

Program: B. Tech- Data Science				Semester : VIII	
Course/Module: Capstone project				Module Code : BTDS08001	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -- in Question Paper)
0	16	0	8	Scaled to 50 marks	-

Pre-requisite: All subjects of B. Tech Data Science

#### Objectives:

Student to understand topics in Data Science and its application to solve any one or more industry problems

#### Outcomes:

After completion of the course, students would be able to:

- It is expected to come up with a paper in reputed journal with guidance from any faculty members

#### Detailed Syllabus: (per session plan)

Unit	Description
1	Contemporary research papers review
2	Identification of problem statement
3	Data collection and validation
4	Tool identification and usage
5	Technique to solve the problem including Model building
6	Model validation
7	Research
8	Publication
9	Next steps
10	Final Project presentation in front of industry/expert panel

#### Text Books:

1. Contemporary research paper review

#### Reference Books: NA

#### Any other information: NIL

Total Marks of Internal Continuous Assessment (ICA): 50 Marks

#### Distribution of ICA Marks:

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
Total Marks :	50



**Details of Term work:**

1. Practical based on 10 Experiments
2. Two class tests.
3. Minimum two assignments



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(Prepared by Concerned Faculty/HOD)



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(Approved by Dean)

<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Financial Engineering and Risk Management (Elective)</b>				<b>Module Code: BTDS08002</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks
<b>Pre-requisite:</b> Nil					
<b>Objectives:</b> After gaining knowledge in basic finance, interested students for this elective subject will learn application on statistical and stochastic methods and processes on financial data and gain advanced knowledge to find deep insight from financial data to make business impact.					
<b>Outcomes:</b> After completion of the course, students would be able to: <ul style="list-style-type: none"> <li>• In this course you will learn to write a document using R markdown, integrate live R code into a literate statistical program, compile R markdown documents using knitr and related tools, and organize a data analysis so that it is reproducible and accessible to others.</li> </ul>					
<b>Detailed Syllabus: ( per session plan )</b>					
Unit	<b>Description</b>				<b>Duration</b>
1	Real Estate and its role in shaping economics development.				4
2	Forecasting methodology- does quantitative approach gives best result?				4
3	Retail sector of the country: present and future				4
4	Macroeconomics- policies, problems, necessary actions				4
5	Business cycles - real estate and economics				4
6	Smart cities: govt. should take this forward for better business environment				4
7	Sustainable development - a necessary condition for sustainable economy				4
8	Financial Risk- overview, definition, types of financial risk, financial and non-financial risks				4
9	Basel Accord and Risk management <ul style="list-style-type: none"> <li>• Evolution of Basel Accords,</li> <li>• Basel I, Basel II and Basel III,</li> <li>• Regulatory mechanism for risk management,</li> <li>• Capital to Risk Weighted Asset ratio (CRAR)</li> </ul>				7



10	Credit risk modelling <ul style="list-style-type: none"> <li>• Standardized approach and IRB approach</li> <li>• Probability of default (PD), loss given default (LGD) and exposure at default (EAD)</li> <li>• Credit rating system</li> <li>• Credit scoring model: Z-Score model, Logistic model to estimate PD</li> <li>• KMV model</li> <li>• Credit matrix and other credit risk models</li> <li>• Credit default swap</li> </ul>	7
11	Operational risk (OR) modelling <ul style="list-style-type: none"> <li>• Definition and concept of OR</li> <li>• Basel II and operational risk management</li> <li>• Operational risk management framework- identification, assessment, measurement and management</li> <li>• Computation of OR capital charge- BIA, TSA and AMA</li> <li>• Advanced measurement Approach (AMA) to model OR</li> <li>• Monte-Carlo simulation to compute OpVaR</li> <li>• Quantitative and qualitative elements of OR management</li> </ul>	7
12	Market risk modelling <ul style="list-style-type: none"> <li>• Definition and types of market risk</li> <li>• Value at Risk (VAR)</li> <li>• Variance co-variance approach</li> <li>• Historical simulation approach</li> </ul>	7
<b>Total</b>		<b>60</b>

**Text Books:** Case Study approach

**Reference Books:**

1. Reto R. Gallati. "Risk management and capital adequacy", McGraw - Hill publication. 2003.
2. Philippe Jorion. "Financial risk manager handbook", GARP.

**Any other information:**

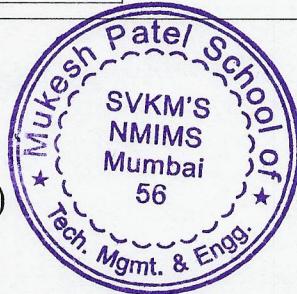
**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

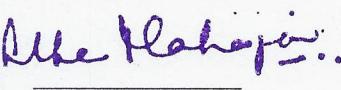
**Distribution of ICA Marks:**

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
<b>Total Marks :</b>	<b>50</b>

  
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<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Marketing Analytics (Elective)</b>				<b>Module Code: BTDS08003</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Prerequisite:** Statistics, Advanced Business Analytics, Research Methodology, working with excel sheets.

