packages Matplotlib and Seaborn.

### **Text Book(s)**

1. Prem S Mann. Introductory statistics. Wiley. Edition: 7th ed. 2010.
2. Ronald E Walpole, Raymond H Myers, Sharon L Myers and Keying Ye. Probability and statistics for engineers and scientists. 8th ed - New Delhi. Pearson. 2007.

### **Web Resources**

1. Statistics full Course for Beginners. <https://www.youtube.com/watch?v=74oUwKezFho>
2. Introduction to R and R Studio. <https://www.youtube.com/watch?v=1L0s1coNtRk>

<b>Course Title and Code:</b>		Cloud Based Big Data System-I: CS2101
Hours per Week		<b>L-T-P: 3-0-2</b>
Credits		<b>4</b>
Students who can take		M.Tech/MS Sem I
<p><b>Course Objective-</b> This course prepares students to use the Big Data platform and methodologies in order to collect and analyze large amounts of data from different sources. The students will acquire skills in Big Data architecture, such as Apache Hadoop, Ambari, Spark, Big SQL, HDFS, YARN, MapReduce, ZooKeeper, Knox, Sqoop, and HBase.</p>		
<p><b>Learning Outcomes:</b>  After completing this course, the students should be able to understand the following topics:</p> <ol style="list-style-type: none"> <li>1. Big Data and Data Analytics</li> <li>2. Hortonworks Data Platform (HDP)</li> <li>3. Apache Ambari</li> <li>4. Hadoop and the Hadoop Distributed File System</li> <li>5. MapReduce and YARN</li> <li>6. Apache Spark, Storing and Querying data</li> <li>7. ZooKeeper, Slider, and Knox</li> <li>8. Loading data with Sqoop, DataPlane Service</li> <li>9. Stream Computing</li> <li>10. Data Science essentials, Drew Conway's Venn Diagram</li> <li>11. The Scientific Process applied to Data Science</li> <li>12. The steps in running a Data Science project</li> <li>13. Languages used for Data Science (Python, R, Scala, Julia, ...)</li> <li>14. Survey of Data Science Notebooks, and Markdown language with notebooks</li> <li>15. Resources for Data Science, including GitHub, Jupyter Notebook</li> <li>16. Essential packages: NumPy, SciPy, Pandas, Scikit-learn, NLTK, BeautifulSoup</li> <li>17. Data visualizations: matplotlib, PixieDust</li> <li>18. Using Jupyter "Magic" commands</li> <li>19. Using Big SQL to access HDFS data, Creating Big SQL schemas and tables, Querying Big SQL tables, and Configuring Big SQL security</li> <li>20. Data federation with Big SQL</li> </ol>		
Prerequisites		Linux, Programming, SQL
<b>Sr. No</b>	<b>Specifications</b>	<b>Marks</b>
01	Attendance	Nil
02	Assignment	Nil
03	Class Participation	Nil

04	Quiz	15
05	Theory Exam-I	Nil
06	Theory Exam-II	Nil
07	Theory Exam-III	25
08	Report-I	20
09	Report-II	Nil
10	Report-III	Nil
11	Project-I	Nil
12	Project-II	Nil
13	Project-III	Nil
14	Lab Evaluation-I	20
15	Lab Evaluation-II	20
16	Course Portfolio	Nil
	<b>Total (100)</b>	<b>100</b>

### Syllabus (Theory)

Big Data Overview: Data Overview, Industry Applications, Case Studies, Understanding Big Data  
 Big Data and Analytics: Hortonworks Data Platform (HDP), Apache Ambari, Hadoop and the Hadoop Distributed File System, MapReduce and YARN, Apache Spark, Storing and Querying data, ZooKeeper, Slider, and Knox. Loading data with Sqoop, DataPlane Service, Stream Computing, Data Science essentials, Drew Conway's Venn Diagram - and that of others, The Scientific Process applied to Data Science, The steps in running a Data Science project, Languages used for Data Science (Python, R, Scala, Julia, ...), Markdown language with notebooks, Resources for Data Science, including GitHub, Jupyter Notebook, Essential packages: NumPy, SciPy, Pandas, Scikit-learn, NLTK, BeautifulSoup..., Data visualizations: matplotlib, ..., PixieDust, Using Jupyter "Magic" commands, Using Big SQL to access HDFS data, Creating Big SQL schemas and tables, Querying Big SQL tables, Configuring Big SQL security, Data federation with Big SQL

