



**D. Y. Patil College of  
Engineering and Technology**  
Kasaba Bawada, Kolhapur

**(An Autonomous Institute)**

**Accredited by NAAC with 'A' Grade**

**Structure and Syllabus  
of  
B. Tech in Computer Science and Engineering  
(Data Science)  
2023-24**

**Final Year B. Tech. Program in Computer Science & Engineering (Data Science)  
Semester – VII**

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme			
				Lecture	Tutorial	Practical			Type	Max. Marks	Min Marks for Passing	
1	201DSL401	PCC	Advanced Machine Learning	3			3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201DSL402	PCC	Cloud Computing	3			3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201DSL4PX	PEC	Professional Elective-II	3	1		4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
4	201DSL4OX	OEC	Open Elective-II	3	1		4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
5	201DSP408	PCC	Advanced ML Laboratory			2	1	50	ISE	25	10	20
									ESE (POE)	25	10	
6	201DSP409	PCC	Cloud Computing Laboratory			2	1	50	ISE	25	10	20
									ESE (OE)	25	10	
7	201DSP410	PROJ	Project - III			4	2	150	ISE	75	30	60
									ESE (POE)	75	30	
8	201DSP411	PROJ	Internship		\$1		4	100	ISE	30	12	40
									ESE (POE)	70	28	
<b>Total</b>				<b>12</b>	<b>2</b>	<b>8</b>	<b>22</b>	<b>750</b>	<b>-</b>	<b>750</b>	<b>300</b>	<b>300</b>

**ISE: In Semester Evaluation MSE: Mid Semester Examination ESE: End Semester Examination**

**Note 1: Tutorials and practical shall be conducted in batches with batch strength not exceeding 15 students.**

**Note 2: ESE will be conducted for 50 marks.**

**\$1: Faculty will be assigned a work load of 1 to evaluate the internship work for 10 students.**

<b>Professional Elective- II</b>	<b>Open Elective-II</b>
1. Cyber Forensics. 2. Computer Vision. 3. Business Analytics	<ul style="list-style-type: none"> <li>• List Attached</li> </ul>

**Open Elective:**

Open elective courses are offered to gain the knowledge of multidisciplinary areas. Students must choose one open elective course from the list of courses offered by other departments (excluding open elective courses offered by their department). Following is the list of open elective courses. The detailed syllabus is available on to the college website under academic tab.

<b>Department</b>	<b>Subject Name</b>
Computer Science and Engineering	i) Security and Privacy in Social Networks
	ii) Web Applications Development
Electronics and Telecommunication	i) Biomedical Instrumentation
	ii) Electronic Automation
Civil	i) GPS & Remote Sensing
	ii) Smart Cities
Mechanical	i) Industrial Management (IM)
	ii) Computer Integrated Manufacturing System (CIMS)
Chemical	i) Fuel Cell Technology
	ii) Industrial Behavior and Practices
Computer Science & Engineering (Artificial Intelligent & Machine Learning)	i) AI For Everyone
	ii) Machine Learning with Python
Architecture	i) Low-Cost Housings
	ii) Sustainable Community Living

**Final Year B. Tech. Program in Computer Science & Engineering (Data Science)  
Semester – VIII**

➤ Student can choose any one track for the Semester-VIII from the following –

**1. Regular Academic Track:**

- This is the regular academic track where lectures, practical and project – V work will be conducted regularly as per the time table in the department and college campus.
- Practical batch size should be considered as 15 students per batch
- \* - For Project-V, consider the workload of 2 hours per week for each project group consisting of 4/5 students.
- The elective should be offered by the department, if the minimum number of students opting for a particular elective is 15 students and it should be taught by the concerned teacher.

ISE: In Semester Evaluation, MSE: Mid Semester Examination, ESE: End Semester Examination

Sr. No	CourseCode	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme			
				Lecture	Tutorial	Practical			Type	Max. Marks	Min Marks for Passing	
1	201DSL412	PCC	Deep Learning	3			3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201DSL413	PCC	Text Mining and Analytics	3			3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201DSL414	PEC	Time Series and Forecasting	3	1		4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
4	201DSL415	PCC	Deep Learning Laboratory			2	1	50	ISE	25	10	20
									ESE (POE)	25	10	
5	201DSL416	PCC	Time Series and Forecasting Laboratory			2	1	50	ISE	25	10	20
									ESE (OE)	25	10	
6	201DSP417	PROJ	Project-IV			4	2	100	ISE	50	20	40
									ESE (POE)	50	20	
7	201DSMOOC418	MOOC	MOOC				3	100		75	40	40
<b>Total</b>				<b>9</b>	<b>1</b>	<b>8</b>	<b>17</b>	<b>600</b>		<b>600</b>	<b>240</b>	<b>240</b>
				<b>18</b>								



**D.Y. PATIL COLLEGE OF ENGINEERING &  
TECHNOLOGY KASABA BAWADA KOLHAPUR-416006**

(An Autonomous Institute)

**B. Tech. Data Science**

(Academic Year-2023-24)

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***ISE: In Semester Evaluation MSE: Mid Semester Examination ESE: End Semester Examination.***

**Note 1: Tutorials and practical shall be conducted in batches with batch strength not exceeding 15 students.**

**Note 2: ESE will be conducted for 50 marks.**

## 2. Professional Track:

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, KOLHAPUR												
Teaching and Evaluation Scheme from Year 2023-24												
Final Year B. Tech- Computer Science & Engineering (Data Science)												
SEMESTER-VIII – Professional Track												
Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme per Week				Total Marks	Evaluation Scheme			
				Lecture	Tutorial	Practical	Credits		Type	Max. Marks	Min. for Passing	
1	201DSP419	PROJ	Professional Skill Development **	-	-	34	17	500	ISE	200	80	200
									ESE-OE	300	120	
Total				-	-	34	17	500				200

**To join this track following are the prerequisite which shall be completed by the student before choosing this track as:**

- The students must submit the willingness to this track by the end of term before start of ESE of semester – VII.
- Student can apply the Professional Track in following scenarios
  1. If student is selected in the company with PPO (Pre-placement offer) program.
  2. If student has an opportunity to work on the sponsored projects in Industry/Research Institute.
  3. If student is getting onsite Internship offer for a period from 5-6 months.
  4. If student is getting Company Training program of 3-5 months.
  5. If student want to do Entrepreneurship by starting a new startup.
- All formalities of getting offer letter permission of working in Industry / Research Institute / etc is to be done from the concerned authority in writing before starting of ESE of Sem – VII.
- Student can submit his/her application in front of the Professional Track Committee (PTC) comprising – HoD, Department T & P coordinator, T & P officer and two experts from Industry / Research Institute / etc. The decision of the committee will be final.

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- There should be a proper written communication between the Industry, TPO officer and department T & P Coordinator/HoD mentioning the details clearly as per the syllabus structure.
  - There should also be an undertaking from the students mentioning completion of the Professional Track as per Industry / Research Institute / etc. requirements and Guidelines.
  - This process must be completed before starting of the ESE semester-VII.
  - Head of the department will appoint one faculty coordinator to look after the evaluation committee work and manage all activities concerned with this track like assigning mentors to the students, organise PTC meetings, monitoring the entire process concerned with Professional Track.

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**Following are the guidelines regarding Professional Track Course:**

- a) The evaluation of the **Professional Skill Development** will be based on the work done by the student during the Onsite Internship/Company training/ PPO program/ Entrepreneurship / Research Internship for 3-6 months.
- b) The faculty mentor assigned will be responsible for monitoring and assessment of the student on weekly basis. Students must present their work to the faculty mentor every month in online mode in coordination with Industry Reporting Manager/supervisor.
- c) The ISE marks are given based on the continuous assessment done by the faculty mentor and Industry Reporting Manager/Supervisor.
- d) The ESE-OE is conducted based on the work done by the students during the Internship / Company training / PPO program / Entrepreneurship / Research Internship.
- e) The ESE-OE is to be conducted in the Industry / Research Institute / etc. where the student is doing his work. The ESE-OE will be conducted by faculty mentor and Industry Reporting Manager/Supervisor.
- f) Students should preferably complete the **Professional Global Certification** either assigned by the Industry Reporting Manager/supervisor based on his assigned work or on his own like e.g., Palo-Alto, AWS, Blue prism, Java Certifications, etc.
- g) The maximum 17 credits will be earned by the student on completion of ISE and ESE-OE.
- h) Every faculty mentor will be assigned workload of 1 hour/week for every student.
- i) Industry / Research Institute / etc. should provide certificate of completion of assigned task along with grading like O – Outstanding, E – Excellent, VG – Very Good, G – Good, S – Satisfactory, P – Poor before the conduct of ESE-OE exam.



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**B. Tech. Data Science**

**SEM-VII (Academic Year-2023-24)**

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# **Semester VII**



**Course Plan**

<b>Course Title: Advanced Machine Learning</b>	
<b>Course Code: 201DSL401</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P: 3-0-0</b>	<b>Credits: 3</b>
<b>Evaluation Scheme: ISE: 20 + MSE: 30</b>	<b>ESE Marks: 50</b>

**Course Description:**

This course improves understanding of machine learning. Explore advanced techniques and how to use them. The topics covered will be Artificial Neural Network, Back Propagation algorithm, Ensemble learning and Recommendation system, Dimensionality Reduction, Evolutionary Learning and Applications of Machine Learning.

**Course Objectives:**

1. To understand the fundamentals of Artificial Neural Networks (ANNs) and their training algorithms.
2. To Gain knowledge of ensemble learning methods and their applications in recommendation systems.
3. To explore evolutionary learning techniques and their components, along with an introduction to reinforcement learning.
4. To learn dimensionality reduction techniques and their practical implementation, along with the application of machine learning in various domains.