**Objectives:**

- To understand the role of analytical techniques and computer spreadsheet models and metrics for marketing decisions
- To provide exposure to examples demonstrating the value of data-based marketing in managerial context

**Outcomes:**

After completion of the course, students would be able to:

- Enables its participant to put together data, models and analyses and translate concepts into context specific strategic and tactical marketing decisions
- Enhances skills in viewing marketing processes and relationships systematically and analytically

**Detailed Syllabus: ( per session plan )**

Unit	Description	Duration
1.	Introduction to the marketing response models, their properties and related concepts	5
2.	Segmentation and Targeting Decisions using cluster analysis and discriminant analysis	6
3.	Leveraging data to make positioning decisions through perceptual and preference maps	6
4.	Customer Life time value	5
5.	New Product Decisions using conjoint analysis	5
6.	Optimizing Resource Allocation Decisions	6
7.	Advertising and Communications Decisions ADBUDG	6
8.	Sales Force and Channel Decisions: allocating sales revenues,	7
9.	Pricing and Decisions : Value in use pricing and Demand oriented	7
10.	Brand Analytics – Measuring brand value	7
	<b>Total</b>	60



**Prescribed text:**

1. Lilien G. L, Rangaswamy A. and Bruyn A. (2012). *Principles of Marketing Engineering*. Trafford Publishers

**Reference Books:**

1. Venkatesan, R.; Farris, P.; Wilcox, R. T. (2014), *Cutting Edge Marketing Analytics: Real World Cases and Data Sets for Hands on Learning*, Pearson FT Press
2. Sorger, S. (2013), *Marketing Analytics: Strategic Models and Metrics*, CreateSpace Independent Publishing Platform
3. Mark J. (2010), *Data-Driven Marketing: The 15 Metrics Everyone in Marketing Should Know*, Wiley
4. Winston, W. L. (2014), *Marketing Analytics: Data-Driven Techniques with Microsoft Excel*, Wiley.

**Any other information:**

**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

**Distribution of ICA Marks:**

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
<b>Total Marks :</b>	<b>50</b>

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<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Operation and Supply Chain Analytics (Elective)</b>				<b>Module Code: BTDS08004</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite:** Nil

**Objectives:**

- To provide advanced Knowledge and methodologies for Price and Revenue Optimization and Risk Analysis in Operations, Project Management and Supply Chain Management.

**Outcomes:**

After completion of the course, students would be able to:

- Students will be able to learn advanced concepts and Tools and apply them to the analysis of real data sets from different fields.
- Will become proficient to model and solve problems with adv. software Tools.

**Detailed Syllabus: ( per session plan )**

Unit	Description	Duration
1	Introduction What is Price and Revenue Optimization?	3
2	Review of Pricing Theory : Market Segmentation with differential Pricing	3
3	Quantitative Models of Consumer Demand	3
4	Regression Model	3
5	Quantitative Models of Consumer Demand Models of Consumer Demand; Reservation Prices; Aggregate Demand Models; Discrete Choice Models	3
6	Consumer Choice Models	2
7	Customized Pricing	2
8	Pricing as Constrained Optimization	2
9	Markdown Management (in Poor Market and Retail scenario)	2
10	Capacity Control by Linear Programming ; Capacity Control with Stochastic Demand	3
11	Implementation Challenges in PRO	3
12	Yield Management Optimal Ordering for Style Goods	2
	Annual Planning(Aggregate Planning) under Uncertainty	3



**SVKM's NMIMS**  
**Mukesh Patel School of Technology Management & Engineering**

15	Manpower scheduling under uncertainty	2
16	Optimal Plant Capacity planning under stochastic environment	3
17	Optimal Truck Loading	3
18	Decision making under uncertainty	3
19	Optimal Bidding in great uncertainty (oil and Gas , Elect Power)	4
20	Optimal Machine Replacement / Reconditioning decision	4
21	Capital Budgeting with uncertain machine usage pattern	4
	<b>Total</b>	<b>60</b>

**Text Books:**

1. Price and Revenue Optimization -Don T. Phillips
2. Decision Making under uncertainty with Palisade Risk Optimizer for EXCEL-Wayne Winston

**Reference Books/Reading Materials:**

1. Statistics for Management, Seventh Edition, by Richard I. Levin, David S. Rubin, Pearson
2. Operations Research -Hillier , Liebermann
3. Profit and Revenue Management related Cases and Journal Articles from Airlines, Hotel , Travel Industry

**Software's:**

1. Microsoft EXCEL, Palisade Decision Tools ([www.palisade.com](http://www.palisade.com)) , LINDO/LINGO

**Any other information:**

**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

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<b>Total Marks :</b>	<b>50</b>

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<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Human Resource Analytics (Elective)</b>				<b>Module Code: BTDS08005</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
<b>Lecture (Hours per week)</b>	<b>Practical (Hours per week)</b>	<b>Tutorial (Hours per week)</b>	<b>Credit</b>	<b>Internal Continuous Assessment (ICA) (Marks -50)</b>	<b>Term End Examinations (TEE) (Marks -70 in Question Paper)</b>
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite: NIL**

**Objectives:**

- To be as effective as possible in HR you have to be able to make decisions based on data and evidence—the same way people in the line of business do.
- Want to prove and communicate the value of HR and talent programs to the business, you need to possess some foundational analytical skills. We're not talking about the ability to do statistical calculations—most organizations have experts who do that with data.
- It's something that is more valuable—increasing your ability to gain insight from data and use it to communicate and make decisions.
- HR can't be all about feelings—it is the combination of understanding people, knowing the business, and using data for decisions that will make you more of a strategic partner and more valuable to your clients.