### **Reference Books:**

1. Benjamin Bengfort and Jenny Kim. Data Analytics with Hadoop: An Introduction for Data Scientists. O'Reilly Media, 2016.
2. Jake VanderPlas. Python Data Science Handbook: Essential Tools for Working with Data. O'Reilly Media, 2016.

<b>Course Title and Code:</b> Machine Learning and Data Mining CS2102		
Hours per Week		<b>L-T-P: 3-0-4</b>
Credits		<b>5</b>
Students who can take		M. Tech Sem I (2020-2022)
<p><b>Course Objective:</b> This course introduces the fundamental concepts of machine learning and data mining techniques. The course will cover the state-of-the art data mining techniques along with its usage with machine learning algorithms on real-world data (or big data). This course helps the students to pursue project related ML and data mining with real-world research problems.</p>		
<p>Learning Outcome:</p> <p>On successful completion of this course, the students should be able to:</p> <ol style="list-style-type: none"> <li>1. Utilize advanced knowledge of data mining, data warehousing and KDD concepts and techniques.</li> <li>2. Organize and Prepare the data needed for data mining using pre-preprocessing techniques.</li> <li>3. Generate and apply different mining techniques such as rule generation, association mining, Bayesian techniques and Frequent Itemset generation.</li> <li>4. Apply the techniques of clustering, classification, association finding, feature selection and visualization on real world data.</li> <li>5. Demonstrate knowledge in scalability and management of large dataset.</li> <li>6. Identify machine learning techniques suitable for a given problem.</li> <li>7. Interpret fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.</li> <li>8. Apply dimensionality reduction techniques.</li> <li>9. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.</li> <li>10. Utilize state-of-the art algorithms of Machine Learning for building applications.</li> </ol>		
Prerequisites		Nil
<b>Sr. No</b>	<b>Specifications</b>	<b>Marks</b>
1	Attendance	Nil
2	Assignment	10
3	Class Participation	10
4	Quiz	10
5	Theory Exam	20
6	Theory Exam	Nil
7	Theory Exam	Nil
8	Report-1	10
9	Report-2	Nil
10	Report-3	Nil

11	Project -1	20
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation1	Nil
15	Lab Evaluation2	20
16	Course portfolio	Nil
	Total (100)	100

## Syllabus (Theory)

**UNIT – I:** Introduction: Data warehouse – Difference between Operational DBs and Data warehouses – Multidimensional Data Model, The process of knowledge discovery in databases, predictive and descriptive data mining techniques, supervised and unsupervised learning techniques.

**UNIT – II:** Techniques of Data Mining: Link analysis, predictive modeling, database segmentation, score functions for data mining algorithms, Bayesian techniques in data mining, Association Analysis: Problem Definition; Frequent Itemset generation; Rule Generation; Compact representation of frequent itemsets; Alternative methods for generating frequent item-sets

**UNIT – III:** Issues in Data Mining: Scalability and data management issues in data mining algorithms, parallel and distributed data mining, privacy, social, ethical issues in Knowledge Discovery in Databases (KDD) and data mining, pitfalls of KDD and data mining.

