D. Y. Patil College of Engineering and Technology

Kasaba Bawada, Kolhapur

(An Autonomous Institute)

NBA Accredited

Accredited by NAAC with 'A' Grade

Structure and Syllabus
of
Final Year B. Tech in
Computer Science and Engineering
(Artificial Intelligence–Machine Learning)

Department of

Computer Science and Engineering (AI-ML)

Effective from Academic year 2023-24

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, KOLHAPUR
Teaching and Evaluation Scheme from Year 2023-24
Final Year B. Tech - Computer Science & Engineering (AI-ML)
SEMESTER-VII

Sr. No.	Course Code	Course Type	Name of the Course	Lecture	Tutorial	Practical	Credits	Total Marks	Type	Max. Marks	Min. for Passing	
1	201AIMLL401	PCC	Deep Learning	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201AIMLL402 - 404	PEC	Professional Elective-II	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201AIMLL405 - 406	OEC	Open Elective-II	3	1	-	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
4	201AIMLP407	PCC-LC	Application Development Laboratory	2	-	4	4	100	ISE	50	20	40
									ESE POE	50	20	
5	201AIMLP408	PCC-LC	Deep Learning Laboratory	-	-	2	1	50	ISE	25	10	20
									ESE POE	25	10	
6	201AIMLP409 -411	PEC-LC	Professional Elective-II Laboratory	-	-	2	1	25	ISE	25	10	10
7	201AIMLP412	PROJ	Internship	-	1$	-	4	100	ISE	100	40	40
8	201AIMLP413	PROJ	Project-III	-	-	4*	2	100	ISE	50	20	40
									ESE-POE	50	20	
Total				11	2	12*	22	675				270

Professional Elective-II:			Open Elective-II:		
Sr. no.	Course Code	Name of the Course	Sr. no.	Course Code	Name of the Course
1.	201AIMLL402	Internet of Things	1.	201AIMLL405	AI For Everyone
2.	201AIMLL403	Digital Image Processing	2.	201AIMLL406	Machine Learning with Python
3.	201AIMLL404	Pattern Recognition		Other Department List Attached	

Note –
- Practical batch size should be considered as 15 students per batch.
- * - For Project – III, consider the workload of 2 hours per week for each project group consisting of 4/5 students.
- $ - Faculty workload of 1hour for batch of 10 students per week will be considered for Internship to evaluate the work done during Internship after ESE of Sem.-IV/ Sem.-VI.
- The elective should be offered by the department, if the minimum number of students opting for a particular elective must be 15 students and it should be taught by the concerned teacher.
  - ISE: In Semester Evaluation
  - MSE: Mid Semester Examination
  - ESE: End Semester Examination

D.Y. PATIL COLLEGE OF ENGINEERING TECHNOLOGY
KASABABAWADA, KOLHAPUR -416006

An Autonomous Institute

Final Year B. Tech. Open Elective –II List

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-II courses. The detailed syllabus is available on to the college website under academic tab.

Sr. No.	Department	Course Code	Subject Name
1	Computer Science & Engineering	201CSL409	Security and Privacy in Social Networks
		201CSL410	Web Applications Development
2	Electronics and Telecommunication	201ETL409	Biomedical Instrumentation
		201ETL410	Electronic Automation
3	Civil	201CEL415	Smart Cities
		201CEL416	GPS & Remote Sensing
4	Mechanical	201MEL406	Industrial Management (IM)
		201MEL407	Computer Integrated Manufacturing System (CIMS)
5	Chemical	201CHL45.1	Fuel Cell Technology
		201CHL45.2	Industrial Behavior and Practices
6	Computer Science & Engineering (Data Science)	201DSL406	Business Intelligence & Analytics.
		201DSL407	Data Visualization and Story telling.
7	Architecture	201AR408-A	Affordable Housing
		201AR408-B	Sustainable Community Living

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 – IV work will be conducted regularly as per the time table in the department and college campus.