**Course Outcomes (COs):**

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

<b>401.1</b>	Describe Artificial Neural Networks (ANNs) for solving problems.	Apply
<b>401.2</b>	Implement ensemble learning techniques and evaluate recommendation systems.	Apply
<b>401.3</b>	Develop a foundational understanding of evolutionary learning algorithms and their relevance in optimization problems.	Apply
<b>401.4</b>	Utilize dimensionality reduction techniques and apply machine learning in diverse domains.	Understand

<b>Prerequisite:</b>	Machine Learning
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
401.1	2	3	2	2	-	-	-	-	-	-	-	2	2	-	3
401.2	2	2	2	2	-	-	-	-	-	-	-	2	1	-	3
401.3	1	2	3	2	-	-	-	-	-	-	-	2	2	-	3
401.4	2	2	2	2	-	-	-	-	-	-	-	2	1	-	2

Content	Hours
<b>Unit 1: Artificial Neural Network:</b> The brain and the Neuron- Hebb's rule, McCulloch and Pits Neurons. Perceptron – Representational Power of Perceptrons. The Perceptron Training Rule. Gradient Decent and Delta Rule. Multilayer Perceptron algorithm.	05
<b>Unit 2: Multilayer Network:</b> Feed forward Network- Multilayer networks and Back Propagation algorithm, The Differentiable Threshold Unit, The Back propagation Algorithm, Introduction to hyperparameters and their significance in neural networks Popular hyperparameters to tune (e.g., learning rate, batch size, number of hidden units) Grid search and random search techniques Hyperparameter optimization using libraries (e.g., scikit-learn, Keras)	05
<b>Unit 3: Ensemble learning and Recommendation system:</b> Overview of bagging, boosting, and stacking techniques, comparing ensemble learning with single models. Bagging and Random Forests: Bagging technique and model aggregation, Feature importance and variable selection in Random Forests Boosting Algorithms: Introduction to boosting algorithms (e.g., AdaBoost, Gradient Boosting), Adapting weak learners into strong learners. Recommendation Systems: Overview of collaborative filtering and content-based filtering, Evaluation metrics for recommendation systems.	08
<b>Unit 4: Introduction to Evolutionary Learning and Reinforcement Learning:</b> Introduction to Evolutionary Algorithms: Components and overview. Genetic Algorithms and Genetic Operators: Population selection, and variation. Fitness Evaluation and Selection Mechanisms: Assessing fitness and selecting solutions. Evolutionary Strategies: Introduction to strategies and variants, CMA-ES. Reinforcement Learning: Markov decision processes, Q-Learning, SARSA. Policy Gradient Methods: Policy gradient algorithms (e.g., REINFORCE), A2C, PPO.	08

<p><b>Unit 5: Dimensionality Reduction:</b></p> <p>Introduction to Dimensionality Reduction: Linear Discriminate Analysis LDA for classification Algorithm and steps, Principal Component Analysis: CA for dimensionality reduction Algorithm and interpretation, Nonlinear techniques Kernel PCA, Sparse PCA, Incremental PCA. Evaluation and Interpretation Reconstruction error and visualization. Interpreting components/vectors, Dimensionality Reduction in Practice: Pre-processing and data scaling, Feature selection vs. extraction.</p>	<p>06</p>
<p><b>Unit 6: Application:</b> Machine Learning: Applications in Image Processing and Pattern Recognition, Application in Bio- informatics, Application in Digital Forensics, Application in retails and finance.</p>	<p>04</p>

**Text Books:**

1. Machine Learning – An Algorithmic Perspective by Stephen Marsland. [Unit 1,2].
2. Ensemble Learning and Recommendation Systems Thomas G. Dietterich  
Publisher: Morgan & Claypool **Publishers** ISBN-10: 1970001506 [Unit 3, 4].
3. "Pattern Recognition and Machine Learning" Author: Christopher M. Bishop  
Publisher: Springer ISBN-10: 0387310738 [5].
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" Author:  
Aurélien Géron Publisher: O'Reilly Media [6].

**Reference Books:**

1. Machine Learning by Tom M. Mitchell, International Edition 1997, McGraw Hill Education.
2. "Neural Networks and Learning Machines "Simon Haykin Pearson ISBN: 978-0131471399.
3. "Pattern Recognition and Machine Learning "Christopher M. Bishop Springer
4. Ensemble Methods in Data Mining: Improving Accuracy Through Combining Predictions "Giovanni Seni and John Elder Morgan Kaufmann.

**Online Resources:**

1. <https://livebook.manning.com/book/machine-learning-in-action/about-this-book/>
2. <https://www.coursera.org/learn/machine-learning>
3. <https://nptel.ac.in/courses/106106139>

### Course Plan

<b>Course Title: Cloud Computing</b>	
<b>Course Code: 201DSL402</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P:3-0-0</b>	<b>Credits:3</b>
<b>Evaluation Scheme: ISE+MSE Marks:20+30</b>	<b>ESE Marks: 50</b>

#### Course Description:

This course intends to develop understanding fundamentals of Distributed System, its framework taking inferences from various applications Viz. Computational technologies, parallel processing, high performance computing leading to formation of cloud and prevailing technologies. The theme of the subject envisages virtualization, services on demand and much more.

#### Course Objectives:

1. To become familiar with computational distributed system.
2. To understand Cloud Computing and its ecosystem.
3. To learn virtualization and its significance.
4. To correlate services, web services and protocol understanding.
5. To explore potential of Cloud Computing and its applications.
6. Case study of open source-based cloud system.

#### Course Outcomes:

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

<b>402.1</b>	Understand the basic concept of distributed system.	Understand
<b>402.2</b>	Describe the main concepts, key technologies, strengths, and limitations of cloud computing.	Understand
<b>402.3</b>	Explain the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud etc.	Understand
<b>402.4</b>	Explore virtualization technology and virtualization of cloud resources.	Apply
<b>402.5</b>	Perform case studies on various open source and commercial Clouds and Services.	Apply

<b>Pre-requisites:</b>	Operating Systems, Fundamentals of Computer Networks.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSO)**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
402.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
402.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
402.3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
402.4	-	-	2	-	-	-	-	-	-	-	-	-	1	-	3
402.5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	3

Content	Hours
<p><b>Unit 1: Overview of computing paradigm:</b> Definition, Goals, Types of distributed systems: Distributed computing system Information System, Architecture: Architectural Styles, System Architecture. Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Evolution of cloud computing- Business driver for adopting cloud computing.</p>	06
<p><b>Unit 2: Process and Communication:</b> Remote Procedure call, Message Oriented Transient Communication, Physical Clock Synchronization, Logical Clock, Mutual Exclusion, Election Algorithms. Introduction to Cloud Computing: Cloud Computing - Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics and Benefits of Cloud Computing.</p>	06
<p><b>Unit 3: Cloud Computing Architecture:</b> Cloud computing stack- Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, Protocols used, Role of Web services. Service Models (XaaS) - Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as eService (SaaS). Deployment Models Public cloud, Private cloud, Hybrid cloud Community cloud.</p>	06
<p><b>Unit 4: Virtualization:</b> Introduction and benefits, Implementation Levels of Virtualization, Virtualization at the OS Level, Virtualization Mechanism, Open-Source Virtualization Technology, Xen Virtualization Architecture, Binary Translation with Full Virtualization, Para virtualization, Virtualization of Memory and IO Devices, Service on Demand.</p>	07

<p><b>Unit 5: Infrastructure as a Service (IaaS):</b> Introduction to IaaS-IaaS definition, Introduction to virtualization, Different Approaches to virtualization, Hypervisors, Machine Image, and Virtual Machine (VM). Resource (Server, Storage, Network, Platform) utilization through Virtualization. Virtual Machine (resource) provisioning and management, Storage as a service- Data storage in cloud computing, Chargeable services, Pricing priority and penalization. Platform as a Service (PaaS): Introduction to PaaS-What is PaaS, Service Oriented Architecture (SOA). Cloud Platform and Management -computation, storage Software as a Service (SaaS): Introduction to SaaS, Webservices, Web2.0, WebOS, Case Study on SaaS.</p>	06
<p><b>Unit6: Case study on Open Source and Commercial Clouds:</b> Amazon EC2, Google Compute Engine, Microsoft Azure, Cloud foundry, OpenStack.</p>	05

### Text Books

1. Tanenbaum, “Distributed System: Principles and Paradigms”, Steen. Unit 1, 2.
2. Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper, “Cloud Computing for Dummies”, Wiley India Edition, Unit -1,2,4,5.
3. Jayaswal, Kallakurchi, Houde, Shah, Jayaswal, Kallakurchi, Houde, Shah, “Cloud Computing Black Book”, Unit-3.
4. Ronald Krutz and Russell Dean Vines, “Cloud Security”, Wiley-India, Unit-6.

### Reference Books

1. Google Apps, Scott Granneman, Pearson.
2. Cloud Security & Privacy, Tim Mather, S. Kumara swammy, S. Latif, SPD, O'REILLY.
3. Cloud Computing: A Practical Approach, Anthony T.Velte ,et.al, McGrawHill.
4. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley India.

### Online Resources:

1. [https://onlinecourses.nptel.ac.in/noc21\\_cs14/preview](https://onlinecourses.nptel.ac.in/noc21_cs14/preview)
2. <https://www.shiksha.com/online-courses/cloud-computing-by-nptel-course-nptel18>

**Course Plan**

<b>Course Title: Cyber Forensics</b>	
<b>Course Code: 201DSL403</b> <b>Professional Elective-II (PEC)</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P: 3-1-0</b>	<b>Credits: 4</b>
<b>Evaluation Scheme: ISE: 20 + MSE: 30</b>	<b>ESE Marks: 50</b>

**Course Description:**

This comprehensive course provides a thorough understanding of cyber forensics, equipping participants with the essential knowledge and skills required to investigate digital crimes and analyze digital evidence. The course covers a wide range of concepts, including the use of cyber forensics in law enforcement, cyber forensics services, benefits of professional forensics methodology, and the steps taken by cyber forensics specialists.

**Course Objectives:**

1. To learn computer forensics.
2. To become familiar with forensics tools.
3. To analyze and validate forensics data.
4. To understand cyber laws.

