D.Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
KASABA BAWADA KOLHAPUR-416006
(An Autonomous Institute)
B. Tech. Data Science
(AcademicYear-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	20	
									ESE	50		
4	201DSL4OX	OEC	Open Elective-II	3	1		4	100	ISE	20	20	40
									MSE	30	20	
									ESE	50		
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	
Total				**12**	**2**	**8**	**22**	**750**	**-**	**750**	**300**	**300**
				22								

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

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.

Professional Elective- II	Open Elective-II
201DSL4P03 Cyber Forensics. 201DSL4P04 Computer Vision. 201DSL4P05 Business Analytics	• List Attached

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.

Department	Subject Name
Computer Science andEngineering	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 (ArtificialIntelligent & Machine Learning)	i) AI For Everyone
	ii) Machine Learning with Python
Architecture	i) Low-Cost Housings
	ii) Sustainable Community Living

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

Student can choose either Academic track or Professional track for the Semester-VIII.

1. Academic Track:

- This is the regular academic track where lectures, practical and project – IV work will be conducted regularly as per the time table in the department and college campus.

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	201DSL412	PCC	Deep Learning	3			3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201DSL413	PCC	Text Mining and Analytics	3	1		4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201DSL414	PCC	Time Series and Forecasting	3			3	100	ISE	20	20	40
									MSE	30	20	
									ESE	50		
4	201DSP415	PCC	Deep Learning Laboratory			2	1	50	ISE	25	10	20
									ESE (POE)	25	10	
5	201DSP416	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			6	3	100	ISE	20	40	40
									MSE	30		
									ESE(OE)	50		
Total				**9**	**1**	**14**	**17**	**600**		**600**	**240**	**240**
				24								

ISE: In Semester Evaluation	*MSE: Mid Semester Examination*	*ESE: End Semester Examination*
Note 1: Tutorials and practical shall be conducted in batches with batchstrength 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	201DSP441	PROJ	Professional Skills Development**	-	-	26	6	200	ISE-I	200	160	200
							6	200	ISE-II	200		
							3	100	ESE-OE	100	40	
2	201DSP417	PROJ	Project-IV	-	-	4	2	100	ISE	50	20	40
									ESE-POE	50	20	
Total				-	-	30	17	600		600	240	240

Guidelines for Professional Track:

1. Student must submit his/her willingness for this track before the term end of semester – VII.
2. Professional track Coordinator will manage activities concerned with this track like assigning mentors to the students, organizing Professional Track Committee (PTC) meetings, monitoring the entire process concerned with Professional Track, etc.
3. Student can apply the Professional Track in following scenarios provided he/she obtains a letter accordingly from the concerned authority from Industry while applying for this track –
   a. If student is selected in the company with PPO (Pre-Placement Offer) program through the college Training and Placement Cell.
   b. If student has an opportunity to work on the sponsored projects in Industry/Research Institute for a period of 3-5 months.
   c. If student is getting onsite Internship offer for a period of 3-5 months.
   d. If student is getting Company Training program of 3-5 months.

4. Students should submit the application along with all communication details to Professional Track faculty coordinator before the term end of semester – VII.
5. The work concerned with this track should be worth 360-450 hours and completed during semester-VIII.
6. All formalities of getting offer letter/permission of working in concerned organization (a-e) are to be completed from the concerned authority (a-e) in writing before starting of ESE of Semester – VII.
7. Student should submit his/her application to the Professional Track Committee (PTC) along with details of communication done with the concerned authorities for its approval.
8. Professional Track Committee (PTC) comprises of HoD, Department T & P coordinator, T & P officer, faculty coordinator and two, third-party experts from Industry / Research Institute / Entrepreneur. The role of PTC is confined to assessment and approval of applications only.
9. Professional Track Committee (PTC) will assess the applications based on the communications, kind of work that is expected to be done by the student in concerned organization (a-e), allocation of concerned organization (a-e) supervisor, depth of the technical exposure, student's development and feasibility of work. Committee will accordingly approve application satisfying the guidelines for professional track and the decision of the committee will be final.
10. There should be a proper written communication between the concerned organization, TPO, department T & P Coordinator and faculty coordinator.
11. Professional Track faculty coordinator should declare the list of students approved for undertaking Professional Track before end of ESE of semester-VII.
12. It is mandatory for students those who opt for Professional Track to complete the Project work of semester- VIII in continuation with semester- VII and with the same project group.
13. It is mandatory for a student and his/her parent to submit an undertaking, mentioning completion of Professional Track as per concerned organization requirements and guidelines as per syllabus structure.
14. If the student fails to complete above Professional Track as per the guidelines within the stipulated period of semester-VIII, he/she will be declared as FAIL. Such candidate has to complete the said work in subsequent 3-5 months' period and then ESE-OE examination will be conducted during the regular examination schedule of the college.
15. Professional Track Committee may asses the student who has applied for Professional Track on the basis of CGPA of VI semester.