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Teaching and Evaluation Scheme from Year 2023-24
Final Year B. Tech- Computer Science & Engineering (AI-ML)
SEMESTER-VIII – Regular Track

Sr. No	Course Code	Course Type	Name of the Course	Lecture	Tutorial	Practical	Credits	Total Marks	Type	Max. Marks	Min. for Passing	
1	201AIMLL414	PCC	Applications of AI-ML	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201AIMLL415	PCC	Data Visualization	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201AIMLL416-418	PEC	Professional Elective-III	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
4	201AIMLP419-421	PCC	Professional Elective-IV	3	1	-	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
5	201AIMLP422	PCC-LC	Applications of AI-ML Laboratory	-	-	2	1	50	ISE	25	10	20
									ESE-POE	25	10	
6	201AIMLP423	PCC	Data Visualization Laboratory	-	-	2	1	50	ISE	25	10	20
									ESE-POE	25	10	
7	201AIMLP424-426	PEC	Professional Elective-III Laboratory	-	-	2	1	25	ISE	25	10	10
8	201AIMLP427	PROJ	Project-IV	-	-	4*	2	100	ISE	50	20	40
									ESE-POE	50	20	
		Total		12	1	10*	18	625				250

Professional Elective-III		
Sr. no.	**Course Code**	**Name of the Course**
1.	201AIMLL416	High Performance Computing with AI
2.	201AIMLL417	Natural Language Processing
3.	201AIMLL418	Data Mining and Business Intelligence

Professional Elective–IV		
Sr. no.	Course Code	Name of the Course
1.	201AIMLL419	Embedded Deep Learning
2.	201AIMLL420	Computer Vision
3.	201AIMLL421	Optimization Techniques in Machine Learning

Note:

- Practical batch size should be considered as 15 students per batch

- * - For Project – IV, 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 must be 15 students and it should be taught by the concerned teacher.

- ISE: In Semester Evaluation

- MSE: Mid Semester Examination

- ESE: End Semester Examination

2. Professional track –

				Teaching Scheme per Week				Total Marks	Evaluation Scheme			

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, KOLHAPUR
Teaching and Evaluation Scheme from Year 2023-24
Final Year B. Tech- Computer Science & Engineering (AI-ML)
SEMESTER-VIII – Professional Track

Sr. No	Course Code	Course Type	Name of the Course	Lecture	Tutorial	Practical	Credits	Total Marks	Type	Max. Marks	Min. for Passing	
1	201AIMLP427	PROJ	Project-IV	-	-	4*	2	100	ISE	50	20	40
									ESE-POE	50	20	
2	201AIMLP428	PROJ	Professional Skills Development ****	-	1	36**	4	125	ISE-I	125	130	210
							6	200	ISE-II	200		
							6	200	ESE-OE	200	80	
	Total			-	1	40	18	625				250

Guidelines for Professional Track:

1. Student must submit his/her willingness for this track before the term end of semester – VII.
2. Head of the department will appoint one faculty coordinator to coordinate PTC work and manage all 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 while applying for this track –
   a. If student is selected in the company with PPO (Pre-Placement Offer) program through the college TPO.
   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.
   e. If student wants to do Innovation/Entrepreneurial activities for a duration 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 400-500 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 organisation, TPO, department T & P Coordinator and faculty coordinator mentioning the details clearly as per the syllabus structure.

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 a student and his/her parent to submit an undertaking, mentioning completion of Professional Track as per concerned organisation requirements and guidelines as per syllabus structure.

13. 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.

**

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 organisation.

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 organisation (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 organisation (a-e) supervisor for 100 marks taken together for all presentations and demonstration under ISE-I with 4 credits.

vi. Concerned organisation (a-e) should provide certificate of completion of assigned task along with marks under ISE-II head for 200 marks with 8 credits, in coordination with the faculty mentor before the conduct of ESE-OE exam.

vii. ESE-OE is to be conducted for 200 marks with 6 credits in the concerned organisation (a-e) where the student is doing his/her work. The ESE-OE will be conducted by both, faculty mentor and concerned organisation (a-e) supervisor.

viii. Students may complete **Professional Global Certification** either assigned by the concerned organisation (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.