**Course Outcomes (COs):**

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

<b>403.1</b>	Understand the basics of computer forensics and Evidence collection	Understand
<b>403.2</b>	Analyze and validate forensics data	Analyze
<b>403.3</b>	Explore the current cyber forensic tools.	Understand
<b>403.4</b>	Describe the cyber laws.	Understand

<b>Prerequisite:</b>	Information Security.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
403.1	2	2	-	2	-	-	-	2	-	-	-	2	1	-	2
403.2	2	2	-	2	-	-	-	2	-	-	-	2	-	1	4
403.3	2	2	2	2	-	-	-	2	-	-	-	2	1	-	2
403.4	2	2	-	-	-	-	-	2	-	-	-	2	-	-	2

Content	Hours
<b>Unit 1: Computer Forensics Fundamentals:</b> Introduction to Computer forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Services, Benefits of professional Forensics Methodology, Steps taken by Computer Forensics Specialists, Types of Computer Forensics Technology, Computer Forensics Evidence and capture.	05
<b>Unit 2: Evidence Collection:</b> Why Collect Evidence? Types of Evidence, Methods of Collections, Collection Steps, Duplication and Preservation of Digital Evidence, Computer image Verification and Authentication.	06
<b>Unit 3: Digital Forensics Analysis and Validation:</b> Determining what data to collect and analyse, validating forensic data, addressing data-hiding techniques, performing remote acquisitions, Network Forensics: Network forensic overview, Processing crime at incident scenes.	06
<b>Unit 4: E-Mail and Social Media Investigations:</b> E-mail investigations: Exploring the role of email in investigations, Exploring the Roles of the Client and Server in E-mail, Investigating E-mail Crimes and Violation, Understanding E-mail Servers.	07
<b>Unit 5: Mobile Device and Cloud Forensics:</b> Understanding Mobile Device Forensics, Understanding Acquisition Procedures for Mobile Devices, An Overview of Cloud Computing, Legal Challenges in Cloud Forensics, Technical Challenges in Cloud Forensics, Tools for Cloud Forensics.	07
<b>Unit 6: Laws and Acts:</b> Computer Crime and Cyber Crime, Types of Cyber Crimes, Indian Laws on Cyber Crimes, Privacy of Online Data, Electronic records.	05



Sr. No	Name of Assignment	S/O	Hours
1.	Write a note discussing the role and significance of computer forensics in law enforcement.	S	1
2.	Create a presentation on the different types of computer forensics technology and their applications in digital investigations.	O	1
3.	Develop a case study highlighting the benefits of using professional forensic methodology in a specific computer forensics investigation.	S	1
4.	Explain the steps taken by computer forensics specialists when handling a digital evidence case.	S	1
5.	Discuss the importance of duplication and preservation of digital evidence in computer forensics, and develop a protocol for ensuring its integrity.	S	1
6.	Analyze the process of determining what data to collect and analyze in a computer forensics investigation, and discuss the challenges and considerations involved.	O	1
7.	Explore different techniques for validating forensic data and addressing data-hiding techniques, and provide examples of real-world cases where these techniques were crucial.	S	1
8.	Examining the interaction between clients and servers during email communication.	S	1
9.	Exploring the challenges and techniques specific to mobile device investigations.	O	1
10.	Compare and contrast different tools used for cloud forensic tools, and provide a critical analysis of their strengths and limitations.	O	1
11.	Write a report on the laws and ethical considerations that govern computer forensics, including the Digital Evidence Controls, Evidence Handling Procedures, and relevant Indian acts such as the IPC, CrPC, and Electronic Communication Privacy Act.	S	1

**Text Books:**

1. Computer Forensics, Computer Crime Investigation by John R, Vacca, Firewall Media, New Delhi (Unit 1,2).
2. Guide to computer forensics and investigations, Bill Nelson, Amelia Philips and Christopher Steuart, course technology, 5th Edition, 2015 Unit (3,4,5).
3. Cyber Crime and Laws, DR.U. S. Pandey, DR. Virender Kumar, Himalaya Publishing House. (Unit 6).

**Reference Books:**

1. Real Digital Forensics by Keith j. Jones, Richard Bejtlich, Curtis W. Rose, Addison Wesley Pearson Education.
2. Forensic Compiling, A Tractitioneris Guide by Tony Sammes and Brain Jenkinson, Springer International edition.

3. Computer Evidence Collection & Presentation by Christopher L.T. Brown, Firewall Media.

**Online Resources:**

1. [https://onlinecourses.swyam2.ac.in/cec20\\_lb06/preview](https://onlinecourses.swyam2.ac.in/cec20_lb06/preview)
2. <https://www.classcentral.com/course/swyam-information-security-and-cyber-forensics-23006>

### Course Plan

<b>Course Title: Computer Vision</b>	
<b>Course Code: 201DSL404</b> <b>Professional Elective-II (PEC)</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P: 3-1-0</b>	<b>Credits: 4</b>
<b>Evaluation Scheme: ISE+MSE Marks: 20+30</b>	<b>ESE Marks: 50</b>

#### Course Description:

This course provides an introduction to computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding.

#### Course Objectives:

1. To cover the fundamentals and mathematical models in digital image processing and Machine Vision
2. To develop time and frequency domain techniques for image enhancement.
3. To expose the students to classification techniques in Machine Vision
4. To develop Applications using image processing and Machine Vision

#### Course Outcomes (COs):

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

<b>404.1</b>	Understand and master basic knowledge, theories and methods in image processing and computer vision.	Understand
<b>404.2</b>	Identify, formulate and solve problems in image processing and computer vision	Understand
<b>404.3</b>	Analyze, evaluate and examine existing practical computer vision systems	Analyze
<b>404.4</b>	Interpret and analyze 2D signals in Spatial and frequency domain through image transforms.	Apply
<b>404.5</b>	Apply quantitative models of image processing for segmentation and restoration for various applications.	Apply

<b>Prerequisite:</b>	Probability, Statistics, Linear Algebra and Image Processing.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
404.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
404.2	-	-	3	-	-	-	-	-	-	-	-	-	1	-	2
404.3	-	-	2	1	2	-	-	-	-	-	-	-	1	-	4
404.4	-	-	2	1	1	-	-	-	-	-	-	-	1	-	3
404.5	-	-	-	-	2	-	-	-	-	-	-	-	1	1	3

Content	Hours
<b>Unit 1: Overview of Computer Vision:</b> Computer vision, image processing, elements of image processing, The Human Eye, Computer versus Human Vision Systems, Evolution of Computer Vision, application of computer vision.	06
<b>Unit 2: Digital Image Processing:</b> Imaging geometry, image sampling, image enhancement, image segmentation, image filtering, Photo metric image Lighting, reflectance and shading, optics, digital camera sampling and aliasing, colour, compression	06
<b>Unit 3: Geometric Techniques in Computer Vision:</b> Image Transformations, Camera Projection, Camera Calibration, Depth from Stereo, Two View Structure from Motion, Object Tracking, computing image gradient, representing image gradient, finding corners and building neighbourhood, describing neighbourhood with SIFT and HOG features.	06
<b>Unit 4: Linear Filters and transforms:</b> Linear filters and convolution, shift invariant Linear system, spatial frequency and Fourier transforms, sampling and aliasing, filters as template, Normalized correlation and finding patterns.	06
<b>Unit 5: Motion Analysis:</b> Differential motion Analysis, Optical Flow, Analysis based on correspondence of interest points, Detection of specific motion Patterns, Video Tracking	06
<b>Unit 6: Deep Learning for Computer Vision:</b> Image Classification, Object Detection, Face detection, face recognition, eigen faces, car on roads, Semantic Segmentation, Metric learning.	06

Sr. No	Name of Assignment	S/O	Hours
1.	Create your first computer vision model with keras the Convolutional Classifier in Python.	O	1
2.	Discover how convnets create features with convolutional layers as Convolution and ReLU.	O	1
3.	Learn more about features extraction with maximum pooling.	O	1
4.	Explore two important parameters: stride and padding.	O	1
5.	Design you own convnet (Custom Convnet).	O	1
6.	Boost performance by creating extra training data (Data Augmentation).	O	1
7.	Implement an image processing pipeline in Python using OpenCV for tasks like image enhancement, segmentation, and filtering.	O	1
8.	Develop a basic image segmentation algorithm using thresholding or region-growing techniques.	O	1

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**Text Books:**

1. "Computer Vision: A Modern Approach", by Forsyth and Ponce (Unit 1,2,3).
2. "Multiple View Geometry in Computer Vision", by Hartley and Isserman (Unit 4,5,6).
3. Sheila Anand and L. Priya, —A Guide for Machine Vision in Quality Control, Taylor & Francis Inc, Imprint CRC Press Inc, Dec 2019.
4. Rafael C. Gonzalez and Richard E. Woods, —Digital Image Processing, Pearson.
5. Computer Vision: Principles, Algorithms, Applications, Learning by E. R. Davies.
6. Computer Vision: Models, Learning, and Inference by Simon J. D. Prince.

**Reference Books:**

1. Computer Vision - A Modern Approach - D. Forsyth, J. Ponce.pdf
2. Ballard, Dana H. and Christopher M. Brown - Computer Vision, Prentice-Hall, Englewood Cliffs NJ (ISBN 0-13-165316-4).

**Online Resources**

1. <https://viso.ai/computer-vision/computer-vision-books/>
2. <https://computer-vision-handbook/general-vision.html>

### Course Plan

<b>Course Title: Business Analytics.</b>	
<b>Course Code: 201DSL405</b> <b>Professional Elective-II (PEC)</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P: 3-1-0</b>	<b>Credits: 4</b>
<b>Evaluation Scheme: ISE+MSE Marks: 20+30</b>	<b>ESE Marks: 50</b>

#### Course Description:

This comprehensive course introduces the dynamic field of business analytics. Explore data analysis history and the roles of data scientists, engineers, and analysts. Discover diverse career opportunities and essential skills. Learn data collection, management, visualization, and advanced analytics. Utilize popular tools like Excel, Power BI, and Tableau. Gain hands-on experience through practical case studies. Excel in the world of business analytics with this course.

#### Course Objectives:

1. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
2. To become familiar with the processes needed to develop, report, and analyze business data.
3. To learn how to use and apply Excel and Excel add-ins to solve business problems.