Following are the evaluation guidelines for Professional Skills Development Course -

i. The evaluation of the **Professional Skills Development** will be based on the work done by the student in concerned organization.

ii. The faculty mentor assigned will be responsible for monitoring and assessment of the student on continuous basis.

iii. Every faculty mentor will be assigned workload of 1 hour per week for every student.

iv. The ISE marks are to be given based on the continuous assessment done by the concerned organization (a-e) supervisor and faculty mentor.

v. Students must present their work to the faculty mentor every month in an online mode or onsite (Minimum 3 presentations) in coordination with concerned organization (a-e) supervisor for 200 marks taken together for all presentations and demonstration under ISE-I with 6 credits.

vi. Concerned organization (a-e) should provide certificate of completion of assigned task along with marks under ISE-II head for 200 marks with 6 credits, in coordination with the faculty mentor before ESE-OE exam.

vii. ESE-OE is to be conducted for 100 marks with 3 credits in the concerned organization (a-e) where the student is doing his/her work. The ESE-OE will be conducted by both, faculty mentor and concerned organization (a-e) supervisor.

viii. Students may complete Professional Global Certification either assigned by the concerned organization (a-e) supervisor based on his/her assigned work or on his/her own, like Palo-Alto, AWS, Blue prism, Java Certifications, etc.

ix. All credits will be earned by the student on completion of ISE and ESE-OE.

DR. G. V. Patil
HOD (Data Science)

DR. B. D. Jitkar
Dean Academics

DR. S. D. Chede
Principal

Semester VII

Course Plan

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

Course Description:
This course covers key topics in artificial neural networks, including perceptron, multi-layer networks, back propagation, ensemble learning, recommendation systems, evolutionary learning, reinforcement learning, and dimensionality reduction. Students will gain a solid understanding of neural network structures and algorithms, explore hyper-parameter optimization techniques, and learn about applications in image processing, bio informatics, digital forensics, and retail and finance.

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:

401.1	Describe fundamentals of Artificial Neural Networks (ANNs).	Understand
401.2	Discuss ensemble learning techniques and evaluate recommendation systems.	Apply
401.3	Explain foundational understanding of evolutionary learning algorithms and their relevance in optimization problems.	Understand
401.4	Use dimensionality reduction techniques and apply machine learning in diverse domains.	Apply

Prerequisite:	Machine Learning

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
401.1	2	-	-	-	-	-	-	-	-	-	-	2	2	-	2
401.2	2	2	2	1	-	-	-	-	-	-	-	-	2	-	3
401.3	2	-	-	-	-	-	-	-	-	-	-	2	2	-	2
401.4	2	2	2	2	-	-	-	-	-	-	-	-	2	-	3

Content	Hours
Unit 1: Artificial Neural Network: The brain and the Neuron- Hebb's rule, McCulloch and Pits Neurons. Perceptron Representational Power of Perceptron. The Perceptron Training Rule. Gradient Decent and Delta Rule. Multi-layer Perceptron algorithm**.**	05
Unit 2: Multi layer Network: Feed forward Network- Multi layer networks and Back Propagation algorithm, The Differentiable Threshold Unit, The Back propagation Algorithm, Introduction to hyper-parameters and their significance in neural networks Popular hyper-parameters to tune (e.g., learning rate, batch size, number of hidden units) Grid search and random search techniques Hyper-parameter optimization using libraries (e.g., scikit-learn, Keras).	05
Unit 3: Ensemble learning and Recommendation system: 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
Unit 4: Introduction to Evolutionary Learning and Reinforcement Learning: 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).	08

Unit 5: Dimensionality Reduction: 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, preprocessing and data scaling, Feature selection vs. extraction.	06
Unit 6: Application: Machine Learning: Applications in Image Processing and Pattern Recognition, Application in Bio- informatics, Application in Digital Forensics, Application in retails and finance.	04

Text Books:

1. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”,CRC Press. [Unit 1,2].
2. Thomas G. Dietterich, “Ensemble Learning and Recommendation Systems”, Morgan & Claypool [Unit 3, 4].
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning”, Springer [Unit 5].
4. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media [Unit 6].

Reference Books:

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

Online Resources:

1. https://www.coursera.org/learn/machine-learning
2. https://nptel.ac.in/courses/106106139

Course Plan

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

Course Description:
This course provides introduction to fundamentals of distributed systems and cloud computing. The course also discusses characteristics and benefits of cloud computing. It provides in-depth knowledge of cloud computing architecture along with basics of virtualization. It covers all the cloud services (IaaS, PaaS, SaaS) and includes case studies on open-source and commercial cloud platforms.

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:

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

Pre-requisites:	Operating Systems, Fundamentals of Computer Networks.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (PO's)and Program Specific Outcomes (PSO's).

CO's	PO's												PSO's		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
Unit 1: Overview of computing paradigm: 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.	06
Unit 2: Process and Communication: 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.	06
Unit 3: Cloud Computing Architecture: 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.	06
Unit 4: Virtualization: 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.	07

Unit 5: Infrastructure as a Service (IaaS): 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.	06
Unit6: Case study on Open Source and Commercial Clouds: Amazon EC2, Google Compute Engine, Microsoft Azure, Cloud foundry, OpenStack.	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
2. https://www.shiksha.com/online-courses/cloud-computing-by-nptel-course-nptel18

Course Plan

Course Title: Cyber Forensics	
Course Code: 201DSL4P03 **Professional Elective-II (PEC)**	**Semester: VII**
Teaching Scheme: L-T-P: 3-1-0	**Credits: 4**
Evaluation Scheme: ISE+MSE Marks: 20+30	**ESE Marks: 50**

Course Description:
This 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 Understand computer forensics principles and methodologies in law enforcement.
2. To Develop skills in evidence collection and preservation of digital evidence.
3. To Gain proficiency in analyzing and validating digital forensic data.
4. To Conduct effective e-mail and social media investigations in forensic contexts.