**UNIT – IV:** Introduction to Machine Learning, Supervised Learning: Classification: Preliminaries; General approach to solving a classification problem; Decision tree induction; Rule-based classifier; Simple and Multiple Linear Regression ; Nearest-neighbor classifier, SVM, Unsupervised Learning: Clustering; K-Means, Hierarchical Clustering

**UNIT – V:** Model Evaluation Measures: Cross-Validation Technique, Confusion matrix for evaluation, Class probabilities and class predictions, ROC Curve, Model evaluation metrics, Fitting dataset and evaluating their performance set, Evaluation of selected features, Model evaluation metrics, making predictions on new data

Usage of AI and ML Techniques for achieving sustainable practices, NIST and IEEE standards for AI and ML libraries, tools and techniques

## **Reference Books:**

1. Mitchell, Tom. Machine Learning, McGraw Hill 1997.
2. Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012. (Electronic copy available through the Bodleian library.)
3. Bishop, Christopher M. Pattern recognition and machine learning. Springer, 2006.
4. Han, Jiawei, Jian Pei, and Micheline Kamber. Data mining: concepts and techniques. Elsevier, 2011.

5. Tan, Pang-Ning, Michael Steinbach, Vipin Kumar, and Anuj Karpatne. Introduction to Data Mining, Global Edition. Pearson Education Limited, 2019.
6. Witten, Ian H., Eibe Frank, Mark A. Hall, and Christopher J. Pal. Data Mining: Practical machine learning tools and techniques. Morgan Kaufmann, 2016.

## CS2103: Robotic Process Automation

<b>Course Title and Code: Robotic Process Automation: CS2103:</b>		
Hours per Week	<b>L-T-P: 3-0-4</b>	
Credits	<b>5</b>	
Students who can take		
<b>Course Objective:</b>		
<ul style="list-style-type: none"> <li>The course aim is to develop understanding about Robotic Process Automation for automating business processes using software robots with cost efficient digital delivery.</li> </ul>		
<b>Learning Outcome:</b>		
On successful completion of this course, the students should be able to:		
<ul style="list-style-type: none"> <li>Use and understand the various functionalities and features of UiPath Studio and Orchestrator.</li> <li>Design, implement, and use RPA activities.</li> <li>Develop basic robots using UiPath Community Edition.</li> <li>Explore various data extraction techniques.</li> <li>Deploy, monitor and control robots with UiPath Orchestrator.</li> <li>Identify processes which can be automated.</li> <li>Apply best practices in RPA projects.</li> </ul>		
<b>Prerequisites:</b> To understand and complete the course successfully the student must have basic programming skills.		
<b>Sr. No</b>	<b>Specifications</b>	<b>Marks</b>
01	Attendance	Nil
02	Assignments	10
03	Class Participation	10
04	Quiz	20
05	Theory Exam	Nil
06	Theory Exam	Nil
07	Theory Exam(Final)	Nil
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project-1	20
12	Project-2	20
13	Project-3	Nil
14	Lab Evaluation-1	10
15	Lab Evaluation-2	Nil
16	Course portfolio	10
	<b>Total (100)</b>	<b>100</b>

### Retest

1	Quiz	20
2	Lab Evaluation-1	10

## **Syllabus (Theory):**

Unit I: Programming Basic & Recap: Programming concept basic; **Introduction to RPA:** scopes and techniques of automation, RPA components and various RPA platforms, Introduction to UiPath as RPA platform, Applications and Benefits of RPA, Introduction to UiPath Studio, UiPath robot, types of robots, and UiPath Orchestrator. Brief on Studio interface and components.

Unit II: **RPA Projects:** Types of Projects in RPA: Sequence, Flowcharts, and State machines; Variables, Arguments, Data Types and Control flow: flow chart activities and sequences activities. **Data Manipulation:** Text and Data Manipulation, Data tables, clipboard management, file operation, importing from and exporting to CSV/Excel file and data table.

Unit III: **Control of Controls:** Attach window activity, Finding the control, Waiting for a control, Act on Control- mouse and keyboard activity. Handling event driven controls as working with UiExplorer handling events. Introduction to Recorder, OCR, types of OCR and Screen Scrapping Using OCR. **Selectors:** Selectors, Defining and Assessing Selectors, Customization, Debugging, Dynamic Selectors, Partial Selectors, RPA Challenge.