#### Course Outcomes (COs):

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

<b>405.1</b>	Understand the basics of business analysis and Data Science	Understand
<b>405.2</b>	Understand data management and handling and Data Science Project Life Cycle	Understand
<b>405.3</b>	Understand the data mining concept and its techniques	Understand
<b>405.4</b>	Understand and Analyzing machine learning concept	Analyze
<b>405.5</b>	Understand the application of business analysis in different domain	Apply

<b>Prerequisite:</b>	Business Statistics, Business intelligence
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>405.1</b>	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
<b>405.2</b>	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
<b>405.3</b>	2	1	1	-	1	-	-	-	-	-	-	1	1	-	2
<b>405.4</b>	1	-	-	1	2	-	-	-	-	-	-	1	1	-	4
<b>405.5</b>	2	2	-	2	2	-	-	-	-	-	-	1	1	1	3

Content	Hours
<p><b>Unit 1: Business Analytics:</b> Introduction to business analytics, Historical Overview of data analysis, Data Scientist vs. Data Engineer vs. Business Analyst, Career in Business Analytics,</p>	06
<p><b>Unit 2: Data Analytics:</b> Data Collection, Data Management, Big Data Management, Organization/sources of data, Importance of data quality, Dealing with missing or incomplete data, Data Visualization, Data Classification Data Science Project Life Cycle: Business Requirement, Data Acquisition, Data Preparation, Hypothesis and Modeling, Evaluation and Interpretation, Deployment, Operations, Optimization.</p>	06
<p><b>Unit 3: Data Analytics using Excel:</b> Basics of Excel: Organizing data with Excel - Performing simple computations and aggregations using Excel - Working with Summing and other Reporting functions in Excel - Working with pivot tables and charts, Descriptive statistics using Excel: Describe data using charts and basic statistical measures – Histograms - Pareto charts – Box plots - Tree map and Sunburst charts</p>	06
<p><b>Unit 4: Data Warehousing:</b> Data Warehousing: Identify purpose of data warehousing - Identify between key components of a data warehouse - Distinguish between data warehouses and data lakes - Determine the role of different warehousing techniques - Data Warehousing Tools: Differentiate between utility of relational DW, cubes, and in-memory scenarios -</p>	06

Compare techniques for data integration with regards to warehousing - Use warehousing tools - Use integration tools for warehousing.	
<b>Unit 5: Business Intelligence using Power BI:</b> Getting data in Power BI: Overview of Power BI Desktop - Connect to data sources in Power BI Desktop - Clean and transform data with the Query Editor - advanced data import and cleaning techniques - Cleaning irregularly formatted data - Modeling the data: Manage data relationships – Create calculated columns – Optimizing data models – Create calculated measures – Create calculated tables – Explore time-based data - Exploring data: Introduction to the Power BI service - Turn business intelligence data into data insights	06
<b>Unit 6: Application of Business Analysis: Case study using Tableau:</b> Download data from Kaggle and build the data visualization by using Tableau Software: Retail Analytics, Marketing Analytics, Financial Analytics, Healthcare Analytics, Supply Chain Analytics.	06

Sr. No	Name of Assignment	S/O	Hours
1.	Explain data mining, clustering and ETL process.	S	1
2.	With the help of tableau create data source with any server (SQL, MySQL)	O	1
3.	Create Pivot table, Pareto charts with any Kaggle data in excel.	O	1
4.	Create a simple dashboard using Kaggle data with the help of excel	O	1
5.	What are the different types of data sources that can be connected to Power BI Desktop? Provide three examples of each type.	S	1
6.	Explain the process of cleaning and transforming data using the Query Editor in Power BI Desktop. Provide an example of a common data cleaning technique.	S	1
7.	Discuss the importance of managing data relationships in Power BI Desktop. Provide an example of how you can create a calculated column to enhance data analysis.	S	1
8.	<b>CASE STUDIES USING Power BI:</b> Retail Analytics, Marketing Analytics, Financial Analytics, Healthcare Analytics, Supply Chain Analytics OR As per student's choice, building the dashboard using Power BI, tableau in any domain.	O	1

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**Text Books:**

1. Essentials of Business Analytics: An Introduction to the methodology and its application, Bhima Sankaram Pochiraju, Sridhar Seshadri, Springer.
2. G C Beri – Business Statistics, 3rd ed, TATA McGrawHill.



3. Introduction to Data Science, Laura Igual Santi Seguí, Springer.
4. Business Analysis with Microsoft Excel and Power BI, 5th edition; Conrad G. Carlberg; Pearson.
5. Data Analytics with R; Bharti Motwani; Wiley.

**Reference Books:**

1. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education India.

**Online Resources:**

1. [www.googlesearch.com](http://www.googlesearch.com)
2. [www.ibm.com](http://www.ibm.com)
3. [www.coursera.org](http://www.coursera.org)

### Course Plan

<b>Course Title: Business Intelligence and Analytics</b>	
<b>Course Code: 201DSL406</b> <b>Open Elective- II (OEC)</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P: 3-1-0</b>	<b>Credits: 4</b>
<b>Evaluation Scheme: ISE+MSE Marks: 20+30</b>	<b>ESE Marks: 50</b>

### Course Description:

Business analytics provides knowledge and skills needed to analyze data for effective decision making. This course focuses on various analytical techniques, statistical methods and visualization tools. It is a process of transforming data into actions through analysis and insights in the context of organizational, decision making and problem solving. Analytics includes a range of activities, including business intelligence, which is comprised of standard adhoc reports, queries and alerts.

### Course Objectives:

1. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
2. To become familiar with the processes needed to develop, report, and analyze business data.
3. To learn how to use and apply Excel and Excel add-ins to solve business problems.

### Course Outcomes (COs):

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

<b>406.1</b>	Study the basics of business analysis and Data Science.	Understand
<b>406.2</b>	Understand data management, handling a Data Science Project Life Cycle.	Understand
<b>406.3</b>	Apply the data mining concept and its techniques.	Apply
<b>406.4</b>	Analyze machine learning concept.	Analyze
<b>406.5</b>	Apply the application of business analysis in different domains.	Apply

<b>Prerequisite:</b>	Business Statistics, Business intelligence
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>406.1</b>	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
<b>406.2</b>	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
<b>406.3</b>	2	1	1	-	1	-	-	-	-	-	-	1	1	-	3
<b>406.4</b>	1	-	-	1	2	-	-	-	-	-	-	1	1	-	4
<b>406.5</b>	2	2	-	2	2	-	-	-	-	-	-	1	1	-	3

Content	Hours
<b>Unit 1: Introduction to Business Intelligence and Analytics:</b> Definition and importance of BI and analytics, Overview of the BI and analytics process, Trends and challenges in BI and analytics.	06
<b>Unit 2: Data Warehousing:</b> Introduction to data warehousing concepts, Dimensional modeling, Extract, transform, Load (ETL) processes, Data integration and quality.	06
<b>Unit 3: Data Mining and Predictive Analytics:</b> Introduction to data mining techniques, Data Preprocessing and feature selection, Classification and regression models, Clustering and association models.	05
<b>Unit 4: Data Analytics using Excel:</b> Basics of Excel: Organizing data with Excel - Performing simple computations and aggregations using Excel - Working with Summing and other Reporting functions in Excel - Working with pivot tables and charts, Descriptive statistics using Excel: Describe data using charts and basic statistical measures – Histograms - Pareto charts – Box plots - Tree map and Sunburst charts.	07
<b>Unit 5: Data Visualization:</b> Principles of effective data visualization, Visualization techniques and tools, Dashboard design and storytelling, Interactive visualizations and exploratory data analysis.	06
<b>Unit 6: Business Intelligence Platforms:</b> Introduction to BI platforms and tools, Reporting and dashboards, Ad-hoc querying and data discovery, Self-service BI and data democratization, Privacy and data protection, Bias and fairness in predictive analytics, Regulatory compliance (e.g., GDPR, CCPA), Ethical considerations in data-driven decision making.	06

Sr. No	Name of Assignment	S/O	Hours
1.	Explain data mining, clustering and ETL process.	S	1
2.	With the help of tableau create data source with any server (SQL, MySQL)	O	1
3.	Create Pivot table with any Kaggle data.	O	1
4.	Create a simple dashboard using Kaggle data with the help of excel	O	1
5.	Explain the purpose and benefits of reporting and dashboards in a business intelligence (BI) context. Provide an example of a key performance indicator (KPI) that can be effectively tracked and visualized using a dashboard.	S	1
6.	Describe the concept of ad-hoc querying and data discovery in BI. Discuss the advantages and limitations of allowing users to perform ad-hoc queries. Provide an example of a situation where ad-hoc querying can be beneficial for decision-making.	S	1
7.	Discuss the importance of privacy and data protection in the context of BI platforms and tools. Explain how organizations can ensure compliance with regulations such as GDPR (General Data Protection Regulation) and CCPA (California Consumer Privacy Act) while using BI systems. Provide an example of a data protection measure that can be implemented in a BI environment.	S	1
8.	Case Studies and Applications: Real-world examples of BI and analytics applications, Industry-specific use cases (Using any software Tableau, Power BI)	O	1

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#### Text Books:

1. "Business Intelligence Guidebook: From Data Integration to Analytics" by Rick Sherman (Unit 1,6)
2. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett (Unit 3)
3. "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball and Margy Ross (Unit 2)

#### Reference Books:

1. "Business Analysis with Microsoft Excel and Power BI, 5th edition; Conrad G. Carlberg; Pearson (unit 4)
2. "Data Visualization: A Handbook for Data Driven Design" by Andy Kirk (Unit 5)

#### Online Resources:

1. [www.googlesearch.com](http://www.googlesearch.com)
2. [www.ibm.com](http://www.ibm.com)
3. [www.coursera.org](http://www.coursera.org)

### Course Plan

<b>Course Title: Data Visualization and Storytelling</b>	
<b>Course Code: 201DSL407</b> <b>Open Elective- II (OEC)</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P: 3-1-0</b>	<b>Credits: 4</b>
<b>Evaluation Scheme: ISE+MSE Marks: 20+30</b>	<b>ESE Marks: 50</b>

#### Course Description:

A data storytelling approach gives the managers the ability to visualize the insights you derive from your data science problem. Data analysis is useless for you and your business if you do not know how to present the insights to your key stakeholders to make better business decisions. If we can't tell a compelling story with the data, no one will act on our analysis. In this course, we will discuss data insights through visuals and show how to make those visuals compelling and easy to understand through a series of real-world examples.

#### Course Objectives:

1. This course is designed to give participants a solid grounding in fundamental data visualization data storytelling learning concepts.
2. To become familiar with the processes needed to develop, report, and visualize business data.
3. To learn how to use and apply Excel and Excel add-ins to solve business problems.