Course Outcomes (CO's):

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

403.1	Describe computer forensics principles in law enforcement	Understand
403.2	Illustrate the techniques to collect, preserve, and authenticate digital evidence	Apply
403.3	Analyze and validate digital forensic data	Apply
403.4	Explain investigative strategies to conduct comprehensive e-mail and social media investigations,	Understand

Prerequisite:	Information Security

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

COs	PO's												PSO's		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	
403.3	2	2	2	2	-	-	-	2	-	-	-	2	1	-	2
403.4	2	2	-	-	-	-	-	2	-	-	-	2	-	-	2

Content	Hours
Unit 1: Computer Forensics Fundamentals: 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
Unit 2: Evidence Collection: Why Collect Evidence? Types of Evidence, Methods of Collections, Collection Steps, Duplication and Preservation of Digital Evidence, Computer image Verification and Authentication.	06
Unit 3: Digital Forensics Analysis and Validation: 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
Unit 4: E-Mail and Social Media Investigations: 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
Unit 5: Mobile Device and Cloud Forensics: 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
Unit 6: Laws and Acts: 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. John R, Vacca, “Computer Forensics, Computer Crime Investigation” 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. Keith Jones, Richard Bejitlich, Curtis W. Rose, Addison Wesley “Real Digital Forensics” Pearson Education.
2. Tony Sammes and Brain Jenkinson, “Forensic Compiling, A Tractitioneris Guide”, Springer International edition.
3. Chrostopher L.T. Brown, “Computer Evidence Collection &Presentation”, Firewall Media.

Online Resources:

1. https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
2. https://www.classcentral.com/course/swayam-information-security-and-cyber-forensics-23006

Course Plan

Course Title: Computer Vision	
Course Code: 201DSL4P04 **Professional Elective-II (PEC)**	**Semester: VII**
Teaching Scheme: L-T-P: 3-1-0	**Credits: 4**
Evaluation Scheme: ISE+MSE Marks: 20+30	**ESE Marks: 50**

Course Description:
This course explores the field of Computer Vision, covering various topics including image processing, geometric techniques, linear filters, motion analysis, and deep learning. Gain an understanding of the principles, applications, and evolution of computer vision, focusing on areas such as image enhancement, segmentation, object tracking, camera projection, depth estimation, and feature extraction. Explore linear filters, Fourier transforms, optical flow, pattern recognition, and deep learning techniques for tasks such as image classification, object detection, and face recognition.

Course Objectives:
1. To understand and apply concepts of Computer Vision, including image processing, geometric techniques, linear filters, motion analysis, and deep learning.
2. To develop practical skills in image processing, utilizing deep learning for tasks such as enhancement, segmentation, and object tracking.
3. To explore geometric techniques for camera projection, depth estimation, and feature extraction, incorporating deep learning models.
4. To gain proficiency in deep learning techniques for computer vision tasks, including image classification, object detection, and face recognition.

Course Outcomes (CO's):
Upon successful completion of this course, the students will be able to:

404.1	Explain fundamental concepts of Computer Vision, including image processing, geometric techniques, linear filters, motion analysis, and deep learning.	Understand
404.2	Illustrate practical skills in image processing using deep learning for tasks like enhancement, segmentation, and object tracking.	Apply
404.3	Utilize geometric techniques with deep learning models for camera projection, depth estimation, and feature extraction.	Apply
404.4	Demonstrate proficiency in applying deep learning techniques to computer vision tasks such as image classification, object detection, and face recognition.	Apply

Prerequisite:	Probability, Statistics, Linear Algebra.

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
404.1	2	-	-	-	-	-	-	-	-	-	-	2	1	-	2
404.2	2	-	-	-	-	-	-	-	-	-	-	1	1	-	2
404.3	2	1	1	1	1	-	-	-	-	-	-	-	1	-	4
404.4	2	2	2	1	1	-	-	-	-	-	-	-	1	-	3

Content	Hours
Unit 1: Overview of Computer Vision: 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
Unit 2: Digital Image Processing: 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
Unit 3: Geometric Techniques in Computer Vision: Image Tran formations, 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
Unit 4: Linear Filters and transforms: 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
Unit 5: Motion Analysis: Differential motion Analysis, Optical Flow, Analysis based on correspondence of interest points, Detection of specific motion Patterns, Video Tracking**.**	06
Unit 6: Deep Learning for Computer Vision: 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. Forsyth and Ponce, "Computer Vision: A Modern Approach", [Unit 1,2,3].
2. Hartley and Isserman, "Multiple View Geometry in Computer Vision", [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. E. R. Davies "Computer Vision: Principles, Algorithms, Applications, Learning" .
6. Simon J. D. Prince "Computer Vision: Models, Learning, and Inference".

Reference Books:

1. D. Forsyth, J. Ponce."Computer Vision - A Modern Approach" .pdf
2. Ballard, Dana H. and Christopher M. Brown -" Computer Vision" Prentice-Hall, Englewood Cliffs NJ.

Online Resources:

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

Course Plan

Course Title: Business Analytics.	
Course Code: 201DSL4P05 **Professional Elective-II (PEC)**	**Semester: VII**
Teaching Scheme: L-T-P: 3-1-0	**Credits: 4**
Evaluation Scheme: ISE+MSE Marks: 20+30	**ESE Marks: 50**

Course Description:
This course gives overview of business analytics, data analytics, data warehousing, and business intelligence using Power BI. Explore the historical background of data analysis and different roles in the field. Learn data collection, management, and visualization techniques, including handling incomplete data. Develop Excel skills for descriptive statistics and delve into data warehousing concepts. Apply your knowledge through real-world case studies using Tableau for data visualization in domains.

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Course Objectives:

1. To gain knowledge and skills in business analytics and data analytics.
2. To apply data collection, management, and visualization techniques.
3. To utilize the data science project life cycle for effective analysis.
4. To apply business analysis techniques to real-world case studies.