**Outcomes:**

After completion of the course, students would be able to :

- Understand all pillars of HR function and their analytics
- Understand HR data for decision making
- Critical decision making applying different techniques
- Making your organization grow and different from others

**Detailed Syllabus: ( per session plan )**

<b>Unit</b>	<b>Description</b>	<b>Duration</b>
1	<p>The Role of Data in HR: The Transformation of HR</p> <ul style="list-style-type: none"> <li>• Why analytics matters</li> <li>• Types of analytics: descriptive/predictive/prescriptive</li> <li>• The analytics continuum</li> <li>• The Talent Management Value Chain: What outcomes can HR directly impact?</li> <li>• Applying Analytics</li> </ul> <p>Case Study: Talent Acquisition at NCR</p>	10
2	<p>Analytical Thinking</p> <ul style="list-style-type: none"> <li>• Developing &amp; Testing Your Hypothesis</li> <li>• Hypothesis: a possible answer</li> <li>• Knowing what to measure</li> <li>• Use path diagrams to identify drivers and surface hypotheses</li> <li>• Correlation does not equal causation</li> <li>• Test your hypothesis with rigorous scientific methods</li> </ul>	15



	<ul style="list-style-type: none"> <li>• Helpful Statistics, Sample size and control groups</li> <li>• Regression modeling, Assessing p-value, R, and R-squared</li> <li>• Common Errors to Avoid, Review results in context, Confirmation bias</li> <li>• Accessing the Data You Need</li> <li>• Overcoming Obstacles, Difficulties with data, Types of Data, Structured and unstructured data, "Big data"</li> <li>• Common sources of data and how to integrate them</li> <li>• Privacy and confidentiality concerns</li> <li>• Handling Data: Hands-on Practice</li> </ul>	
3	<p>Spotting mistakes</p> <ul style="list-style-type: none"> <li>• Missing data</li> <li>• Standardizing data</li> <li>• Applying Analytics</li> <li>• Case Study: Manager Performance and Employee Engagement at Google</li> </ul>	11
4	<p>Analytics Practice</p> <ul style="list-style-type: none"> <li>• Working with Data: Hands-on Practice</li> <li>• Clean and prepare data</li> <li>• Integrate data from multiple sources (HRIS/LMS)</li> <li>• Generate hypotheses based on the data</li> <li>• Standardize the data</li> <li>• Test hypothesis using pivot tables</li> <li>• Extend exploration of data using multiple regression analysis</li> <li>• Applying Analytics</li> </ul> <p>Case Study: Talent Retention at Credit Suisse</p>	12
5	<p>Practical Steps to Get Started</p> <ul style="list-style-type: none"> <li>• Moving Up the Continuum</li> <li>• Keys to success in analytics</li> <li>• Telling a Story with Data</li> <li>• The importance of narrative</li> <li>• Graphics and visualization</li> <li>• Objection handling: How to handle pushback</li> <li>• Building a Team</li> <li>• Gathering the skills you need</li> <li>• Getting stakeholders aligned</li> <li>• Tips and Inspiration</li> </ul> <p>Case Study: Workforce Planning at GE Aviation</p>	12
	Total	60



**Text Books:**

1. Winning on HR Analytics: Leveraging Data for Competitive Advantage, by Kuldeep Singh and Ramesh Soundararajan, 2016
2. Predictive HR Analytics: Mastering the HR Metric, by Kirsten Edwards and Martin Edwards, 2016
3. The Practical Guide to HR Analytics, by Shonna D. Waters, Valerie N. Streets, Johnson-Murray Rachael, Lindsay McFarlane, 2018

**Reference Books:**

1. Data-Driven HR: How to Use Analytics and Metrics to Drive Performance, by Bernard Marr, 2018
2. The New HR Analytics: Predicting the Economic Value of Your Company's Human Capital Investments, by Jac Fitz-enz, 2015
3. Doing Hr Analytics: A Practitioner's Handbook With R Examples, by Lyndon Sundmark, 2017

**Any other information:**

**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

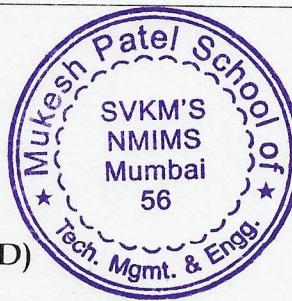
**Distribution of ICA Marks:**

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
Total Marks :	50



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(Approved by Dean)

<b>Program : B. Tech – Data Science</b>				<b>Semester : VIII</b>	
<b>Course/Module : Design Thinking (Elective)</b>				<b>Module Code : BTDS08006</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite:** None

**Objectives:**

- Understand the concept of Design thinking through engaging the students in projects/ assignments that illustrate the various pillars of Design thinking
- Understand the fundamental concepts related to Innovation
- Understand the stages of Design process that leads to Innovation
- Understand the importance of creating a marketing, operational and financial plan for the Innovative idea in order to take the idea to the market.
- Learn about the Strategy canvas used by companies to launch new offerings
- Apply the Process of Design thinking to achieve Innovation
- Design a game on AI framework

**Course Outcomes:**

After completion of the course, students would be able to:

- Develop a human centered approach to problem solving
- Apply design thinking principles to come up with innovative solutions to the problems, as new products, services, experiences or new Business models.
- Develop a low fidelity prototype of the alternative Solutions to the identified Problem
- Design a Business Plan for his own Project

**Detailed Syllabus:**

Unit	Description	Duration
1	<p><b>The Concept of Innovation and it's need in today's dynamic environment</b></p> <p>Introducing the Concept of Design thinking; Pillars of Design thinking, Illustrated with examples and assignments</p> <p>Reading: HBR Article on Design Thinking</p> <p>Case: ABC Nightline- IDEO Shopping Cart</p> <p>CO 1</p>	2
2	<p><b>Applied Design Thinking in Business &amp; Strategy, 10 Design Thinking Principles; Tools for the Design Journey</b></p> <p>Group Activity: Understanding of Issues/ Challenges and Application of DT Principles in the Campus</p> <p>CO 1</p>	3
3	<p><b>Process of Design:</b> The Phases used in a Design Process for Business goals:</p> <p>The five phases of the module are akin to 'Empathize', 'Define', 'Ideate', 'Prototype' and 'Take to market'.</p> <p>Assignment – 1 begins: Develop a new product/service using the Design Process</p>	3