#### Course Outcomes (COs):

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

<b>407.1</b>	Study the importance of visual communication and storytelling	Understand
<b>407.2</b>	Understand concept of data visualization.	Understand
<b>407.3</b>	Apply industry-standard tool to identify the appropriate charts, graphs, and visual elements required for data visualization.	Apply
<b>407.4</b>	Visualize data to communicate marketing and organizational strategies and get stakeholder buy-in.	Apply

<b>Prerequisite:</b>	Business Statistics, Business intelligence
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
407.1	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
407.2	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
407.3	2	1	1	-	1	-	-	-	-	-	-	1	1	-	3
407.4	1	-	-	1	2	-	-	-	-	-	-	1	1	-	3

Content	Hours
<p><b>Unit 1: Introduction to Visualization:</b> Need to visualize data and how visualization can be an essential tool for exploring and communicating complicated information. Seven stages of data visualization and various types of charts like comparison, distribution, composition, and relationship. Exploratory and Explanatory analysis.</p>	06
<p><b>Unit 2: Visual best practices:</b> Edward Tufte's visual encoding. Conversion of data into visualizations to draw valuable insights.</p>	06
<p><b>Unit 3: Visualization of Numerical Data:</b> Choosing right chart for the data on hand. Data analysis as a dashboard to provide narrative and communicate the results.</p>	06
<p><b>Unit 4: Visualization of Text data:</b> Visualization and the challenges of handling text data. Use of chart types such as word clouds, scatterplots, histograms, line charts etc. to visualize a document. Topic models, word embedding, and creating visualizations with bubble charts, bar charts, and t-SNE clusters.</p>	06
<p><b>Unit 5: Visual Storytelling:</b> Various types of visual storytelling techniques and the pitfalls of traditional presentation methods. Strategy for businesses are adapting various presentation techniques like Pecha-Kucha, Presentation Zen to improve their communication among professionals and how these techniques allow them to weave a story around their presentation to make them more thoughtful, engaging, and interesting to the audience.</p>	06
<p><b>Unit 6: Story telling framework:</b> Types of narratives: author-driven narratives and reader-driven narratives. Seven</p>	06

different types of story types and how to create a narrative around a data science problem through visualization.

**Misleading with charts:** Bad visualization can be misleading in decision making.

Sr. No	Name of Assignment	S/O	Hours
1.	Create Pecha-Kucha techniques for handling business.	O	1
2.	With the help of tableau create data source with any server (SQL,MySQL).	O	1
3.	Create Pivot table with any Kaggle data in excel.	O	1
4.	Create a simple dashboard using Kaggle data with the help of excel	O	1
5.	Explain the concepts of topic modeling and word embedding in the context of text data analysis. Discuss how these techniques can be used to uncover hidden patterns and relationships within large text datasets. Provide an example of a real-world application where topic modeling or word embedding can be used to gain insights from text data.	S	1
6.	Discuss the different types of visual storytelling techniques that can be employed in presentations. Explain how techniques such as data visualization, storytelling frameworks, and multimedia elements enhance the effectiveness of communication. Additionally, highlight the pitfalls of traditional presentation methods that may hinder effective storytelling and audience engagement.	S	1
7.	Compare and contrast author-driven narratives and reader-driven narratives. How do these narrative types differ in terms of control over the story and audience engagement? Provide examples to illustrate the characteristics of each narrative type.	S	1
8.	<b>Case Studies and Applications:</b> Real-world examples of Data Visualization and Storytelling. (Using any software Tableau, Power BI)	O	1

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**Text book/Reference Books:**

1. Storytelling With Data: A Data Visualization Guide for Business Professionals Nussbaumer Knaflic, Cole
2. Data Story: Explain Data and Inspire Action Through Story by Nancy Duarte (Author)
3. Effective Data story telling by Brent Dykes (Wiley)

**Online Resources:**

1. [www.googlesearch.com](http://www.googlesearch.com)
2. <https://www.effectivedatastorytelling.com/>
3. [https:// DataStory-Explain-Inspire-Action-Through/](https://DataStory-Explain-Inspire-Action-Through/)

**Course Plan**

<b>Course Title: Advanced Machine Learning Laboratory.</b>	
<b>Course Code: 201DSP408</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P: 0-0-2</b>	<b>Credits: 1</b>
<b>Evaluation Scheme: ISE: 25</b>	<b>ESE-POE Marks: 25</b>

**Course Description:**

This course explores machine learning techniques and their practical applications. Topics include neural networks, ensemble learning, recommendation systems, evolutionary learning, reinforcement learning, and dimensionality reduction. Through hands-on experiments, students gain proficiency in implementing and evaluating these techniques for real-world problem-solving. Emphasis is on critical evaluation and data interpretation.

**Course Objectives:**

1. Gain practical experience in implementing and training neural networks.
2. Explore ensemble learning and recommendation systems through experiments.
3. Develop skills in applying evolutionary learning and reinforcement learning.
4. Acquire practical knowledge of dimensionality reduction techniques.

**Course Outcomes (COs):**

<b>408.1</b>	Gain practical experience in implementing and applying machine learning techniques.	Understand
<b>408.2</b>	Develop proficiency in solving real-world problems and improving model performance.	Understand
<b>408.3</b>	Demonstrate the ability to select and apply appropriate techniques and evaluate their effectiveness.	Understand

<b>Prerequisite:</b>	Machine Learning
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
408.1	1	2	1	-	-	-	-	-	-	-	-	2	-	-	2
408.2	2	2	2	-	-	-	-	-	-	-	-	2	-	-	2
408.3	2	3	2	2	1	-	-	-	-	-	-	2	2	-	2

Exp. No.	Name of Experiment	S/O	Hours
1.	Implement a basic neuron model based on McCulloch and Pitts' model and observe its behavior with different inputs.	O	2
2.	Train a perception model using the Perception Training Rule on a simple binary classification problem and visualize the decision boundary.	O	2
3.	Implement a feed forward neural network with a differentiable threshold unit and train it using the back-propagation algorithm to classify handwritten digits from the MNIST dataset.	O	2
4.	Compare the performance of a single model and an ensemble model (e.g., random forest) on a dataset by measuring accuracy or F1 score	O	2
5.	Apply bagging techniques to a dataset and analyze the impact on the stability and generalization of the model.	O	2
6.	Implement AdaBoost algorithm to improve the performance of a weak learner on a binary classification task and compare the results with the weak learner alone.	O	2
7.	Build a simple recommendation system using collaborative filtering and evaluate its effectiveness by measuring the precision and recall of the recommendations.	O	2
8.	Implement a basic genetic algorithm to optimize a mathematical function and analyze the convergence behavior.	O	2
9.	Apply Q-Learning algorithm to train an agent in a simple grid world environment and observe its learning progress.	O	2
10.	Use Principal Component Analysis (PCA) for dimensionality	O	2

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	reduction on a dataset and visualize the data in a lower-dimensional space.		
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**Text Books:**

1. Machine Learning – An Algorithmic Perspective by Stephen Marsland. [Unit 1,2]
2. Ensemble Learning and Recommendation Systems Thomas G. Dietterich Publisher: Morgan & Claypool **Publishers** ISBN-10: 1970001506 [Unit 3, 4]
3. "Pattern Recognition and Machine Learning" Author: Christopher M. Bishop Publisher: Springer ISBN-10: 0387310738
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" Author: Aurélien Géron Publisher: O'Reilly Media [6]

**Reference Books:**

1. Machine Learning by Tom M. Mitchell, International Edition 1997, McGraw Hill Education
2. "Neural Networks and Learning Machines" Simon Haykin Pearson ISBN: 978-0131471399
3. "Pattern Recognition and Machine Learning" Christopher M. Bishop Springer
4. Ensemble Methods in Data Mining: Improving Accuracy Through Combining Predictions "Giovanni Seni and John Elder Morgan Kaufmann

**Course Plan**

<b>Course Title: Cloud Computing Laboratory</b>	
<b>Course Code :201DSP409</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P:0-0-2</b>	<b>Credits:1</b>
<b>Evaluation Scheme: ISE Marks :25</b>	<b>ESE-OEMarks:25</b>

**Course Description:**

The course is designed to develop skills to design and analyze Cloud Computing. It strengthens the ability to the students to identify and apply the suitable Cloud Computing for the given real-world problem. It enables them to gain knowledge in practical applications of Cloud Computing.

**Course Objectives:**

1. To Configuring the Client/Server for Distributed System.
2. To learn the how to implement different services of cloud computing
3. To learn the deployment and configuration options in Amazon (AWS), Google Cloud, and Microsoft Azure.

**Course Outcomes (COs):**

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

<b>409.1</b>	Configure various virtualization tools such as Virtual Box, VMware workstation.	Understand
<b>409.2</b>	Install OS on a Virtual Machine Monitor.	Understand
<b>409.3</b>	Study and implement infrastructure as Service using Open Stack	Apply
<b>409.4</b>	Install and configure Google App Engine.	Apply

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>406.1</b>	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>406.2</b>	-	3	3	-	-	-	-	-	-	-	-	-	-	-	2
<b>406.3</b>	-	2	2	-	-	-	-	-	-	-	-	-	1	-	3
<b>406.4</b>	3	-	3	-	-	-	-	-	-	-	-	-	-	-	3

Exp. No.	Name of Experiment	S/O	Hours
1.	RPC, RMI interface implementation	0	2
2.	Configuring the Client/Server for NTP	0	2
3.	Installation and configuration of type 1 Hypervisor. (Esxi)	0	2
4.	Installation and configuration of type 2 Hypervisor (VMware, Virtual Box, etc.)	0	2
5.	Working and Implementation of Infrastructure as a service.	0	2
6.	Working and Implementation of Software as a service.	0	2
7.	Working and Implementation of Platform as a service.	0	2
8.	Practical Implementation of Storage as a Service.	0	2
9.	Installing a private cloud.(Open Stack)	0	2
10.	Installing OS on a Virtual Machine Monitor.	0	2
11.	Offline migration of virtual OS.	0	2
12.	Live migration of virtual OS.	0	2
13.	Study and implementation of infrastructure as Service using Open Stack.	0	2
14.	Install and configure Google App Engine.	0	2
15.	Hands on virtualization using Xen Server.	0	2
16.	Hands on containerization using Docker.	0	2
17.	Deployment and Configuration options in Amazon (AWS).	0	2
18.	Deployment and Configuration options in Google Cloud.	0	2
19.	Deployment and Configuration options in Microsoft Azure.	0	2

- **S-STUDY, O-OPERATIONAL**

- **Note: Minimum of 10 Experiments to be performed from the list given above.**

**Text Books:**

1. Cloud Security, Ronald Krutz and Russell Dean Vines, Wiley-India.
2. Enterprise Cloud Computing, Gautam Shroff, Cambridge

**Reference Books:**

1. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley India.
2. Cloud Computing for Dummies, Judith Hurwitz, Marcia Kaufman, Fern Halper, Robin Bloor, Wiley Publication.