Course Outcomes (CO's):

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

405.1	Describe business analytics and data analytics concepts.	Understand
405.2	Apply data collection, management, and visualization techniques effectively.	Apply
405.3	Apply the data science project life cycle for comprehensive analysis.	Apply
405.4	Examine real-world business scenarios using business analysis tools like Tableau.	Analyse

Prerequisite:	Business Statistics, Business intelligence

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

COs	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
405.1	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
405.2	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
405.3	2	1	1	-	1	-	-	-	-	-	-	1	1	-	2
405.4	1	-	-	1	2	-	-	-	-	-	-	1	1	-	4
405.5	2	2	-	2	2	-	-	-	-	-	-	1	1	1	3

Content	Hours
Unit 1: Business Analytics: Introduction to business analytics, Historical Overview of data analysis, Data Scientist vs. Data Engineer vs. Business Analyst, Career in Business Analytics.	06
Unit 2: Data Analytics: 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.	06
Unit 3: Data Analytics using Excel: 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.	06
Unit 4: Data Warehousing: 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:	06

Differentiate between utility of relational DW, cubes, and in-memory scenarios - Compare techniques for data integration with regards to warehousing - Use warehousing tools - Use integration tools for warehousing.	
Unit 5: Business Intelligence using Power BI: 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
Unit 6: Application of Business Analysis: Case study using Tableau: 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.	**CASE STUDIES USING Power BI:** 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. Bhima Sankaram Pochiraju, Sridhar Seshadri "Essentials of Business Analytics: An Introduction to the methodology and its application", Springer.
2. G C Beri, "Business Statistics", 3rd edition, TATA McGrawHill.
3. Laura Igual Santi Seguí," Introduction to Data Science", Springer.
4. Conrad G. Carlberg "Business Analysis with Microsoft Excel and Power BI", 5th edition; Pearson.
5. Bharti Motwani," Data Analytics with R" Wiley Publication.

Reference Books:

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

Online Resources:

1. https://nptel.ac.in/courses/110105089
2. https://www.coursera.org/specializations/business-analytics

Course Plan

Course Title: Business Intelligence and Analytics	
Course Code: 201DSL4O06 **Open Elective- II (OEC)**	**Semester: VII**
Teaching Scheme: L-T-P: 3-1-0	**Credits: 4**
Evaluation Scheme: ISE+MSE Marks: 20+30	**ESE Marks: 50**

Course Description:
This course covers Business Intelligence (BI) and Analytics, including data warehousing, data mining, Excel-based analytics, data visualization, and BI platforms. Gain insights into trends, challenges, and applications. Learn data integration, ETL, modeling, preprocessing, classification, regression, clustering, and association. Develop skills in Excel for data organization, visualization, and analysis. Understand ethical considerations, privacy, and utilize BI platforms for reporting and self-service BI.

Course Objectives:
1. To understand the fundamental concepts and importance of Business Intelligence (BI) and Analytics.
2. To develop practical skills in data warehousing, including data integration, ETL processes, and dimensional modeling.
3. To apply data mining techniques, such as preprocessing, classification, regression, clustering, and association models.
4. To utilize Excel for data analytics, including data organization, computations, visualization, and basic statistical measures.

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Course Outcomes (CO's):

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

406.1	Understand and apply the fundamental concepts of Business Intelligence (BI) and Analytics.	Understand
406.2	Describe data warehousing, including data integration, ETL processes, and dimensional modeling.	Understand
406.3	Apply data mining techniques for effective data analysis, including preprocessing, classification, regression, and clustering.	Apply
406.4	Utilize Excel for data analytics, including data organization, computations, visualization, and basic statistical measures.	Analyze

Prerequisite:	Business Statistics, Business intelligence

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
406.1	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
406.2	2	-	-	1	1	-	-	-	-	-	-	1	1	-	2
406.3	2	1	1	-	1	-	-	-	-	-	-	1	1	-	3
406.4	1	-	-	1	2	-	-	-	-	-	-	1	1	-	4

Content	Hours
Unit 1: Introduction to Business Intelligence and Analytics: Definition and importance of BI and analytics, Overview of the BI and analytics process, Trends and challenges in BI and analytics.	06
Unit 2: Data Warehousing: Introduction to data warehousing concepts, Dimensional modeling, Extract, transform, Load (ETL) processes, Data integration and quality.	06
Unit 3: Data Mining and Predictive Analytics: Introduction to data mining techniques, Data Preprocessing and feature selection, Classification and regression models, Clustering and association models.	05
Unit 4: Data Analytics using Excel: 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
Unit 5: Data Visualization: Principles of effective data visualization, Visualization techniques and tools, Dashboard design and storytelling, Interactive visualizations and exploratory data analysis.	06
Unit 6: Business Intelligence Platforms: 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. Rick Sherman,"Business Intelligence Guidebook: From Data Integration to Analytics" [Unit 1,6].
2. Foster Provost and Tom Fawcett ,"Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking"[Unit 3].
3. Ralph Kimball and Margy Ross "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" [Unit 2].

Reference Books:

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

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_mg11/preview
2. https://www.shiksha.com/online-courses/business-analytics-courses-certification-training-by-nptel-st583

Course Plan

Course Title: Data Visualization and Storytelling	
Course Code: 201DSL4O07 **Open Elective- II (OEC)**	**Semester: VII**
Teaching Scheme: L-T-P: 3-1-0	**Credits: 4**
Evaluation Scheme: ISE+MSE Marks: 20+30	**ESE Marks: 50**

Course Description:
This course explores the significance of data visualization as a powerful tool for understanding and communicating complex information. Participants will delve into various chart types, best practices, and techniques for visualizing numerical and text data. They will develop skills in visual storytelling, enabling them to create compelling presentations and avoid misleading charts. Through practical exercises and examples, participants will gain proficiency in data visualization and its role in effective data analysis and decision-making processes.