Unit IV: **Application with Plugins and Extensions:** Java plugins, Citrix automation, Mail plugins, PDF plugins, Web integration, excel and word plugins. Extensions- Java, chrome, firefox, and Silverlight. **UiPath Advanced Automation concepts and techniques:** Image, Text and introduction of Citrix Automation; **Excel Data Tables & PDF:** Data Tables in RPA, Excel and Data Table basics, Data Manipulation in excel, Extracting Data from PDF, Extracting a single piece of data, Anchors. **Email Automation:** Incoming Email automation, Sending Email automation.

Unit V: **Debugging and Exception Handling:** Common exceptions and ways to tackle them, Strategies for solving issues, Catching errors. **Introduction to Orchestrator:** Tenants, Authentication, Robots, Environments, Asset. **Capstone Project.**

## **Syllabus (Practical):**

1. Setup, configuration, and introduction of components of UiPath Studio.
2. Execution of prebuilt examples of sequence, flow chart and state machines projects.

Create a sequence/Flow chart activity defining various types of variable as:

3. Generic Value Variables, Text Variables, Boolean Variables, Number Variables,
4. Array Variables, Date and Time Variables, Data Table Variables

Managing Arguments:

5. Create two activities, one activity defined with arguments and second activity which manages the argument to receive value from first activity.
6. Create an activity to manage importing active namespaces.

Create a project to Manage the control Flow:

7. The Assign Activity, The Delay Activity, The Do While Activity, The If Activity
8. The Switch Activity, The While Activity, The For-Each Activity, The Break Activity.



The Recording toolbar Activity:

9. Exercises using basic, web, and Desktop recoding.
10. Automate manual recording projects on Left-click on buttons, check boxes, drop-down lists, GUI elements, and Text typing

Data Scrapping:

11. Bot to extract structured data from your browser, application or document to a database, .csv file or even Excel spreadsheet.
12. Image and Text Automation
13. Excel Data Tables & PDF
14. Email Automation
15. Deployment of plugins and extensions.
16. Deploying and maintaining the BOT.

**Text Books:**

- T1 Tripathi, Alok Mani. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool–UiPath. Packt Publishing Ltd, 2018.
- T2. Murdoch, Richard. "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant." Middletown, DE. Omakustanne (2018).

**Reference Books:**

- R1. Abhinav Sabharwal, "Introduction To RPA", Independently Published Kindle Edition on Amazon Asia-Pacific Holdings Private Limited, 2018
- R2. Gerardus Blokdyk, "Rpa Robotic Process Automation", 5Starcook, Second Edition, 2018
- R3. Kelly Wibbenmeyer, "The Simple Implementation Guide to Robotic Process Automation (Rpa): How to Best Implement Rpa in an Organization" Paperback, iUniverse, 2018
- R4. Willcocks, Leslie P., Mary Lacity, and Andrew Craig. "The IT function and robotic process automation." (2015).

**Course Name: Critical Thinking for Developing Perspectives – CC2171**  
**Course Faculty: Dr. Richa Mishra & Ms Shraddha Bharatiya**  
**Prog. & Semester: Mtech Sem I**  
**Credit: 2**

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### **Course Description**

The ability to clearly reason through problems and to present arguments in a logical, and compelling way, have become a key skill for survival in today's world. In this course, students will learn to dissect and evaluate the components of argument. Students will learn to raise vital questions, think from multiple perspectives, become aware of their biases, gather and assess information and come to a well-reasoned position.

### **Learning Outcomes:**

The students will be able to:

- Explain the relevance of critical thinking
- Formulate significant questions for inquiry.
- Evaluate information and evidence for correctness, consistency, and relevance.
- Compose well-structured and well-reasoned arguments.
- Recognize their own beliefs, biases, claims and assumptions by viewing the issues from multiple perspectives

### **Reference Books:**

1. Moore, B. N., & Parker, R. (2009). Critical thinking. Boston, MA: McGraw-Hill. eBook
2. Sinnott-Armstrong, W., & Fogelin, R. J. (2014). Cengage Advantage Books: Understanding Arguments: An Introduction to Informal Logic. Cengage Learning eBook

### **Pedagogy**

This course will be an amalgamation of lectures and activity-based learning i.e. films, group discussions, debates, and case studies. The objective behind utilizing activity-based learning is for the learners to have a more hands on experience.