**Course Plan**

<b>Course Title: Project-III</b>	
<b>Course Code:201DSL410</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P:0-0-4</b>	<b>Credits:2</b>
<b>Evaluation Scheme: ISE marks: 75</b>	<b>ESE POE Marks: 75</b>

**Course Description:**

This course is intended for students interested in artificial intelligence. Reinforcement learning is an area.

**Course Objectives:**

1. Identify the area of project work.
2. Recognize the need and ability to engage in lifelong learning.
3. Function effectively on teams and to communicate effectively.
4. Able to prepare the technical report.

**Course Outcomes (COs):**

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

<b>410.1</b>	Explain the need of a software project for the society	Understand
<b>410.2</b>	Identify requirement analysis like functional and technical requirements for the project	Understand
<b>410.3</b>	Come up with design documents for the project consisting of Architecture, Dataflow diagram, Class Diagram, Algorithmic descriptions of various modules, collaboration diagram, ER Diagrams, Database Design Documents, Sequence Diagram, Use Case Diagram	Understand
<b>410.4</b>	Able to demonstrate analysis and design.	Apply
<b>410.5</b>	Prepare the technical report consisting of Requirement specification, Analysis and Design of Project	Apply

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>410.1</b>	1	2	1	-	-	-	-	-	-	-	-	2	-	-	2
<b>410.2</b>	2	2	2	-	-	-	-	-	-	-	-	2	-	-	2
<b>410.3</b>	2	3	2	2	1	-	-	-	-	-	-	2	2	-	2
<b>410.4</b>	2	3	2	2	1	-	-	-	-	-	-	2	2	-	3
<b>410.5</b>	2	3	2	2	1	-	-	-	-	-	-	2	2	-	3

### **Content**

The project work is to be carried out in two semesters of Final Year Data Science. The project should be undertaken preferably by a group of 4-5 students who will jointly work and implement the project in two semesters.

In Semester VII, the group will select a project with the approval of the guide (faculty member) and submit the project title. Along with the synopsis of the proposed work of maximum 8 pages before second week of August in the academic year. The group is expected to complete detailed project by the end of semester –VIII as a part of the term work submission in the form of a joint report.

The term work will be assessed by panel of teachers appointed by Head of the Department. Oral examination will be conducted by an internal and external examiner.

#### **Note:**

1. Project work should be continually evaluated based on the contributions of the group members, originality of the work, innovations brought in, research and developmental efforts, depth and applicability, etc.
2. Two mid-term evaluations should be done, which will include presentations and demos of the work done.
3. Care should be taken to avoid copying and outsourcing of the project work.

**Course Plan**

<b>Course Title: Internship</b>	
<b>Course Code:201DSL411</b>	<b>Semester: VII</b>
<b>Teaching Scheme: L-T-P:0-1-0</b>	<b>Credits:4</b>
<b>Evaluation Scheme: ISE Marks: 30</b>	<b>ESE- POE Marks: 70</b>

The students are expected to undergo **4 to 6 weeks** Internship/training in the industry and work on the relevant area as assigned by the industry. The work done should be monitored and evaluated by the concerned industry expert based on the report prepared by the student. The department has to assign faculty mentors to a student who has to communicate with the industry and monitor the entire internship related work periodically.

The scheme of evaluation as stated under: -

- a) Industry expert/ supervisor: - 70%**
- b) Department & Faculty mentor: - 30%**

**The faculty mentor will conduct presentation and submission of report, at the beginning of the subsequent semester.**

- 1) The Internship can be availed by the students during the summer vacations after completion of semester IV or VI.
- 2) The Credit of the Internship will be considered in semester VII.
- 3) Industry experts/ supervisors should assign the work of minimum 100 to 120 hours for 4 weeks duration with periodical monitoring and evaluation.
- 4) On completion of Internship work, the student is expected to prepare a report on the work done and get it certified from the industry expert and also submit it to the department.

# Semester VIII



## Regular Track Syllabus

### Course Plan

<b>Course Title: Deep Learning</b>	
<b>Course Code: 201DSL412</b>	<b>Semester: VIII</b>
<b>Teaching Scheme: L-T-P: 3-0-0</b>	<b>Credits: 3</b>
<b>Evaluation Scheme: ISE: 20 + MSE: 30</b>	<b>ESE Marks: 50</b>

### Course Description:

This comprehensive course provides an introduction to deep learning, covering topics such as perception learning algorithms, neural networks, convolutional neural networks, natural language processing using RNNs, and deep reinforcement and unsupervised learning. Students will gain a strong foundation in deep learning concepts, including data manipulation, model building, optimization, and transfer learning. The course also explores generative deep learning techniques for text and image generation. By the end of the course, students will have a solid understanding of deep learning principles and applications in various domains.

### Course Objectives:

1. To Understand deep learning concepts and perception learning algorithms.
2. To Build and train neural networks, apply CNNs for image processing, and utilize NLP techniques with RNNs.
3. To Explore deep reinforcement learning and unsupervised learning methods.
4. To Develop skills in generative modeling for text and image generation.

### Course Outcomes (COs):

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

<b>412.1</b>	Describe the fundamental concepts of deep learning and perception learning algorithms.	Understand
<b>412.2</b>	Build and train neural networks for various tasks, such as image processing and natural language processing.	Apply
<b>412.3</b>	Explore convolutional neural networks (CNNs) for advanced image analysis and transfer learning techniques.	Understand
<b>412.4</b>	Apply deep reinforcement learning and unsupervised learning methods for decision-making and generative modeling.	Understand

<b>Prerequisite:</b>	Machine Learning
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
412.1	2	2	2	2	-	-	-	-	-	-	-	2	2	-	2
412.2	2	2	2	2	-	-	-	-	-	-	-	2	1	-	3
412.3	1	2	3	2	-	-	-	-	-	-	-	2	2	-	2
412.4	2	2	2	2	-	-	-	-	-	-	-	2	1	-	2

Content	Hours
<p><b>Unit 1: Deep Learning Concepts:</b></p> <p>Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.</p>	08
<p><b>Unit 2: Neural Networks:</b></p> <p>About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data pre-processing for neural networks, Feature Engineering. Over fitting and Under Fitting. Hyper parameters.</p>	07
<p><b>Unit 3: Convolutional Neural Network:</b></p> <p>Introduction to CNN and LTI Systems. Image Processing Filtering: Convolution, Edge Detection, Blurring, Sharpening. Building a CNN: Input Layers, Convolution Layers, Pooling Layers, Dense Layers. Backpropagation in Convolutional Layers: Gradients and Weight Updates. Filters and Feature Maps: Extraction and Visualization. Transfer Learning: Pre-trained Models (Inception, VGG, ResNet), Object Detection (R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN).</p>	08
<p><b>Unit 4: Introduction To Recurrent Neural Networks:</b></p> <p>Overview of Recurrent Neural Networks (RNNs) and their applications. Key differences between RNNs and feed-forward neural networks. RNN Architecture: Recurrent connection and hidden state. Backpropagation Through Time (BPTT) algorithm for training RNNs. Addressing the vanishing and exploding gradient problems in RNNs. Introduction to Long</p>	08

Short-Term Memory (LSTM) units: Architecture, components, and advantages in capturing long-term dependencies. Bidirectional RNNs (BRNN): Benefits, architecture, and training for capturing context from both past and future inputs.	
<b>Unit 5: Deep Reinforcement &amp; Unsupervised Learning:</b> About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. Autoencoding. Convolutional Auto Encoding. Variation Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification Denoising Autoencoders, Sparse Autoencoders,	08
<b>Unit 6: Generative Deep Learning:</b> Text generation with LSTM, Deep Dream, Neural Style Transfer, Generating images with variation auto encoders, Introduction to generative adversarial network	06

**Text Books:**

1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O’Reilly Media, Inc.2017 [Unit 1].
2. Deep Learning by Ian Good fellow, Yoshua Bengio, Aaron Courvil MIT Press Book [Unit 2 3].
3. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017 [Unit 4 5] .
4. Generative Deep Learning David Foster. O’Reilly Media 2019 [Unit 6].

**Reference Books:**

1. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018.
2. Pro Deep Learning with TensorFlow, Santanu Pattana yak, Apress,2017.

**Online Resources**

1. <https://livebook.manning.com/book/machine-learning-in-action/about-this-book/>
2. <https://www.coursera.org/learn/deep-learning>
3. <https://nptel.ac.in/courses/deeplearning>

**Course Plan**

<b>Course Title: Text Mining and Analytics</b>	
<b>Course Code: 201DSL413</b>	<b>Semester: VIII</b>
<b>Teaching Scheme: L-T-P: 3-0-0</b>	<b>Credits: 3</b>
<b>Evaluation Scheme: ISE + MSE Marks:20 + 30</b>	<b>ESE Marks: 50</b>

**Course Description:**

This course provides an in-depth exploration of text mining techniques and their application in extracting meaningful information from unstructured textual data. Students will learn various methods for text preprocessing, feature extraction, and text classification. The course will also cover the use of natural language processing (NLP) libraries and tools for text analysis, sentiment analysis, topic modeling, and text visualization. Through hands-on exercises and projects, students will develop practical skills in mining and analyzing large volumes of text data.

**Course Objectives:**

- 1) To understand basic text analytics concepts and applications.
- 2) To learn fundamentals of Information retrieval and natural language processing.
- 3) To explore text analytics framework.
- 4) To discuss theoretical techniques and applications in text analytics (e.g. social media).
- 5) To identify different python packages and commands to perform text analytics.