Course Objectives:
1. To understand the significance of data visualization in comprehending and conveying complex information effectively.
2. To explore various chart types, best practices, and techniques for visualizing numerical and text data accurately.
3. To develop skills in visual storytelling, enabling the creation of engaging presentations and narratives around data.
4. To learn how to identify and avoid misleading charts, ensuring the integrity of data analysis and decision-making processes.

Course Outcomes (CO's):

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

407.1	Understand the significance of data visualization in effectively communicating complex information and insights.	Understand
407.2	Illustrate diverse chart types, best practices, and techniques for accurate and visualization of numerical and text data.	Apply
407.3	Describe visual storytelling to create compelling presentations and narratives that engage and inform audiences.	Understand
407.4	Describe data visualization decision-making processes and enhance communication across diverse stakeholders	Understand

Prerequisite:	Business Statistics, Business intelligence

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		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
Unit 1: Introduction to Visualization: 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.	06
Unit 2: Visual best practices: Edward Tufte's visual encoding. Conversion of data into visualizations to draw valuable insights.	06
Unit 3: Visualization of Numerical Data: Choosing right chart for the data on hand. Data analysis as a dashboard to provide narrative and communicate the results.	06
Unit 4: Visualization of Text data: Visualization and the challenges of handling text data. Use of chart types such as word clouds, scatter plots, histograms, line charts etc. to visualize a document. Topic models, word embedding, and creating visualizations with bubble charts, bar charts, and t-SNE clusters.	06
Unit 5: Visual Storytelling: 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.	06

Unit 6: Story telling framework: Types of narratives: author-driven narratives and reader-driven narratives. Seven 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	06

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.	Case Studies and Applications: 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. Nussbaumer Knaflic, Cole Storytelling With Data: A Data Visualization Guide for Business Professionals.
2. Nancy Duarte, "Data Story: Explain Data and Inspire Action Through Story".
3. Brent Dykes,"Effective Data story telling" Wiley.

Online Resources:

1. https://www.effectivedatastorytelling.com/
2. https://DataStory-Explain-Inspire-Action-Through/

Course Plan

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

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):

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

Prerequisite:	Machine Learning

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
408.1	1	2	1	-	-	-	-	-	-	-	-	2	2	-	2
408.2	2	2	2	-	-	-	-	-	-	-	-	2	2	-	2
408.3	2	2	2	2	1	-	-	-	-	-	-	2	2	-	2

Exp. No.	Name of Experiment	S/O	Hours
1.	Conduct experiments to observe and analyze the behavior of a basic neuron model.	O	2
2.	Perform experiments to train perception models and visualize decision boundaries.	O	2
3.	Implement and experiment with feed-forward neural networks	O	2
4.	Experiment Compare the performance of single and ensemble models	O	2
5.	Implement and experiment with AdaBoost	O	2
6.	Implement and analyze basic genetic algorithms for optimization.	O	2
7.	Experiment with Principal Component Analysis (PCA) for dimensionality reduction.	O	2
8.	Conduct experiments to analyze the impact of different activation functions on neural network performance.	O	2
9.	Experiments to evaluate the effectiveness of different feature selection methods in machine learning.	O	2
10.	Experiment with different hyper parameters tuning methods to optimize the performance of machine learning models	O	2
11	Analyze the impact of different activation functions on neural network performance.	S	2
12	Analyse different hyper parameters tuning methods to optimize the performance of machine learning models	S	2

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Text Books:

1. Stephen Marsland,"Machine Learning – An Algorithmic Perspective"
2. Thomas G. Dietterich,"Ensemble Learning and Recommendation Systems" Morgan & Claypool.

3. Aurélien Géron “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" Publisher: O'Reilly Media

Reference Books:

1. Tom M. Mitchell “Machine Learning”, McGraw Hill Education
2. Simon Haykin,"Neural Networks and Learning Machines" Pearson.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning" Springer

Course Plan

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

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 (CO's):
Upon successful completion of this course, the students will be able to:

409.1	Apply knowledge of configuring client/server systems for distributed setups.	Apply
409.2	Analyze diverse cloud computing services effectively.	Analyze
409.3	Utilize appropriate deployment and configuration options in major cloud platforms for creating cloud-based solutions.	Apply

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
409.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
409.2	-	3	3	-	-	-	-	-	-	-	-	-	-	-	2
409.3	-	2	2	-		-	-	-	-	-	-	-	1	-	3
409.4	3	-	3	-	-	-	-	-	-	-	-		-	-	3

Exp. No.	Name of Experiment	S/O	Hours
1.	RPC, RMI interface implementation	O	2
2.	Configuring the Client/Server for NTP	O	2
3.	Installationandconfigurationoftype1Hypervisor. (Esxi)	O	2
4.	Installation and configuration of type 2 Hypervisor (VMware, Virtual Box, etc.)	O	2
5.	Working and Implementation of Infrastructure as a service.	O	2
6.	Working and Implementation of Software as a service.	O	2
7.	Working and Implementation of Platform as a service.	O	2
8.	Practical Implementation of Storage as a Service.	O	2
9.	Installing a private cloud.(Open Stack)	O	2
10.	Installing OS on a Virtual Machine Monitor.	O	2
11.	Offline migration of virtual OS.	O	2
12.	Live migration of virtual OS.	O	2
13.	Study and implementation of infrastructure as Service using Open Stack.	O	2
14.	Install and configure Google App Engine.	O	2
15.	Hands on virtualization using Xen Server.	O	2
16.	Hands on containerization using Docker.	O	2
17.	Deployment and Configuration options in Amazon (AWS).	O	2
18.	Deployment and Configuration options in Google Cloud.	O	2
19.	Deployment and Configuration options in Microsoft Azure.	O	2

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Text Books:

1. Ronald Krutz and Russell DeanVines “Cloud Security”, Wiley-India.
2. Gautam Shroff, “Enterprise Cloud Computing”, Cambridge.