	Step -1 (A): Empathy - Understanding the pain points through shadowing, personal interactions etc. CO 1	
4	<b>Step - 1 (B):</b> Empathy Phase – Observations and Insights, Stakeholder canvas (Direct and Indirect users, influencers, Facilitators) Class Activity – Listing Pain points related to the project CO 1	4
5	<b>Step - 1 (C):</b> Empathy Phase – Empathetic design Class Activity – Making the Stakeholder canvas and User journey map for the project CO 1	4
6	<b>Step - 2 (A):</b> Define – Conceptual Modelling. Developing affinity diagrams using clustering of observations and drawing insights from them Class Activity: Affinity diagrams based on observations and insights CO 2	4
7	<b>Step - 2 (B):</b> Define – Developing “How May We...” questions for finalizing the problem statement for Innovation project Class Activity: Develop “How May We...” questions for project CO 2	4
8	<b>Step - 3 (A):</b> Ideate – Brainstorming/ Brain writing to generate ideas for solutions to the identified problem Class Activity: Brainstorming/ Brain writing Session of Student's Project (Idea) CO 2	4
9	<b>Step - 3 (B):</b> Ideate – Idea Menu/ Decision Matrix/ Co- Creation & other creativity tools to generate ideas for solutions to the identified problem Class Activity: Brainstorm Session for selecting top 3 ideas for Student's Project CO 2	3
1	<b>Step - 4 (A):</b> Prototype – Techniques of prototyping, examples of Jugaad, improvisations, Creating User journey maps after the solution is implemented CO 1  Case: Autodesk, Pg. 164 ('Design a Better Business'), Creating User journey maps	5
2	<b>Step - 4 (B):</b> Prototype - Presentations by students showcasing the low fidelity prototypes of their “Innovations” developed through the Design Process in semester - VII CO 2  Class Activity – Showcasing low fidelity prototypes and User journey maps after solution is implemented	4
3	<b>Stage - 5:</b> Take to Market - Concept of Strategy Canvas CO 2  Stage - 5: Take to Market – Using the Strategy canvas to showcase the business strategy of the Innovation developed by the student. Class Activity: Presentation by Students on Strategy Canvas	4



	CO 1 and 2	
5	<b>Stage - 5:</b> Take to Market – Blue ocean strategy, Four Action Framework; The Buyer Experience Cycle, The Price Corridor; Manoeuvring Organizational Hurdles CO 1 and 2	4
6	<b>Formulation</b> of Appropriate Marketing Strategy and Link with Financial Strategy -1 CO 1 and 2 Activity – Creating the Financial plan	4
7	<b>Formulation</b> of Appropriate Marketing Strategy and Link with Financial Strategy -1 CO 1 and 2 Activity – Concept Show	4
	<b>Total</b>	60

#### **Text Books:**

1. Design Thinking Methodology Book Paperback, ArtBizTech, Emrah Yayici, (2016)
2. Design Thinking for Strategic Innovation, by Idris Mootee, CEO Idea Couture, Wiley (2014)
3. Blue Ocean Strategy, by W. Chan Kim & Renee Mauborgne (2015)
4. New Business Road Test, by John Mullins (2017)

#### **Reference Books:**

1. "SL Schensul, JJ Schensul, MD LeCompte", (latest reprint) Essential Ethnographic Methods: Observations, Interviews, and Questionnaires: 2 (Ethnographer's Toolkit), <https://rowman.com/ISBN/9780759122017>
2. Paddy Miller, Thomas Wedell- Wedellsborg, (2013), Innovation as Usual: How to Help Your People Bring Great Ideas to Life, HBR Press
3. Tim Brown, (2010), Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HBR Press
4. "SL Schensul, JJ Schensul, MD LeCompte", (latest reprint) Essential Ethnographic Methods: Observations, Interviews, and Questionnaires: 2 (Ethnographer's Toolkit), <https://rowman.com/ISBN/9780759122017>
5. Patrick van der Pijl, Justin Lokitz and Lisa Kay Solomon, "Design a Better Business", Wiley (2016).
6. Vijay Kumar, (2012), 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, Kindle edition.

#### **Articles:**

HBR: Reading and Discussions: What is Disruptive Innovation by Christensen et.al  
<https://hbr.org/2015/12/what-is-disruptive-innovation>

#### **Internet references:**

1. Knowledge@Wharton 'Reverse Innovation': GE Makes India a Lab for Global Markets



2. HBR IDEO Article on Design Thinking: <https://www.ideo.com/post/design-thinking-in-harvard-business-review>

#### **Details of Internal Continuous Assessment (ICA)**

Guidelines for evaluation: -

- The student's projects will be evaluated as the following stage gates: -
1. Empathies Stage Deliverables- eg. Crucial observations/ identifying actionable pain-points, Stakeholder canvas (Direct & Indirect users, Influencers, Facilitators), User Journey Map
  2. Define Stage Deliverables- eg. Affinity Diagrams based on Observations & Insights and 'How Might We...?' Questions
  3. Ideation Stage Deliverables- eg. Brain writing 6-3-5 Worksheet, Brainstorming on Clusters of solutions with Dot Voting/ Post-it Voting

**Any other information:**

**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

**Distribution of ICA Marks:**

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
<b>Total Marks :</b>	<b>50</b>



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<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Network Analytics (Elective)</b>				<b>Module Code: BTDS08007</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite:** Programming, Big Data, DBMS

**Objectives:**

- Want to understand your data network structure and how it changes under different conditions.
- Curious to know how to identify closely interacting clusters within a graph.
- you have heard of the fast-growing area of graph analytics and want to learn more
- This course gives you a broad overview of the field of graph analytics so you can learn new ways to model, store, retrieve and analyze graph-structured data

**Outcomes:**

After completion of the course, students would be able to:

After completing this course, you will be able to model a problem into a graph database and perform analytical tasks over the graph in a scalable manner. Better yet, you will be able to apply these techniques to understand the significance of your data sets for your own projects.