**Course Outcomes (COs):**

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

<b>413.1</b>	Understand text mining and analytics framework.	Understand
<b>413.2</b>	Analyze various sources of text data.	Analyze
<b>413.3</b>	Design text mining models to solve problems by extracting knowledge from data.	Apply
<b>413.4</b>	Implement text mining techniques appropriately.	Apply

<b>Prerequisite:</b>	Python Programming, Exploratory Data Analysis and Visualization, Probability and Statistics.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>413.1</b>	2	2	-	-	-	-	-	-	-	-	-	2	2	-	2
<b>413.2</b>	3	2	-	-	-	-	-	-	-	-	-	2	2	-	4
<b>413.3</b>	3	2	-	-	-	-	-	-	-	-	-	2	1	-	3
<b>413.4</b>	3	2	-	-	-	-	-	-	-	-	-	2	2	-	3

Content	Hours
<p><b>Unit 1: Text Mining and its operations:</b> Defining Text Mining, General Architecture of Text Mining Systems, Core Text Mining Operations, Using Background Knowledge for Text Mining, Text Mining Query Languages, Task-Oriented Approaches.</p>	04
<p><b>Unit 2: Categorization and Clustering:</b> Categorization: Applications of Text Categorization, Definition of the Problem, Document Representation, Evaluation of Text Classifiers, Knowledge Engineering Approach to TC, Machine Learning Approach to TC, Using Unlabelled Data to Improve Classification. Clustering: Clustering Algorithms, Clustering of Textual Data, Clustering Tasks in Text Analysis, The General Clustering Problem.</p>	07
<p><b>Unit 3: Information Extraction and its Probabilistic Models:</b> Anaphora Resolution, Architecture of IE Systems, Historical Evolution of IE: The Message Understanding, Inductive Algorithms for IE, Introduction to Information Extraction, Structural IE. Hidden Markov Models, Stochastic Context-Free Grammars, Maximal Entropy Modelling, Maximal Entropy Markov Models, Conditional Random Fields.</p>	06
<p><b>Unit 4: Pre-processing applications using probabilistic and hybrid approaches:</b> Bootstrapping, Statistical-Knowledge-Based IE, Using A stochastic context-free grammar (SCFG) Rules for Hybrid, Presentation-Layer Considerations for Browsing and Query Refinement: Browsing, Accessing Constraints and Simple Specification Filters at the Presentation Layer, Accessing the Underlying Query Language.</p>	07

<p><b>Unit 5: Text Mining in Multimedia and Text Analytics in social media:</b> Introduction, Surrounding Text Mining, Tag Mining, Tag Ranking, Tag Refinement, Tag Information Enrichment, Joint Text and Visual Content Mining, Visual Re-ranking, Cross Text and Visual Content Mining, Distinct Aspects of Text in social media, Applying Text Analytics to social media, An Illustrative Example.</p>	<p>06</p>
<p><b>Unit 6: A Survey of Opinion Mining and Sentiment Analysis:</b> The Problem of Opinion Mining, Classification based on Supervised and Unsupervised Learning for Document sentiment analysis, Sentence Subjectivity and Sentiment Classification, Opinion Lexicon Expansion, Aspect-Based Sentiment Analysis, Mining Comparative Opinions and Opinion Spam Detection.</p>	<p>06</p>

**Text Books:**

1. Ronen Feldman; James Sanger. (2007). The Text Mining Handbook: advanced approaches in analysing unstructured data. Cambridge University Press. (Unit 1, 2, 3, 4).
2. Charu C. Aggarwal, Cheng Xiang Zhai, Mining Text Data, Springer (Unit 5 & 6).

**Reference Books:**

1. Introduction to Information Retrieval. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schuetze, Cambridge University Press, 2007.
2. Natural Language Processing with Python, by Bird, Steven, Edward Loper and Ewan Klein. O'Reilly Media Inc, 2009.
3. Speech and Language Processing, by Daniel Jurafsky, James H. Martin. Copyright c 2015. All rights reserved. Draft of June 26, 2015.
4. Han, J., Kamber, M., & Pei, Y. (2012). Data Mining: Concepts and Technique. 03. Morgan Kaufmann Publishers. San Francisco. ISBN: 978-0-12-381479-1.

**Online Resources:**

1. <https://www.coursera.org/learn/text-mining-analytics>

**Course Plan**

<b>Course Title: Time Series and Forecasting</b>	
<b>Course Code: 201DSL414</b>	<b>Semester: VIII</b>
<b>Teaching Scheme: L-T-P: 3-0-0</b>	<b>Credits: 3</b>
<b>Evaluation Scheme: ISE + MSE Marks:20 + 30</b>	<b>ESE Marks: 50</b>

**Course Description:**

The course will provide a basic introduction to modern time series analysis. We will cover time series regression and exploratory data analysis, ARMA/ARIMA models, model Identification /estimation/linear operators, Fourier analysis, spectral estimation, and state space models.

**Course Objectives:**

1. To understand basic analysis of time series data.
2. To understand basic concepts in time series regression.
3. To learn auto-regressive and model averaging models.
4. To learn basic concepts of spectral analysis and space-time models.
5. To utilize R for computation, visualization, and analysis of time series data.

**Course Outcomes (COs):**

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

<b>414.1</b>	Knowledge of basic concepts in time series analysis and forecasting.	Understand
<b>414.2</b>	Understanding the use of time series models for forecasting and the limitations of the methods.	Understand
<b>414.3</b>	Ability to criticize and judge time series regression models.	Apply
<b>414.4</b>	Distinguish the ARIMA modeling of stationary and non-stationary time series.	Apply
<b>414.5</b>	Compare with multivariate times series and other methods of applications.	Apply

**Prerequisite:** Data Analytics, Mathematics and Basic Programming Language.

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>414.1</b>	2	-	-	2	-	-	-	-	-	1	-	-	-	-	2
<b>414.2</b>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>414.3</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
<b>414.4</b>	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
<b>414.5</b>	3	2	-	2	-	-	-	-	-	-	2	-	-	-	3

<b>Content</b>	<b>Hours</b>
<p><b>Unit 1: Introduction of Time series Analysis:</b> Introduction to Time Series and Forecasting -Different types of data-Internal structures of time series Models for time series analysis- Auto correlation and Partial auto correlation. Examples of Time series Nature and uses of forecasting-Forecasting Process-Data for forecasting – Resources for forecasting.</p>	06
<p><b>Unit 2: Statistics Background for Forecasting:</b> Graphical Displays -Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modelling and Forecasting- Evaluating and Monitoring Forecasting Model Performance.</p>	06
<p><b>Unit 3: Time Series Regression Model:</b> Introduction - Least Squares Estimation in Linear Regression Models - Statistical Inference in Linear Regression- Prediction of New Observations - Model Adequacy Checking -Variable Selection Methods in Regression - Generalized and Weighted Least Squares- Regression Models for General Time Series Data- Exponential Smoothing-First order and Second order.</p>	06
<p><b>Unit 4: Auto-regressive Integrated Moving Average (Arima) Models:</b> Auto-regressive Moving Average (ARMA) Models - Stationary and Inevitability of ARMA Models -Checking for Stationary using Variogram- Detecting Non stationary - Auto-regressive Integrated Moving Average (ARIMA) Models - Forecasting using ARIMA - Seasonal Data - Seasonal ARIMA Models Forecasting using Seasonal ARIMA Models Introduction - Finding the “BEST” Model -Example: Internet Users Data- Model Selection Criteria - Impulse Response Function to Study the Differences in Models - Comparing Impulse Response Functions for Competing Models .</p>	06
<p><b>Unit 5: Multivariate Time Series Models and Forecasting:</b> Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis – Bayesian Methods in Forecasting.</p>	06
<p><b>Unit 6: Case Study:</b> Forecasting Demand of single product category SKUs, Time Series Forecast Case Study with Python: Annual Water Usage in Baltimore, Time-Series Econometric Forecasting: Global Forecast of the Price of a Raw Material, Analysis of Telephone Data: A Case Study of Forecasting Seasonal Time Series.</p>	06



**Text Books:**

1. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017) (Unit I & II).
2. Time Series Analysis and Forecasting By Example Søren Bisgaard Murat Kulahci Technical University Of Denmark Copyright © 2011 By John Wiley & Sons, Inc. All Rights Reserved (Unit III, IV and V).

**Reference Books:**

1. Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting Third Edition.(2016).
2. Multivariate Time Series Analysis and Applications William W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons Ltd.
3. Time Series Analysis by James D Hamilton Copyright © 1994 by prince town university press.

**Online Resources:**

1. <https://www.stat.ipb.ac.id/en/uploads/KS/S2%20%20ADW/3%20Montgomer%20%20Introduction%20to%20Time%20Series%20Analysis%20and%20Forecasting.pdf>
2. <https://ru.b-ok2.org/terms/?q=forecasting>
3. <http://home.iitj.ac.in/~parmod/document/introduction%20time%20series.pdf>
4. <https://www.coursera.org/learn/practical-time-series-analysis>
5. <https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/>
6. [https://swayam.gov.in/nd1\\_noc19\\_mg46/preview](https://swayam.gov.in/nd1_noc19_mg46/preview)

**Course Plan**

<b>Course Title: Deep Learning Laboratory</b>	
<b>Course Code: PCC 201DSL415</b>	<b>Semester: VIII</b>
<b>Teaching Scheme: L-T-P: 0-0-2</b>	<b>Credits: 1</b>
<b>Evaluation Scheme: ISE: 25</b>	<b>ESE-POE Marks: 25</b>

**Course Description:**

This hands-on course provides practical experience in deep learning through a series of experiments. Students will implement algorithms and techniques using popular frameworks, covering topics such as neural networks, CNNs for image classification, RNNs for text generation, and GANs for image synthesis. By the end of the course, students will have gained practical skills in deep learning and the ability to build and train neural networks for different application

**Course Objectives:**

1. Understand deep learning concepts and techniques, including neural networks, CNNs, RNNs, and GANs.
2. Develop practical skills in implementing and training deep learning models using popular frameworks.
3. Apply deep learning techniques to solve real-world problems in areas such as image classification, text generation, and image synthesis.
4. Evaluate and optimize the performance of deep learning models through experimentation and analysis.