Reference Books:

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

Course Plan

Course Title: Project-III	
Course Code:201DSP410	**Semester: VII**
Teaching Scheme: L-T-P:0-0-4	**Credits:2**
Evaluation Scheme: ISE marks: 75	**ESE POE Marks: 75**

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 (CO's):

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

410.1	Explain the need of a software project for the society	Understand
410.2	Identify requirement analysis like functional and technical requirements for the project	Understand
410.3	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
410.4	Able to demonstrate analysis and design.	Apply
410.5	Prepare the technical report consisting of Requirement specification, Analysis and Design of Project	Apply

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	**PO's**												**PSO's**		**BTL**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	
410.1	1	2	1	-	-	-	-	-	-	-	-	2	-	-	2
410.2	2	2	2	-	-	-	-	-	-	-	-	2	-	-	2
410.3	2	3	2	2	1	-	-	-	-	-	-	2	2	-	2
410.4	2	3	2	2	1	-	-	-	-	-	-	2	2	-	3
410.5	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

Course Title: Internship	
Course Code:201DSP411	**Semester: VII**
Teaching Scheme: L-T-P:0-1-0	**Credits:4**
Evaluation Scheme: ISE Marks: 30	**ESE- POE Marks: 70**

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

1. Regular Track Syllabus

Course Plan

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

Course Description:
This course provides an introduction to deep learning, covering topics such as perceptron learning algorithms, neural networks, Convolutional neural networks, natural language processing using RNNs, and deep reinforcement and unsupervised learning. This course comprehends in-depth deep learning concepts, including data manipulation, model building, optimization, and transfer learning and also explores generative deep learning techniques for text and image generation.

Course Objectives:
1. To understand deep learning concepts and perceptron 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:

412.1	Describe the fundamental concepts of deep learning and perceptron learning algorithms.	Understand
412.2	Use and train fundamentals of neural networks for image processing and natural language processing.	Apply
412.3	Explore Convolutional neural networks (CNNs) for advanced image analysis and transfer learning techniques.	Understand
412.4	Use deep reinforcement learning and unsupervised learning methods for decision-making and generative modeling.	Apply

Prerequisite:	Machine Learning

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
412.1	2	-	-	-	-	-	-	-	-	-	-	2	2	-	2
412.2	2	2	2	1	2	-	-	-	-	-	-	-	1	-	3
412.3	2	-	-	-	2	-	-	-	-	-	-	1	2	-	2
412.4	2	2	2	2	2	-	-	-	-	-	-	-	1	-	3

Content	Hours
Unit 1: Deep Learning Concepts: Fundamentals about Deep Learning. Perceptron Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrices, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.	05
Unit 2: Neural Networks: bout Neural Network. Building Blocks of Neural Network. Optimizer. Activation Functions. Loss Functions. Data preprocessing for neural networks, Feature Engineering. Over fitting and Under Fitting. Hyper parameters.	05
Unit 3: Convolutional Neural Network: 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. Back propagation in Convolutional Layers: Gradients and Weight Updates. Filters and Feature Maps: Extraction and Visualization. Transfer Learning: Pretrained Models (Inception, VGG, ResNet), Object Detection (R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN).	07
Unit 4: Introduction to Recurrent Neural Networks: 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. Back propagation Through Time (BPTT) algorithm for training RNNs. Addressing the vanishing and exploding gradient problems in RNNs. Introduction to Long	07

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.	
Unit 5: Deep Reinforcement & Unsupervised Learning: About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. Auto encoding. Convolutional Auto Encoding. Variation Auto Encoding. Generative Adversarial Networks. Auto encoder for Feature Extraction. Auto Encoders for Classification Denoising Auto encoder, Sparse Auto encoder,	06
Unit 6: Generative Deep Learning: Text generation with LSTM, Deep Dream, Neural Style Transfer, Generating images with variation auto encoders, Introduction to generative adversarial network	06

Text Books:

1. Josh Patterson and Adam Gibson, "Deep Learning A Practitioner's Approach" O'Reilly Media, Inc.2017 [Unit 1].
2. Ian Good fellow, Yoshua Bengio, Aaron Courvil, "Deep Learning" MIT Press Book [Unit 2 3].
3. François Chollet, Manning shelter , "Deep Learning with Python" [Unit 4 5] .
4. David FosterGenerative, "Deep Learning" . O'Reilly Media 2019 [Unit 6].

Reference Books:

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

Course Plan

Course Title: Text Mining and Analytics	
Course Code: 201DSL413	**Semester: VIII**
Teaching Scheme: L-T-P: 3-1-0	**Credits: 4**
Evaluation Scheme: ISE + MSE Marks:20 + 30	**ESE Marks: 50**

Course Description:

This course provides an in-depth exploration of text mining techniques and their application in extracting meaningful information from unstructured textual data. It includes 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.

Course Objectives:

1) To understand fundamentals of text analytics and its applications.
2) To learn fundamentals of Information retrieval and natural language processing.
3) To explore text analytics framework for social media contents.
4) To discuss theoretical techniques of opinion mining and sentiment analysis.