**Detailed Syllabus: ( per session plan )**

Unit	Description	Duration
1	Get a first exposure to graphs and their use in everyday life. <ul style="list-style-type: none"> <li>Create a graph applying core mathematical properties of graphs, and identify the kinds of analysis questions one might be able to ask of such a graph.</li> <li>How graphical representations might enable you to answer new Big Data problems</li> </ul>	06
2	Graph Analytics: <ul style="list-style-type: none"> <li>Why graphs</li> <li>What and how Graph Analytics techniques can help</li> <li>Graph Vrs Big Data</li> <li>Case studies: Graphs in               <ol style="list-style-type: none"> <li>Social Media</li> <li>Human Network</li> <li>Smart cities</li> <li>Biology</li> </ol> </li> </ul>	12
3	<ul style="list-style-type: none"> <li>Path Analytics</li> <li>Connectivity Analytics</li> <li>Community Analytics with Centrality Analytics</li> </ul>	08



4	Adding Modifying graph Basic Queries Connectivity with neo4j (open source) software, Download, installation and usage for neo4j Import data Path and connectivity analytics	08
5	Large Scale graph processing Parallel programming model for graphs Vertex computation	06
6	Beyond single vertex computation	04
7	Dataset and Libraries for examples for Analytics hands on	04
8	Hands on: building a graph Building and plotting a degree histogram	04
9	Network connectivity and clustering components	04
10	Different kind of joining graph datasets	04
<b>Total</b>		<b>60</b>

**Text Books:**

1. Graph Algorithms: Practical Examples in Apache Spark and Neo4j, by Amy E. Hodler and Mark Needham, 2019
2. Practical Graph Analytics with Apache Giraph, by Claudio Martella, Dionysios Logothetis, and Roman Shaposhnik, 2015
3. Systems for Big Graph Analytics, by Da Yan, James Cheng, and Yuanyuan Tian, 2017
4. Big Graph Analytics Platforms, by Da Yan, Amol Deshpande, Yuanyuan Tian, Yingyi Bu, 2017

**Reference Books:**

1. A First Course in Graph Theory, by Gary Chartrand and Ping Zhang, 2012
2. Graph-Based Social Media Analysis, Ioannis Pitas, 2017
3. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, David Loshin, 2013
4. Large-Scale Graph Processing Using Apache Giraph, by Sherif Sakr, Faisal Moeen Orakzai, Zuhair Khayyat, Ibrahim Abdelaziz, 2017
5. Spatio-Temporal Graph Data Analytics, by Shashi Shekhar and Venkata M. V. Gunturi, 2017



Any other information:

Total Marks of Internal Continuous Assessment (ICA): 50 Marks

Distribution of ICA Marks:

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
Total Marks :	50



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<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Advanced Neural Network (Elective)</b>				<b>Module Code: BTDS08008</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite:** Probability/Python/Deep learning/Neural Network

**Objectives:**

Aim to understand sequential data, relationship between previous data and current data by building a Long Short-term memory model of Neural Network

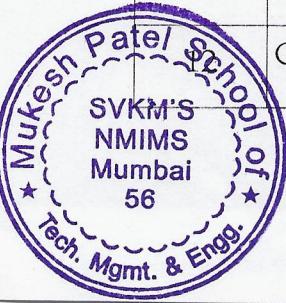
**Outcomes:**

After completion of the course, students would be able to :

- Understand Neural network
- Advance research in LSTM

**Detailed Syllabus: ( per session plan )**

Unit	Description	Duration
1	Understanding Neural network	4
2	Understanding Time Series	12
3	Different models in time series (ARIMA, ARMA etc.)	3
4	AI Neural Network in financial Data	3
5	Recurrence Neural Network and its advantage and disadvantage	4
6	Long Short-term Memory Model	6
7	Model Building	4
8	Model Validation	4
9	Working with Time series data (Sensex)	4
10	Model Validation	4
11	Model Deployment	6
	Conclusion with a project	6



Total	60								
<b>Text Books:</b>									
1. RECURRENT NEURAL NETWORKS, Design and Applications, by L.R. Medsker, L.C. Jain, 2016									
2. Time Series Analysis Forecasting and Control Authors: George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung · Publicaton: Wiley - 2015									
<b>Reference Books:</b>									
1. <a href="http://www.statslab.cam.ac.uk/~rrwl/opt/O.pdf">http://www.statslab.cam.ac.uk/~rrwl/opt/O.pdf</a>									
<b>Any other information:</b>									
<b>Total Marks of Internal Continuous Assessment (ICA): 50 Marks</b>									
<b>Distribution of ICA Marks:</b>									
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(Approved by Dean)

<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Cloud Computing (Elective)</b>				<b>Module Code: BTDS08009</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite:** Information Storage & Management, Computer Networks

**Objectives:**

1. The course educates students on building cloud infrastructure based on a cloud computing reference model.
2. The course also covers technologies, components, processes, and mechanisms of cloud infrastructure
3. This course prepares students to take the EMC Cloud Infrastructure and Services Associate Certification (EMCCIS).