### **❖ Topics to be Covered**

#### **I. Introduction to the concept of critical thinking:**

- Evolution of the concept: Philosophy and Cognitive psychology as origins of critical thinking
- Revisit Paul-Elder Critical Thinking Framework

#### **II. Questioning for Critical Thinking**

- Importance of questioning
- Models of Questioning: Questioning Circles Model, Christenbury and Kelly (1983), Webb's Depth of Knowledge (1997). Elder & Paul (2007). Socratic Questioning Taxonomy.

#### **III. Understanding Arguments**

The sessions under this topic will make use of the context of current media, social and political debates to comprehend the topics.

- Meaning and Elements of Reasoning
- Formation of Arguments: Premise and Conclusion
- Inductive –Deductive reasoning: Difference between valid and invalid arguments/ between sound and unsound arguments.
- Evaluating Arguments: Examining data and information critically
- Cognitive Biases and Fallacies: Distinguishing between fact and opinion

### **Readings/Video(s)**

1. The Evolution of Critical Thinking (Research project by Barba Albers, Washington, State University ,2004
2. Bowker, M. H., & Fazioli, K. P. (2016). Rethinking Critical Thinking: A Relational and Contextual Approach. *Pedagogy and the Human Sciences*, 6(1), 1-26.
3. Bauer, N. J. (1991). *Dewey and Schon: An Analysis of Reflective Thinking*.
4. Nappi, J. S. (2017). The importance of questioning in developing critical thinking skills. *Delta Kappa Gamma Bulletin*, 84(1), 30.
5. <https://cpb-us-e1.wpmucdn.com/cobblearning.net/dist/6/3101/files/2018/05/The-Importance-of-Questioning-2aqkc5j.pdf>Bloom, B. S. (1956). *Taxonomy of educational objectives. Vol. 1: Cognitive domain*. New York: McKay, 20-24.
6. Paul, R., & Binker, A. J. A. (1990). Socratic questioning. *Critical thinking. Center for Critical Thinking and Moral Critique*. <http://www.criticalthinking.org/files/SocraticQuestioning2006.pdf>
7. The Art of Asking Questions | Dan Moulthrop | TEDxSHHS  
<https://www.youtube.com/watch?v=hZSY0PssqH0>
8. Analysing the argument - Part 1 of 2 (Video)

### **Evaluation Scheme**

Prerequisites		N/A
Hours per Week		L-T-P: 2-0-1
Credits		2
Sr. No	Specifications	Weightage
01	Attendance	Nil
02	<b>Assignment</b>	<b>40</b>
03	<b>Class Participation</b>	<b>20</b>
04	<b>Quiz</b>	<b>20</b>
05	Theory Exam	Nil
06	Theory Exam	Nil
07	<b>Theory Exam</b>	<b>20</b>
08	Report-1	Nil
09	Report-2	Nil
10	Report-3	Nil
11	Project -1	nil
12	Project -2	Nil
13	Project -3	Nil
14	Lab Evaluation	Nil
15	Lab Evaluation	Nil
16	Course portfolio	Nil
	<b>Total (100)</b>	<b>100</b>