<table>
<tr><td>**HOD**</td><td>**Dean**</td><td>**Principal**</td></tr>
<tr><td>**CSE(AIML)**</td><td>**Academics**</td><td></td></tr>
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D.Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY KASABA BAWADA KOLHAPUR-416006

(An Autonomous Institute) B. Tech. Curriculum
B. Tech. Computer Science & Engineering (AI-ML)

SEM-VII (Academic Year -2023-24)

Course Plan

Course Title : Deep Learning	
Course Code : 201AIMLL401	Semester : VII
Teaching Scheme : L-T-P : 3-0-0	Credits : 3
Evaluation Scheme : ISE : 20 + MSE : 30	ESE Marks : 50

Course Description:

Deep learning is a sub-field of machine learning that focuses on learning complex, hierarchical feature representations from raw data. The dominant method for achieving this, artificial neural networks, has revolutionized the processing of data (e.g. images, videos, text, and audio) as well as decision-making tasks (e.g. game-playing). Its success has enabled a tremendous amount of practical commercial applications and has had a significant impact on society.

In this course, students will learn the fundamental principles, underlying mathematics, and implementation details of deep learning. This includes the concepts and methods used to optimize Applications ranging from computer vision to natural language processing and decision-making (reinforcement learning) will be demonstrated.

Course Objectives:

1. To introduce the fundamentals of deep learning.

2. To introduce different models of deep learning to work with various types of inputs with respect to various applications.

3. To learn architectures and optimization methods for deep neural network training.

Course Outcomes (COs):

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

C401.1	Understand the fundamentals of neural networks.
C401.2	Remember architectures and optimization methods for deep neural network training.
C401.3	Apply attention mechanisms to the neural network.
C401.4	Critically evaluate the method's applicability in new contexts and construct new applications.

Prerequisite:	Machine learning

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	
C401.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	L-2
C401.2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	L-1
C401.3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	L-3
C401.4	3	3	3	-	-	-	-	-	-	-	-	-	3	-	L-3

Content	Hours
Unit 1: Introduction Biological Neuron, Idea of computational units, McCulloch–Pitts unit History of Deep Learning, Deep learning workflow, Learning types McCulloch Pitts Neuron.	06
Unit 2: Activation functions and parameters Introduction to neural network and multilayer perceptrons (MLPs) , representation power of MLPs, sigmoid neurons, gradient descent, feed forward neural networks representation, Back propagation.	06
Unit 3: Convolutional Neural Networks Deep learning techniques, The convolutional operation, The max pooling operation, Training a convnet from scratch on a small dataset, Using pre-trained convnet, Visualizing what convnet learn.	06

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Unit 4: Recurrent Neural Networks Introduction to RCNN, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs, Encoder-Decoder Models, Attention Mechanism.	06
Unit 5: Optimization and Generalization Optimization in Deep Learning–Non–convex optimization for deep networks-stochastic optimization Generalization in neural networks -spatial transformer networks-recurrent networks, LSTM-recurrent neural network language models-world-level RNNs & deep Reinforcement learning-computational & artificial neuroscience.	08
Unit 6: Case Study Emotion Recognition using human face and body language, Natural Language Processing, Speech recognition, Transformers, and Sequence to sequence learning.	06

Text Books:
1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016.
2. Bengio, Yoshua. " Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1, Now Publishers, 2009
3. Deep Learning, Rajiv Chopra, Khanna Book Publishing, Delhi 2020.

Online Resources:
1. https://nptel.ac.in/courses/106/106/106106184/
2. https://www.coursera.org/specializations/deep-learning

Course Plan

Course Title : Professional Elective-II : Internet of Things	
Course Code : 201AIMLL402	Semester : VII
Teaching Scheme : L-T-P : 3-0-0	Credits : 3
Evaluation Scheme : ISE + MSE Marks : 20 + 30	ESE Marks : 50

Course Description:

Internet of Things known as IoT is the study that describes the network of objects that are different things which are embedded with sensors, software, and also other technologies to connect and exchange data with other systems and devices over the Internet.

Course Objectives:
1. To explore to the interconnection and integration of the physical world and the cyber space.
2. To design & develop IOT Devices and Applications.