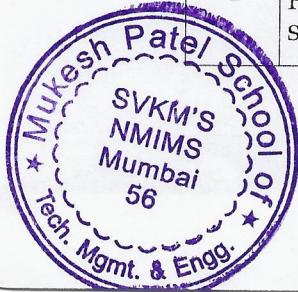
**Outcomes:**

After completion of the course, students would be able to:

1. Understand the fundamental concepts of cloud computing
2. Understand building cloud infrastructure and infrastructure components.
3. Analyse service and orchestration layers and understand business continuity.
4. Understand cloud security and service management.

**Detailed Syllabus: ( per session plan )**

Unit	Description	Duration
1	<b>Introduction:</b> Essential characteristics of cloud computing, Cloud service models and cloud service brokerage, Cloud deployment models	07
2	<b>Building the Cloud Infrastructure:</b> Cloud computing reference model, Deployment options and solutions for building cloud infrastructure, Considerations for building cloud infrastructure	07
3	<b>Cloud Infrastructure Components:</b> <b>Physical Layer:</b> Compute system, Storage system architectures, Network connectivity <b>Virtual Layer:</b> Virtual layer functions, Virtualization software, Resource pool and virtual resources <b>Control Layer:</b> Control layer functions, Control software, Software defined approach for managing IT infrastructure, Resource optimization techniques	18
4	<b>Service and Orchestration Layers:</b> Service layer functions, Cloud portal, Cloud interface standards, Protocols for accessing cloud services - Service orchestration, Cloud service lifecycle	10



5	<b>Business Continuity:</b> Business continuity and service availability, Fault tolerance mechanisms, Backup and replication, Cloud application resiliency	08
6	<b>Cloud Security and Service Management:</b> Cloud security threats - Cloud security mechanisms - Governance, risk, and compliance, Service portfolio management processes - Service operation management processes	10
	<b>Total</b>	60

**Text Books:**

1. Dr. Kumar Saurabh, "Cloud Computing: Insights into New-Era Infrastructure", Wiley India, First Edition, 2011 ISBN: 978-81-265-2833-7.

**Reference Books:**

1. Anthony T.Velte, "Cloud Computing: A Practical", Tata Mcgraw Hill Education Private Limited (2009) ISBN: 0070683514
2. Halper Fern, Kaufman Marcia, Bloor Robin, Hurwit Judith, "Cloud Computing For Dummies", Wiley India Pvt. Ltd. (2009) ISBN: 8126524871
3. Michael Miller, "Cloud Computing Web- based applications that change the way you work and collaborate online", Pearson, 2013 ISBN:978-81-317-2533-7

**Any other information:**

**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

**Distribution of ICA Marks:**

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
<b>Total Marks :</b>	<b>50</b>

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(Approved by Dean)

<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Web Analytics (Elective)</b>				<b>Module Code: BTDS08010</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite:** DS I and DS II

**Objectives:**

- Understanding extraction of insight from unstructured web. Text analytics is the process of analyzing unstructured text, extracting relevant information, and transforming it into useful business intelligence.
- Building model around Sentiment analysis determines if an expression is positive, negative, or neutral, and to what degree

**Outcomes:**

After completion of the course, students would be able to:

After the course students will be equipped with tools and knowledge to extract information and insight from web, text to make business impact. Students also will be equipped to understand sentiments from unstructured information flow from web or streams

**Detailed Syllabus: ( per session plan )**

Unit	Description	Duration
1	Part of speech tagging, Syntactic analysis, Semantic analysis, Ambiguity, Text representation, especially bag-of-words representation, Context of a word; context similarity, Paradigmatic relation, Syntagmatic relation	08
2	Entropy, Conditional entropy, Mutual information, Topic and coverage of topic, Language model, Generative model, Unigram language model, Word distribution, Background language model, Parameters of a probabilistic model, Likelihood, Bayes rule, Maximum likelihood estimation, Prior and posterior distributions, Bayesian estimation & inference, Maximum a posteriori (MAP) estimate, Prior model, Posterior mode	08
3	Mixture model, Component model, Constraints on probabilities, Probabilistic Latent Semantic Analysis (PLSA), Expectation-Maximization (EM) algorithm, E-step and M-step, Hidden variables, Hill climbing, Local maximum, Latent Dirichlet Allocation (LDA)	08



4	Clustering, document clustering, and term clustering, Clustering bias, Perspective of similarity, Mixture model, likelihood, and maximum likelihood estimation, EM algorithm, E-step, M-step, underflow, normalization (to avoid underflow), Hierarchical Agglomerative Clustering, and k-Means, Direction evaluation (of clustering), indirect evaluation (of clustering), Text categorization, topic categorization, sentiment categorization, email routing, Spam filtering, Naïve Bayes	08
5	Generative classifier vs. discriminative classifier, Training data, Logistic regression, K-Nearest Neighbor classifier, Support Vector Machine (SVM), margin, and linear separator, Classification accuracy, precision, recall, F measure, macro-averaging, and micro-averaging, Opinion holder, opinion target, sentiment, opinion representation, Sentiment classification, Features, n-grams, frequent patterns, and over-fitting, Ordinal logistic regression, Rating prediction	14
6	Aspect rating and aspect weight, Latent aspect rating analysis (LARA), Latent rating regression model, Generative model, Rating prediction, Normal/Gaussian distribution, Prior vs. posterior probability, Text-based prediction, The "data mining loop", Context (of text data) and contextual text mining, Contextual probabilistic latent semantic analysis (CPLSA): views of a topic and coverage of topics, Spatiotemporal trends of topics, Event impact analysis, Network-regularized topic modeling, NetPLSA, Causal topics, Iterative topic modeling with time series supervision	14
<b>Total</b>		60