<b>Course Title and Code: Project-I: PR2101</b>																																																								
Prerequisites	Nil																																																							
Hours per Week	L-T-P: 2-0-0																																																							
Credits	02																																																							
Students who can take	M.Tech. Semester I																																																							
<p><b>Course Objective:</b> The course aims to equip the students with knowledge of the nuances of building a project utilizing the concepts either attained in undergraduate or in parallel being attained in semester I. The course includes basics of preparation of project proposal, project creation and management cycle, team work, converting into a usable application and test cases to evaluate the project and preparation of report of project.</p> <p><b>Learning Outcome</b></p> <ul style="list-style-type: none"> <li>• Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements to serve requirement</li> <li>• Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project success</li> <li>• Utilize technology tools for communication, collaboration, information management, and decision support</li> <li>• Apply appropriate legal and ethical standards.</li> <li>• Test the Project with varied test cases.</li> </ul>																																																								
<table border="1"> <thead> <tr> <th>Sr. No</th> <th>Specifications</th> <th>Marks</th> </tr> </thead> <tbody> <tr><td>01</td><td>Attendance</td><td>NIL</td></tr> <tr><td>02</td><td>Assignment</td><td>NIL</td></tr> <tr><td>03</td><td>Class Participation (Day to Day work)</td><td>30</td></tr> <tr><td>04</td><td>Quiz</td><td>NIL</td></tr> <tr><td>05</td><td>Theory Exam</td><td>NIL</td></tr> <tr><td>06</td><td>Theory Exam</td><td>NIL</td></tr> <tr><td>07</td><td>Theory Exam (Final)</td><td>NIL</td></tr> <tr><td>08</td><td>Report-1 (Synopsis)</td><td>10</td></tr> <tr><td>09</td><td>Report-2 (Final report)</td><td>20</td></tr> <tr><td>10</td><td>Report-3</td><td>NIL</td></tr> <tr><td>11</td><td>Project -1</td><td>40</td></tr> <tr><td>12</td><td>Project -2</td><td>NIL</td></tr> <tr><td>13</td><td>Project -3</td><td>NIL</td></tr> <tr><td>14</td><td>Lab Evaluation - I</td><td>NIL</td></tr> <tr><td>15</td><td>Lab Evaluation - II</td><td>NIL</td></tr> <tr><td>16</td><td>Course portfolio</td><td>NIL</td></tr> <tr><td></td><td><b>Total (100)</b></td><td><b>100</b></td></tr> </tbody> </table>			Sr. No	Specifications	Marks	01	Attendance	NIL	02	Assignment	NIL	03	Class Participation (Day to Day work)	30	04	Quiz	NIL	05	Theory Exam	NIL	06	Theory Exam	NIL	07	Theory Exam (Final)	NIL	08	Report-1 (Synopsis)	10	09	Report-2 (Final report)	20	10	Report-3	NIL	11	Project -1	40	12	Project -2	NIL	13	Project -3	NIL	14	Lab Evaluation - I	NIL	15	Lab Evaluation - II	NIL	16	Course portfolio	NIL		<b>Total (100)</b>	<b>100</b>
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Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
	<b>Statistical Data Analysis-II</b>	<b>3</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>5</b>

### Syllabus:

Bayesian Statistics: Bayesian concepts: Bayesian versus frequentist probability, exchangeability and the likelihood principle, choice of prior distributions, the likelihood function, summarizing the posterior distribution, conjugate priors, Markov Chain Monte Carlo methods: Gibbs sampler, Metropolis-Hastings, slice, sampling, etc. Bayesian estimation: (multivariate) linear regression, choice models: logit, probit, multinomial, longitudinal data analysis, Bayesian hypothesis testing, Bayesian variable selection, Bayesian decision theory

Experimental Design: General concepts: randomization, adaptive randomization, blocking and stratification, bias, confounding, Sample size calculation: exact and approximation methods using simulation, Designs for ANOVA: screening design, block experiments, full and fractional factorial designs (aliasing and confounding), multiple comparisons, designs with randomization restrictions, orthogonal designs, Design of experiments using R/Python

Data Estimation and Forecasting: Density Estimation, Recursive Partitioning, Smoothers and Generalized Additive Models, Survival Analysis, Analyzing Longitudinal Data, Principal Component Analysis, Multidimensional Scaling, Cluster Analysis, Introduction and Objectives of time series Identification of trend Variation in Time series, Secular Variation, Cyclical Variation Seasonal Variation and Irregular Variation Methods of Estimating Trends Choosing Appropriate Forecasting Model, Reliability and hazard rate, Failure time distribution, reliability of series and parallel systems, exponential model in reliability and life testing, Data analysis using R/Python

Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
<b>CS2103</b>	<b>Cloud based Big Data System-II</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>4</b>

**Syllabus:**

Large Scale Data Storage, Distributed Key-Value Store, Storage Using Ceph, HIVE, Tez, SWIFT, Dropbox. Querying big data with Hive - Comparison with SQL Language - From SQL to HiveQL. Big Data & Machine Learning Spark & SparkML, H2O, Azure ML.