Course Outcomes (COs):

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

C402.1	Understand core technology, applications, sensors used and IOT architecture along with the industry perspective.
C402.2	Understand Raspberry's working and implementation
C402.3	Understand various communication protocols used in IoT.
C402.4	Apply various IOT technologies in real-life applications

Prerequisite:	Computer Networks, Computer Architecture and Microprocessors

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	
C402.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	L-2
C402.2	2	1	1	-	-	-	-	-	-	-	-	-	1	-	L-2
C402.3	2	3	1	-	-	-	-	-	-	-	-	-	-	-	L-2
C402.4	3	1	-	1	-	-	-	-	-	-	-	-	-	-	L-3

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SEM-VII (Academic Year -2023-24)

Content	Hours
Unit 1: Introduction to IoT Introduction to IoT, Current technological trends and future prospects, Evolution of IoT, IoT Devices - IoT Devices vs. Computers, Trends in the Adoption of IoT, Societal Benefits of IoT, Business Scope, Relation with embedded system, IoT Reference Architecture, physical-logical design of IOT- From M2M to IoT,	6
Unit 2: Elements of IoT Application Sensors & Actuators, Edge Networking (WSN), Gateways, IoT Communication Model – WPAN & LPWA, Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards	6
Unit 3: Communication and Connective Technologies IoT Communication Model, Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination. Long range Wireless Protocols, Short-range Wireless Protocols, Communication technologies	6
Unit 4: IoT and Cloud Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Cloud computing in IoT, IoT in cloud architecture, Logging on to cloud, Cloud based IoT platforms, IBM Watson, Google cloud	6
Unit 5: Domain specific applications of IoT Home automation, Industry applications, Surveillance applications, Other IoT applications – Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform – case studies: Soil moisture monitoring, Weather monitoring, Air quality Monitoring, Movement Detection.	6
Unit 6: IoT Case Studies Developing sensor based application through embedded system platform, Soil moisture monitoring, Weather monitoring, Air quality Monitoring, Movement Detection	6

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Textbooks:

1. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on Approach), 1st Edition, VPT, 2014

Reference Books:

1. Francis da Costa, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1stEdition, Apress Publications, 2014.

2. CunoPfister, Getting Started with the Internet of Things, O Reilly Media, 2011 .

3. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing, 2015.

Online Resources :

1. Introduction to Internet of Things Prof. Sudip Misra IIT Kharagpur. https://onlinecourses.nptel.ac.in/noc22_cs96/preview

Course Plan

Course Title: Professional Elective- II – Digital Image Processing	
Course Code:201AIMLL403	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 is intended for students to learn digital image processing techniques including representation, sampling and quantization, image acquisition, imaging geometry, image transforms, image enhancement, image smoothing and sharpening, and image restoration. More advanced topics include degradation models, image filtering, color image processing, and image segmentation are also to be learned to gain accuracy in machine learning models.

Course Objectives:

1. To learn and understand various image transform used in digital image processing.
2. To learn and understand various image enhancement technique used in digital image processing.
3. To learn and understand various image restoration technique and methods used in digital image processing.
4. To learn and understand various image compression and Segmentation used in digital image processing.

Course Outcomes (COs):

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

C403.1	Describe the basic issues and the scope of image processing, and the roles of image processing and systems in a variety of applications.
C403.2	Explore different techniques in image acquisition and color transformation.
C403.3	Understand how digital images are represented.
C403.4	Explore and apply the concepts of Edge detection, segmentation and object recognition.

Prerequisite:	Machine Learning

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	
C403.1	1	2	1	-	-	-	-	-	-	-	-	2	-	-	L-2
C403.2	2	2	2	-	-	-	-	-	-	-	-	2	-	-	L-2
C403.3	2	3	2	2	-	-	-	-	-	-	-	2	2	-	L-2
C403.4	2	3	2	2	-	-	-	-	-	-	-	2	-	-	L-3

Content	Hours
Unit 1: Digital Image Processing Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System	06
Unit 2: Digital Image Fundamentals Elements of Visual Perception, Image Sensing and Acquisition , Image Sampling and Quantization, Digital Image Signal Processing, Fourier Transform, Cosine Transform	07
Unit 3: Image Enhancement in Spatial Domain Basic gray Level Transformation, Histogram processing, Basics of Spatial Filtering, Smoothing Spatial Filters , Sharpening Spatial Filters, Combining Spatial Enhancement Methods, Frequency Domain	05
Unit 4: Image Restoration A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only, Periodic Noise Reduction by Frequency Domain Filtering, Geometric Mean Filter	06
Unit 5: Image Segmentation Fundamentals, Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description	07

Unit 6: Object Recognition Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Method, Structural Methods , Case Study: Handwritten text Recognition	05

Text Books:
1. Digital Image. Processing. Third Edition. Rafael C. Gonzalez. University of Tennessee. Richard E. Woods. NledData Interactive. Pearson International Edition.