**Text Books:**

1. C. Zhai and S. Massung, *Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining*. ACM and Morgan & Claypool Publishers, 2016
2. Manning, Chris D., Prabhakar Raghavan, and Hinrich Schütze. *Introduction to Information Retrieval*. Cambridge: Cambridge University Press, 2007

**Reference Books/Materials:**

1. Chris Manning and Hinrich Schütze, *Foundations of Statistical Natural Language Processing*. MIT Press. Cambridge, MA: May 1999. (Chapter 5 on collocations)
2. Chengxiang Zhai, *Exploiting context to identify lexical atoms: A statistical view of linguistic context*. Proceedings of the International and Interdisciplinary Conference on Modelling and Using Context (CONTEXT-97), Rio de Janeiro, Brazil, Feb. 4-6, 1997. pp. 119-129.
3. Shan Jiang and ChengXiang Zhai, *Random walks on adjacency graphs for mining lexical relations from big text data*. Proceedings of IEEE BigData Conference 2014, pp. 549-554.

Blei, D. 2012. *Probabilistic Topic Models*. Communications of the ACM 55 (4): 77-84. doi: 10.1145/2133806.2133826.



5. Qiaozhu Mei, Xuehua Shen, and ChengXiang Zhai. *Automatic Labeling of Multinomial Topic Models*. Proceedings of ACM KDD 2007, pp. 490-499, DOI=10.1145/1281192.1281246.
6. Yue Lu, Qiaozhu Mei, and Chengxiang Zhai. 2011. *Investigating task performance of probabilistic topic models: an empirical study of PLSA and LDA*. Information Retrieval, 14, 2 (April 2011), 178-203. doi: 10.1007/s10791-010-9141-9.
7. Yang, Yiming. *An Evaluation of Statistical Approaches to Text Categorization*. Inf. Retr. 1, 1-2 (May 1999), 69-90. doi: 10.1023/A:1009982220290
8. Yang, Yiming. An Evaluation of Statistical Approaches to Text Categorization. Inf. Retr. 1, 1-2 (May 1999), 69-90. doi: 10.1023/A:1009982220290
9. Bing Liu, *Sentiment analysis and opinion mining*. Morgan & Claypool Publishers, 2012.
10. Bo Pang and Lillian Lee, *Opinion mining and sentiment analysis, Foundations and Trends in Information Retrieval* 2(1-2), pp. 1-135, 2008.
11. Hongning Wang, Yue Lu, and ChengXiang Zhai, *Latent aspect rating analysis on review text data: a rating regression approach*. In Proceedings of ACM KDD 2010, pp. 783-792, 2010. doi: 10.1145/1835804.1835903
12. Hongning Wang, Yue Lu, and ChengXiang Zhai. 2011. *Latent aspect rating analysis without aspect keyword supervision*. In Proceedings of ACM KDD 2011, pp. 618-626. doi: 10.1145/2020408.2020505
13. ChengXiang Zhai, Atulya Velivelli, and Bei Yu. *A cross-collection mixture model for comparative text mining*. In Proceedings of the 10th ACM SIGKDD international conference on knowledge discovery and data mining (KDD 2004). ACM, New York, NY, USA, 743-748. doi: 10.1145/1014052.1014150
14. Qiaozhu Mei, Contextual Text Mining, Ph.D. Thesis, University of Illinois at Urbana-Champaign, 2009.
15. Noah Smith, *Text-Driven Forecasting*. Retrieved May 31, 2015 from <http://www.cs.cmu.edu/~nasmith/papers/smith.whitepaper10.pdf>

**Any other information:**

**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

**Distribution of ICA Marks:**

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
<b>Total Marks :</b>	<b>50</b>

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<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Block Chain (Elective)</b>				<b>Module Code: BTDS08011</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite:**

Any Computer Programming

**Objectives:**

- The course is designed to introduce students to the concepts of Block-chain and its platforms - Bitcoin, Ethereum, Hyper-ledger and Multi-Chain.
- The course provides an overview of the structure and mechanism of Block-chain and the Ethereum ecosystem, how smart contracts are developed using Solidity and how to deploy a business network using Hyper-ledger Composer

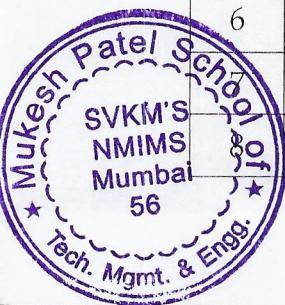
**Outcomes:**

After completion of the course, students would be able to:

- Learn how Block-chain and Bitcoin work.
- Learn programming in the ethereum ecosystem & develop Smart Contracts using Solidity.
- Develop application & use cases in Block-chain.
- Create Block-chain Architecture

**Detailed Syllabus: ( per session plan )**

Unit	Description	Duration
1	<b>Introduction to Block-chain</b> Block-Chain defined, Ethereum Block-chain, Algorithms & Techniques, Trust Essentials	4
2	<b>Smart Contracts:</b> Smart Contract Basics, Solidity, Putting it all Together, Best	4
3	<b>Decentralized Applications (Dapps):</b> Decentralized Applications (Dapps), Truffle Development, Design Improvements, Application Models & Standards	4
4	<b>Block-Chain Platforms:</b> Permissioned Block-chains, Decentralized Applications Platforms, Challenges & Solutions, Alternative Decentralized Solutions	4
5	<b>Block-chain Application Development:</b> Decentralized Applications, interacting with the Bitcoin Block-chain, setting up Libraries and Accounts, creating a smart contract, Executing Smart Contract Functions.	4
6	<b>Business Use Cases</b>	4
	<b>Technology Use Cases</b>	4
	<b>Legal and Governance Use Cases</b>	4