Course Outcomes (CO's):

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

413.1	Describe text mining and analytics framework.	Understand
413.2	Illustrate knowledge engineering and machine learning approach to text categorization and clustering.	Understand
413.3	Design text mining models to solve problems by extracting knowledge from data.	Apply
413.4	Implement text mining techniques appropriately.	Apply

Prerequisite:	Exploratory Data Analysis and Visualization, Probability and Statistics.

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
413.1	2	-	-	-	-	-	-	-	-	-	-	2	2	-	2
413.2	3	2	-	-	-	-	-	-	-	-	-	2	2	-	2
413.3	3	2	-	-	-	-	-	-	-	-	-	2	1	-	3
413.4	3	2	-	-	-	-	-	-	-	-	-	2	2	-	3

Content	Hours
Unit 1: Text Mining and its operations: 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.	04
Unit 2: Categorization and Clustering: 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 Unlabeled Data to Improve Classification. Clustering: Clustering Algorithms, Clustering of Textual Data, Clustering Tasks in Text Analysis, The General Clustering Problem.	07
Unit 3: Information Extraction and its Probabilistic Models: 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.	06
Unit 4: Pre-processing applications using probabilistic and hybrid approaches: 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.	07
Unit 5: Text Mining in Multimedia and Text Analytics in social media: 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.	06

Unit 6: A Survey of Opinion Mining and Sentiment Analysis: 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.	06

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. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schuetze, "Introduction to Information Retrieval", Cambridge University Press, 2007.
2. Bird, Steven, Edward Loper and Ewan Klein, "Natural Language Processing with Python", O'Reilly Media Inc, 2009.
3. Daniel Jurafsky, James H. Martin, "Speech and Language Processing",
4. Han, J., Kamber, M., & Pei, "Data Mining: Concepts and Technique".. Morgan Kaufmann Publishers. San Francisco.

Online Resources:

1. https://www.coursera.org/learn/text-mining-analytics
2. https://onlinecourses.nptel.ac.in/noc19_mg47/preview

Course Plan

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

Course Description:

This course provides an understanding of time series analysis and forecasting. It explores various data types, models, and internal structures. It develops a solid statistical background and learn evaluation techniques specific to forecasting. The course focuses on regression models, ARIMA models, and multivariate time series models. Apply this knowledge through real-world case studies to enhance practical skills.

Course Objectives:

1. To understand the principles and concepts of time series analysis and forecasting.
2. To develop skills in applying various models for time series analysis and forecasting.
3. To gain proficiency in evaluating and monitoring the performance of forecasting models.
4. To apply the acquired knowledge to solve real-world forecasting challenges.

Course Outcomes (CO's):

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

414.1	Explain the principles and concepts of time series analysis and forecasting.	Understand
414.2	Describe different models for time series analysis and forecasting	Understand
414.3	Analyze and assess the performance of forecasting models, to make informed decision	Apply
414.4	Illustrate the knowledge and skills to solve real-world forecasting challenges, providing accurate and reliable forecasts to support decision-making processes.	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):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
414.1	2	-	-	2	-	-	-	-	-	1	-	-	-	-	2
414.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
414.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
414.4	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
414.5	3	2	-	2	-	-	-	-	-	-	2	-	-	-	3

Content	Hours
Unit 1: Introduction of Time series Analysis: 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.	06
Unit 2: Statistics Background for Forecasting: 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.	06
Unit 3: Time Series Regression Model: 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.	06
Unit 4: Auto-regressive Integrated Moving Average (Arima) Models: 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 .	06

Unit 5: Multivariate Time Series Models and Forecasting: 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.	06
Unit 6: Case Study: 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.	06

Text Books:

1. Dr. Avishek Pal Dr. Pks Prakash "Master Time Series Data Processing, Visualization, And Modeling Using Python" [Unit 1and 2].
2. Søren Bisgaard Murat Kulahci "Time Series Analysis and Forecasting"Technical University Of Denmark Copyright © 2011 By John Wiley & Sons, Inc [Unit 3, 4 and 5].

Reference Books:

1. Peter J. Brockwell Richard A. Davis "Introduction To Time Series And Forecasting".
2. William W.S. Wei," Multivariate Time Series Analysis and Applications" Department of Statistical Science Temple University, Philadelphia, PA, SA John Wiley & Sons Ltd.
3. James D Hamilton, "Time Series Analysis" prince town university press.

Online Resources:

1. https://ru.b-ok2.org/terms/?q=forecasting
2. http://home.iitj.ac.in/~parmod/document/introduction%20time%20series.pdf
3. https://www.coursera.org/learn/practical-time-series-analysis
4. https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download course-materials/
5. https://swayam.gov.in/nd1_noc19_mg46/preview

Course Plan

Course Title: Deep Learning Laboratory	
Course Code: 201DSP415	**Semester: VIII**
Teaching Scheme: L-T-P: 0-0-2	**Credits: 1**
Evaluation Scheme: ISE: 25	**ESE-POE Marks: 25**

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.

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Course Outcomes (CO's):

415.1	Apply deep learning concepts and techniques, including neural networks, CNNs, RNNs, and GANs.	Apply
415.2	Implement and train deep learning models for image classification, text generation, and image synthesis.	Apply
415.3	Demonstrate and optimize deep learning models,	Apply

Prerequisite:	Machine Learning.