Reference Books:
1. Digital Image Processing Using MATLAB
2. Principles of Digital Image Processing, Core Algorithms Wilhelm
3. Fundamentals of Digital Image Processing by Sanjay Sharma

Online Resources:
1. https://www.coursera.org/courses?query=image%20processing
2. https://onlinecourses.nptel.ac.in/noc19_ee55/preview

Course Plan

Course Title: Professional Elective – II - Pattern Recognition	
Course Code:201AIMLL404	Semester: VII
Teaching Scheme: L-T-P: 3-0-0	Credits: 3
Evaluation Scheme: ISE + MSE Marks: 20 + 30	ESE Marks : 50

Course Description:

     To help students understand basic mathematical and statistical techniques commonly used in pattern recognition. It introduces students to a variety of pattern recognition algorithms.

Course Objectives:
1. To know the basics of different mathematical and statistical techniques commonly used in pattern recognition.
2. To study different pattern recognition algorithms.
3. To learn various preprocessing algorithms.
4. To introduce various algorithms for image classification.

Course Outcomes (COs):

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

C404.1	Understand the basic mathematical and statistical techniques commonly used in pattern recognition.
C404.2	Apply a variety of pattern recognition algorithms.
C404.3	Understand and apply various preprocessing algorithms.
C404.4	Apply various algorithms for image classification.

Prerequisite:	Probability & Statistics.

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	
C404.1	2	2	-	1		-	-	-	-	-	-	-	-	-	L-2
C404.2	2	2	1	-	2	-	-	-	-	-	-	2	2	-	L-3
C404.3	1	2	1	2	1	-	-	-	-	-	-	2	1	-	L-2
C404.4	2	3	2	-	2	-	-	-	-	-	-	2	-	2	L-3

Content	Hours
Unit 1: Introduction and mathematical Preliminaries Principles of pattern recognition: Uses, mathematics, Classification and Bayesian rules, Clustering vs classification, Basics of linear algebra and vector spaces, Eigen values and eigen vectors, Rank of matrix and SVD.	5
Unit 2: Pattern Recognition basics Bayesian decision theory, Classifiers, Discriminant functions, Decision surfaces, Parameter estimation methods, Hidden Markov models, dimension reduction methods, Fisher discriminant analysis, Principal component analysis, non-parametric techniques for density estimation, nonmetric methods for pattern classification, unsupervised learning, algorithms for clustering: K -Means, Hierarchical and other methods	7
Unit 3: Feature Selection Problem statement and uses, Branch and bound algorithm, Sequential forward and backward selection, Cauchy Schwartz inequality.	6
Unit 4: Feature Extraction Feature extraction criteria function: Probabilistic separability based and Interclass distance based, Feature Extraction: principles	6
Unit 5: Visual Recognition Sources Human visual recognition system, Recognition methods: Low-level modelling (e.g., features), Midlevel abstraction (e.g., segmentation), High-level reasoning (e.g., scene understanding); Detection/Segmentation methods; Context and scenes, Importance and saliency, Large-scale search and recognition, Egocentric vision, systems, Human-in-the-loop interactive systems, 3D scene understanding.	6
Unit 6: Recent advancements in Pattern Recognition Comparison between performance of classifiers, Basics of statistics, covariance and their properties, Data condensation, feature clustering, Data visualization, Probability density estimation, Visualization and Aggregation, FCM and soft-computing techniques, Examples of real-life datasets.	6

Text Books:

1. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006.