9	Private Block-chain Platforms and Use Cases	4
10	Challenges for Block-chain	4
11	Sample Applications	4
12	<b>Block-chain Architecture:</b> Introduction, Existing Block-chain Platforms, Variety of Block-chain Platforms, Use Cases	4
13	<b>Block-chain in Software Architecture:</b> Design Process for Applications on Block-chain, Model Driven Engineering for Block-chain Applications	4
14	<b>Other factors</b> Cost, Performance, Dependability and Security	4
15	<b>Case Studies:</b> Agri Digital, Secure Vote and Origin Chain	4
	<b>Total</b>	<b>60</b>

**Text Books:**

1. Block-chain Technology Explained, by Alan T. Norman, 2017
2. Blockchain Revolution, by Alex Tapscott and Don Tapscott, 2016
3. Mastering Blockchain, by Imran Bashir, 2017

**Reference Books:**

1. The Business Blockchain, by William Mougayar, 2016
2. The Truth Machine: The Blockchain and the Future of Everything, by Michael J. Casey and Paul Vigna, 2018
3. Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond, by Chris Burniske and Jack Tatar, 2017

**Any other information:**

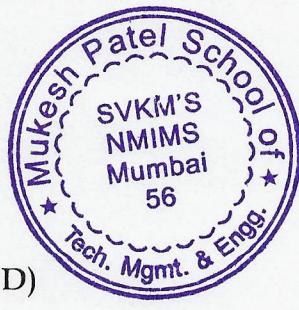
**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

**Distribution of ICA Marks:**

Description of ICA	Marks
Test Marks	20
Term Work Marks	30
Total Marks :	50

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<b>Program: B. Tech- Data Science</b>				<b>Semester: VIII</b>	
<b>Course/Module : Simulation Modeling (Elective)</b>				<b>Module Code: BTDS08012</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Internal Continuous Assessment (ICA) (Marks -50)	Term End Examinations (TEE) (Marks -70 in Question Paper)
3	2	0	4	Scaled to 30 marks	Scaled to 70 Marks

**Pre-requisite:** Programming, Algorithm, CS

**Objectives:**

This course gives you an introduction to modeling methods and simulation tools for a wide range of natural phenomena. The different methodologies that will be presented here can be applied to very wide range of topics such as

- Fluid motion, stellar dynamics, population evolution etc.
- This course does not intend to go deeply into any numerical method or process and does not provide any recipe for the resolution of a particular problem
- It is rather a basic guideline towards different methodologies that can be applied to solve any kind of problem and help you pick the one best suited for you.

The assignments of this course will be made as practical as possible in order to allow you to actually create from scratch short programs that will solve simple problems. Although programming will be used extensively in this course we do not require any advanced programming experience in order to complete it.

**Outcomes:**

After completion of the course, students would be able to:

- Sound understanding of overview and general ideas about modeling and simulation
- Dynamical systems modeling is the principal method developed to study time-space dependent problems
- Understanding of concept of cellular automata by outlining the basic building blocks of this method
- Understanding of introduction to the lattice Boltzmann method, a powerful tool in computational fluid dynamics.

**Detailed Syllabus: ( per session plan )**

Unit	Description	Duration
1	Introduction and general concepts	4
2	Dynamical systems and numerical integration	4
3	Cellular Automata	4
	Lattice Boltzmann modeling of fluid flow	5
	Particles and point-like objects	5



**SVKM's NMIMS**  
**Mukesh Patel School of Technology Management & Engineering**

6	Introduction to Discrete Events Simulation	5
7	Agent based models	6
8	Basic Modeling Concepts: Discrete-time and Continuous-Time Systems	6
9	Modeling Cyber Components: Finite State Machines, Computations, Algorithms, and a First CPS Model	6
10	Modeling Interfaces for Cyber-Physical Systems: Conversion, Networks, and Complete CPS Models	8
11	Trajectories in CPS and Simulations: Time Domains, Executions, and Complete CPS Models	7
	<b>Total</b>	<b>60</b>

**Text Books:**

1. Theory of Modeling and Simulation: Discrete Event & Iterative System Computational Foundations, by Alexandre Muzy, Bernard P. Zeigler, and Ernesto Kofman, 2018
2. Theory of modeling and simulation, by Bernard P. Zeigler, 2015
3. Simulation Modeling and Analysis, by Averill Law, 2016

**Reference Books:**

1. Simulation: The Practice of Model Development and Use, by Stewart Robinson, 2014
2. Modeling and Simulation of Computer Networks and Systems: Methodologies and Applications, by Mohammad S. Obaidat, Petros Nicopolitidis, Faouzi Zarai, 2015

**Any other information:**

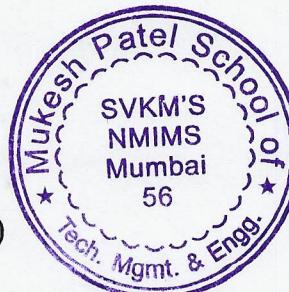
**Total Marks of Internal Continuous Assessment (ICA): 50 Marks**

**Distribution of ICA Marks:**

Description of ICA	Marks
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