Course code	Course Title	Teaching Scheme				
		L	T	P	S	Credits
CS2104	Advanced Machine Learning Algorithms	3	0	4	0	5

### Syllabus:

Introduction to Advanced Machine Learning, DBSCAN Clustering, Agglomerative clustering, Spectral Clustering, Self-Organizing Map, Naïve Bayes Classifier, Ensemble Methods  
 Overview of Artificial Neural Networks Lecture: Multilayer Feedforward Neural networks with Sigmoidal activation functions; Concept of Hidden Layers, Backpropagation Algorithm, Extreme Learning Machines, Introduction to Deep Learning,  
 Multidimensional analysis and descriptive mining of complex data objects; Spatial data mining; Multimedia data mining; Text mining; Web Mining, Outlier analysis, data mining applications; Social impact of Data mining, Pattern Recognition, Image Analysis.

<b>Course Title and Code: Industrial Project-II (PR2107)</b>			
Hours per Week	4 months		
Credits	<b>16</b>		
Students who can take	M.Tech Semester-IV (Batch: 2018-2020) <b>Core</b>		
<b>Course Objective:</b>			
<p>The purpose of the Industry Project is to give students the opportunity to gain an insight into the operation of their field of study and develop an understanding of their profession in a professional context. By enabling students to observe the day-to-day operations of an organization and to prepare a research project based on these observations, with the guidance of a work place and academic supervisor, students will develop a critical perspective of their profession. Students will attend pre and post placement classes to guide the development of their research project, the sourcing of their host organization and the protocols associated with the placement.</p>			
<b>After course completion, the student will be able to:</b>			
<ol style="list-style-type: none"> <li>1. Identify skills and capabilities that intersect effectively with the needs of industry.</li> <li>2. Apply and practice good communication skills in the workplace setting.</li> <li>3. Reflect and evaluate on experiences that might lead to future employment.</li> <li>4. Report research findings in written and verbal forms.</li> <li>5. Demonstrate and apply research skills to complete a project.</li> </ol>			
<b>Evaluation Scheme:</b>			
<b>Expert Evaluation</b>	<b>Evaluation Component</b>	<b>Mid-Term</b>	<b>Final Term</b>
Industry Expert	Day to Day Task Record	20	40
	Report Content & Presentation	10	30
JKLU faculty	Reporting Activity Fortnightly	08	18
	Presentation, Viva, Report	20	50
	Coordinator Feedback	02	02
<b>Total</b>		<b>60</b>	<b>140</b>

### **Course Syllabi:**

Dissertation-II/ Industrial Project-II/Entrepreneurial Project-II - The students who work on a project are expected to work towards the goals and milestones set in Dissertation-II / Industrial Project-II/ Entrepreneurial Project-II. The problem can be extension of Dissertation-I/ Industrial Project-I /Entrepreneurial Project-I or a new problem. The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. At the end there would be a demonstration of the solution and possible future work on the same

problem. The student will have to present the progress of the work through seminars and progress reports.

#### **Operation Procedure**

- Student has to devote full semester for Dissertation/Industrial Project/Entrepreneurial Project.
- Student has to report to the Supervisor regularly.
- Dissertation-II/ Industrial Project-II/Entrepreneurial Project-II evaluation has to be carried out in the presence of a two-member Committee comprising.
- Experts in the relevant area constituted by the Supervisor.
- Final Seminar Report to be submitted has to be in formal hard bound cover bearing of the Institute emblem.

#### **Reference Books and Tools:**

Based on literature survey to be done with peer reviewed journals and magazines and relevant tools required to build the project.