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		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

10.	Build a recurrent neural network (RNN) with LSTM cells to generate text based on a given input sequence.	O	2

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

Text Books:

1. Josh Patterson and Adam Gibson "Deep Learning A Practitioner's Approach" O'Reilly Media, Inc.2017 [Unit 1].
2. Yoshua Bengio, Aaron Courvil , "Deep Learning by Ian Good fellow" MIT Press Book
3. François Chollet, manning Shelte "Deep Learning with Python"
4. David Foster "Generative Deep Learning" . O'Reilly Media

Reference Books:

1. ojo Moolayil "Learn Keras for Deep Neural Networks", J, Apress,2018

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/deeplearnning

Course Plan

Course Title: Time Series and Forecasting Laboratory	
Course Code: 201DSP416	**Semester: VIII**
Teaching Scheme: L-T-P: 0-0-2	**Credits: 1**
Evaluation Scheme: ISE Marks:25	**ESE-OE Marks: 25**

Course Description:

The Time Series Analysis and Forecasting Lab offers a comprehensive understanding of time series data and equips students with forecasting skills. Through theory, hands-on exercises, and case studies, students gain practical knowledge in analyzing time-dependent data and making accurate predictions.

Course Objectives:

1. To learn how to handle and Pre-processing 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:

416.1	Apply time series data cleaning, handling, and pre-processing techniques effectively (application level).	Understand
416.2	Analyze and interpret trends in time series data using various methods (analysis level).	Understand
416.3	Utilize modeling techniques like moving average, exponential smoothing, and ARIMA for accurate predictions (application level).	Understand
416.4	Evaluate and interpret the inter-dependence among variables in time series data using multivariate analysis, structural equation modeling, factor analysis, and cluster analysis (evaluation level).	Analyze
416.5	Apply time series data cleaning, handling, and pre-processing techniques effectively (application level).	Analyze

Prerequisite:	Data Analytics, Knowledge of Mathematics and Programming.

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
416.1	2	-	-	2	-	-	-	-	-	1	-	-	-	-	2
416.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
416.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
416.4	3	2	-	-	2	-	-	-	-	-	-	-	-	-	4
416.5	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. Avishek Pal Dr. Pks Prakash "Master Time Series Data Processing, Visualization, And Modeling Using Python"
2. Søren Bisgaard Murat Kulahci "Time Series Analysis And Forecasting By Example" Technical University Of Denmark John Wiley & Sons, Inc.

Reference Books:

1. Peter J. Brockwell Richard A. Davis "Introduction To Time Series And Forecasting"
2. s William W.S. Wei. "Multivariate Time Series Analysis and Application" Department of Statistical Science Temple University, Philadelphia, PA, SA John Wiley & Sons Ltd.
3. James D Hamilton "Time Series Analysis" Prince town university press.

Online Resources:

1. https://ru.b-ok2.org/terms/?q=forecasting
2. http://home.iitj.ac.in/~parmod/document/introduction%20time%20series.pdf
3. https://www.coursera.org/learn/practical-time-series-analysis
4. https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download course-materials/
5. https://swayam.gov.in/nd1_noc19_mg46/preview

Course Plan

Course Title: Project-IV	
Course Code:201DSP417	**Semester: VIII**
Teaching Scheme: L-T-P: 0-0-4	**Credits: 2**
Evaluation Scheme: ISE: 50	**ESE -POE Marks: 50**

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 (CO's):

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

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

Prerequisite:	Software Engineering, Programming Languages, Database Engineering

Course Articulation Matrix: Mapping of Course Outcomes (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
417.1	-	-	-	-	-	1	1	-	2	-	-	-	-	-	2
417.2	2	3	-	-	-	-	-	-	2	-	2	-	-	-	2
417.3	2	-	2	-	2	-	-	-	2	3	2	-	2	-	2
417.4	2	2	2	-	-	-	-	-	2	3	-	-	2	-	3
417.5	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.

Course Plan

Course Title: MOOC	
Course Code:201DSMOOC418	**Semester: VIII**
Teaching Scheme: L-T-P:0-0-6	**Credits:3**
Evaluation Scheme: ISE + MSE Marks:20 + 30	**ESE OE Marks: 50**
Total : 100 Marks	

During the semester, students will have the opportunity to complete a bellow mentioned list of MOOC courses that focus on advanced topics in data science, machine learning, and related areas. These courses are specifically designed to provide in-depth knowledge and practical skills in these domains. By undertaking this series of courses, students will explore advanced concepts in data science, delve into cutting-edge machine learning techniques, and gain valuable insights into their application in various domains. Through the completion of these courses, students will develop a solid foundation in the advanced aspects of data science and machine learning

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

• Guidelines for MOOCS Evaluation -

1. Every student of Final Year B.Tech. should register compulsorily for the one NPTEL course from the list provided by the MOOC coordinator.
2. The evaluation guidelines for this course are as follows:
   i. The course will be evaluated for total 100 marks.
   ii. The distribution of 100 Marks will be as follows:

Sr. No.	Examination	Marks	Details
1	ISE-I	10	MCQ based test
2	MSE	30	Evaluation will be done based on two presentations –

			i) First presentation on 50% syllabus ii) Second presentation on remaining 50% syllabus
3	ISE-II	10	Result of NPTEL assignments will be converted into 10 marks
4	ESE(OE)	50	Parameters of Evaluation – a. Presentation (10 Marks) b. Oral (10 Marks) c. Evaluation based on Learning Outcome (10 Marks) d. Certification (20 Marks) i) Elite + Gold (20 Marks) ii) Gold (15 Marks) iii) Pass (10 Marks)
Total		100	

HEAD OF DEPARTMENT
CSE - DATA SCIENCE DEPT.
D. Y. Patil College of Engg. & Tech.
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