**Course Outcomes (COs):**

<b>415.1</b>	Apply deep learning concepts and techniques, including neural networks, CNNs, RNNs, and GANs.	Apply
<b>415.2</b>	Implement and train deep learning models for image classification, text generation, and image synthesis.	Apply
<b>415.3</b>	Evaluate and optimize deep learning models, making informed decisions based on experimental results.	Evaluate

<b>Prerequisite:</b>	Machine Learning.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
415.1	1	2	1	-	-	-	-	-	-	-	-	2	-	-	2
415.2	2	2	2	-	-	-	-	-	-	-	-	2	-	-	2
415.3	2	3	2	2	1	-	-	-	-	-	-	2	2	-	6

Exp. No.	Name of Experiment	S/O	Hours
1.	Installation of Anaconda or Miniconda and working with TensorFlow and Keras	O	2
2.	Introduction and working with Google Colab for using GPUs and TPUs for large projects	O	2
3.	Implement a perceptron algorithm to classify a linearly separable dataset.	O	2
4.	Build a feed forward neural network using a deep learning framework and train it to classify images from the MNIST dataset.	O	2
5.	Compare the performance of different activation functions (e.g., ReLU, sigmoid) on a classification task using a neural network.	O	2
6.	Experiment with various optimization algorithms (e.g., stochastic gradient descent, Adam) and observe their impact on model convergence.	O	2
7.	Develop a convolution neural network (CNN) to classify images from the CIFAR-10 dataset and evaluate its accuracy.	O	2
8.	Apply data augmentation techniques, such as rotation and horizontal flipping, to enhance the performance of a CNN on an image classification task.	O	2
9.	Fine-tune a pre-trained CNN model (e.g., VGG16) on a different dataset and measure its transfer learning capabilities.	O	2

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<b>10.</b>	Build a recurrent neural network (RNN) with LSTM cells to generate text based on a given input sequence.	O	2
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• **S-STUDY, O-OPERATIONAL**

**Text Books:**

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017 [Unit 1]
2. Deep Learning by Ian Good fellow, Yoshua Bengio, Aaron Courvil MIT Press Book [Unit 2 3]
3. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017 [Unit 4 5]
4. Generative Deep Learning David Foster. O'Reilly Media 2019 [Unit 6]

**Reference Books:**

1. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
2. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

**Online Resources**

1. <https://livebook.manning.com/book/machine-learning-in-action/about-this-book/>
2. <https://www.coursera.org/learn/deep-learning>
3. <https://nptel.ac.in/courses/deeplearning>

### Course Plan

<b>Course Title: Time Series and Forecasting Laboratory</b>	
<b>Course Code: 201DSL416</b>	<b>Semester: VIII</b>
<b>Teaching Scheme: L-T-P: 0-0-2</b>	<b>Credits: 1</b>
<b>Evaluation Scheme: ISE Marks:50</b>	<b>ESE-OE Marks: 25</b>

#### Course Description:

The Time Series Analysis and Forecasting Lab is designed to provide students with a comprehensive understanding of time series data and equip them with the skills necessary to analyze and forecast future values. Through a combination of theoretical concepts, hands-on exercises, and real-world case studies, students will gain practical knowledge in analyzing time-dependent data and making accurate predictions.

#### Course Objectives:

1. To learn how to handle and pre-process time series data effectively.
2. To explore data visualization techniques.
3. To use statistical methods to analyze time series data.
4. Develop forecasting models using different algorithms and techniques

#### Course Outcomes (COs):

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

<b>416.1</b>	Knowledge of basic concepts in time series analysis and forecasting	Understand
<b>416.2</b>	Understanding the use of time series models for forecasting and the limitations of the methods.	Understand
<b>416.3</b>	Ability to criticize and judge time series regression models.	Understand
<b>416.4</b>	Distinguish the ARIMA modeling of stationary and non-stationary time series	Analyze
<b>416.5</b>	Compare with multivariate times series and other methods of applications	Analyze

<b>Prerequisite:</b>	Data Analytics, Knowledge of Mathematics and Programming.
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>416.1</b>	2	-	-	2	-	-	-	-	-	1	-	-	-	-	2
<b>416.2</b>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>416.3</b>	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
<b>416.4</b>	3	2	-	-	2	-	-	-	-	-	-	-	-	-	4
<b>416.5</b>	3	2	-	2	-	-	-	-	-	-	2	-	-	-	4

Exp. No.	Name of Experiment	S/O	Hours
1	Implementation of Time Series Data Cleaning, Loading and Handling Times series data.	O	2
2	Implementation of Pre-processing Techniques.	O	2
3	Implementation of Stationary of a Time Series.	O	2
4	Estimating & Eliminating Trends of Aggregation, Smoothing, Polynomial Fitting .	O	2
5	Eliminating Trend and Seasonality of Differencing, Decomposition.	O	2
6	Implementation of Moving Average time analysis data and Smoothing the Time analysis Data.	O	2
7	Check out the Time series Linear and non-linear trends and create a modelling.	O	2
8	Implementation of Modelling time series Moving average , Exponential smoothing , ARIMA.	O	2
9	Implementation of Dependence Techniques of Multivariate Analysis of Variance and Covariance, Canonical Correlation Analysis, □ Structural Equation Modelling.	O	2
10	Implementation of Inter-Dependence Techniques of Factor Analysis and Cluster Analysis.	O	2

**Text Books:**

1. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017)
2. Time Series Analysis And Forecasting By Example Søren Bisgaard Murat Kulahci Technical University Of Denmark Copyright © 2011 By John Wiley & Sons, Inc. All Rights Reserved.

**Reference Books:**

1. Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting Third Edition.(2016).
2. Multivariate Time Series Analysis and Applications William W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons Ltd.
3. Time Series Analysis by James D Hamilton Copyright © 1994 by prince town university press.

**Online Resources:**

1. <https://www.stat.ipb.ac.id/en/uploads/KS/S2%20%20ADW/3%20Montgomery%20%20Introduction%20to%20Time%20Series%20Analysis%20and%20Forecasting.pdf>
2. <https://ru.b-ok2.org/terms/?q=forecasting>
3. <http://home.iitj.ac.in/~parmod/document/introduction%20time%20series.pdf>
4. <https://www.coursera.org/learn/practical-time-series-analysis>
5. <https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/>
6. [https://swayam.gov.in/nd1\\_noc19\\_mg46/preview](https://swayam.gov.in/nd1_noc19_mg46/preview)

**Course Plan**

<b>Course Title: Project-IV</b>	
<b>Course Code:201DSL417</b>	<b>Semester: VIII</b>
<b>Teaching Scheme: L-T-P: 0-0-4</b>	<b>Credits: 2</b>
<b>Evaluation Scheme: ISE: 75</b>	<b>ESE -POE Marks: 75</b>

**Course Description:**

This course will implement relevant skills, knowledge and tools to achieve the goal set for a project. Project Management would help aspirants inculcate a strong leadership quality, set goals and targets and take step by step action to achieve those goals. Projects are the gateway to stand apart from others and become productive engineers. The projects fulfill the purpose of synthesizing the knowledge acquired during the years and demonstrating the student's aptitude by applying the knowledge. This course also acts as an aid in understanding the domain through proper modeling and analysis using the state-of art technology and then applying relevant software engineering principles to develop modular and robust applications through the use of standards and various tools.

**Course Objective:**

1. To understand Software Development Life Cycle and prepare project proposal based on real life scenario.
2. Recognize the need and ability to engage in Life Long Learning.
3. To experience project management techniques.
4. Function effectively on teams and to communicate effectively with the outside world.
5. Able to prepare a technical report on basis of their project study.

**Course Outcomes (COs):**

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

<b>417.1</b>	Explain the need of a software project for the society.	Understand
<b>417.2</b>	Identify requirement analysis like functional and technical requirements for the project.	Understand
<b>417.3</b>	Demonstrate the state-of-art technological trends through planning and design project aspects.	Understand
<b>417.4</b>	Demonstrate analysis and design.	Apply
<b>417.5</b>	Prepare the technical report consisting of SRS, Analysis and Design of Project.	Apply

<b>Prerequisite:</b>	Software Engineering, Programming Languages, Database Engineering, Project –II, III
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
<b>417.1</b>	-	-	-	-	-	1	1	-	2	-	-	-	-	-	2
<b>417.2</b>	2	3	-	-	-	-	-	-	2	-	2	-	-	-	2
<b>417.3</b>	2	-	2	-	2	-	-	-	2	3	2	-	2	-	2
<b>417.4</b>	2	2	2	-	-	-	-	-	2	3	-	-	2	-	3
<b>417.5</b>	2	1	1	-	-	-	-	-	3	3	-	-	2	-	3

**Content**

- The project work is to be carried out in two semesters of Final Year Computer Science and Engineering (Data Science). The project should be undertaken preferably by group of 5 students who will jointly work and implement the project in two semesters.
- In Semester VII, the group will select a project with the approval of the Guide (staff member) and submit the title of the project with a synopsis of the proposed work of not more than 08 pages before second week of August in the academic year.
- Students should maintain a project log book containing weekly progress of the project.
- The group is expected to complete detailed system design, analysis, data flow design, procurement of hardware and/or software, implementation of most modules of the proposed work at the end of semester –VII as a part of the term work submission in the form of a joint report.
- The term work assessment will be done jointly by teachers appointed by Head of the Department.
- Students have to complete maximum of the project work (70%) in VII semester.
- Project IV evaluation is based on the continuous basis by the project guide.
- The oral examination will be conducted by an internal and external examiner.

**Note:**

1. Project work should be continually evaluated based on the contributions of the group members, originality of the work, innovations brought in, research and developmental efforts, depth and applicability, etc.
2. Two mid-term evaluations should be done, which includes presentations and demos of the work done.
3. Care should be taken to avoid copying and outsourcing of the project work.

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<b>Course Title: MOOC</b>	
<b>Course Code:201DSMOOC418</b>	<b>Semester: VIII</b>
<b>Teaching Scheme: L-T-P:0-0-0</b>	<b>Credits:3</b>
<b>Evaluation Scheme: ISE marks: 75</b>	<b>ESE POE Marks: 0</b>

Below given is a list of MOOC courses to be completed by the students during the semester. These courses focus on advanced topics in data science, machine learning, and related areas.

1. Natural Language Processing
2. Big Data Analytics
3. Advanced Statistical Analysis
4. Data Mining and Pattern Recognition
5. Ethical and Social Issues in Data Science