2. O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.

3. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009

Reference Books:

1. Pattern Classification by Richard O. Duda , Peter E. Hart, David G. Stork, Wiley, 1973.

2. P.A Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, Prentice-Hall International, Englewood Cliffs, NJ, 1980.

3. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Ed. Academic Press, New York, 1990.

Online Resources:

1. https://nptel.ac.in/courses/106/106/106106046/

Course Plan

Course Title : Open Elective–II - AI For Everyone	
Course Code : 201AIMLL405	Semester : VII
Teaching Scheme : L-T-P : 3-1-0	Credits : 4
Evaluation Scheme : ISE+MSE Marks: 20 + 30	ESE Marks: 50

Course Description:

AI is a part of computer science based on theoretical and applied principles of that field. These principles include the data structures used in knowledge representation, the algorithms needed to apply that knowledge, and the languages and programming techniques used in their implementation.

Course Objectives:

1. To familiarize students with Artificial Intelligence principles and techniques.
2. To introduce the facts of computational model and their applications.
3. To explore problem-solving paradigms, search methodologies and learning algorithms.
4. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.

Course Outcomes (COs):

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

COs	
C405.1	Characterize different types of AI environments, transform a given real world problem to state space problem, understand and identify the stages and issues in the development of an expert system.
C405.2	Apply different searching algorithms and heuristic methodologies to reach the goal in state-space problems.
C405.3	Formulate a given real world problem formally using different knowledge representation methods and draw inferences from it.
C405.4	Implement appropriate searching strategies for a real-world environment.

Prereq uisitos	Knowledge of basic Computer Algorithms

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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	
C405.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	L-2
C405.2	2	3	3	-	-	-	-	-	-	-	-	-	2	-	L-3
C405.3	2	1	2	-	-	-	-	-	-	-	-	-	2	-	L-3
C405.4	3	2	3	-	-	-	-	-	-	-	-	-	3	-	L-3

Content	Hours
Unit 1: Introduction Importance of AI, Evolution of AI, Application of AI, Classification of AI with respect to environment, Intelligent agents, Different type of agents, Expert Systems, Stages in the development of Expert Systems	6
Unit 2: Representation and Search Problem solving by Search, Problem space - State space, Blind Search - Types, Performance measurement. Types, Game playing mini-max algorithm, Alpha-Beta Pruning, Depth first search, Breadth first search.	6
Unit 3: Uncertainty management in rule based expert system Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model. MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs	6
Unit 4: Learning Systems & Expert Systems Forms of Learning Types - Supervised, Unsupervised, Reinforcement Learning, Learning Decision Trees. Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools - Difficulties in Developing Expert Systems - Applications of Expert Systems	6
Unit 5: Reinforcement Learning Passive reinforcement learning, Direct utility estimation, Adaptive dynamic programming, Temporal difference learning, Active reinforcement learning- Q learning.	6
Unit 6: Machine Learning with python Study of important inbuilt libraries of Python like NumPy, SciPy, matplotlib, nltk, SimpleAI. Installing Python. Setting up PATH. Running Python. Study of real time applications of AI with Python	6

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Ass. No.	Name of Assignment	S/O	Hours
1	Study of Problem solving by Search and Problem space - State space	S	1
2	Implementation of uninformed and informed search	O	1
3	Implementation of construction of Bayesian network from given data	O	1
4	Implementation of Depth First Search (DFS)	O	1
5	Implementation of Breadth First Search (BFS)	O	1
6	Implementation of Min-Max Algorithm	O	1
7	Study of development of a simple expert system	S	1
8	Implementation of Tic-Tac-Toe game using Python.	O	1
9	Implementation of program using Numpy, Scipy Libraries	O	1
10	Implementation of program using Pandas Libraries	O	1
11	Study of various AI case studies	S	1
12	Mini project on AI case studies	O	1

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note: Solve all assignments from above list.**

Text Books:

1. Gorge F Luger, "Artificial Intelligence; structures and strategies for complex problem solving", Pearson Education, 5th Edition. [Units 1, 2, 3 &6]
2. Michael Negnevistsky, "Artificial Intelligence: A guide to intelligent systems", Person Education, 2nd edition. [Units 4, 5]
3. Giancarlo Zaccone, "Getting started with Tensor Flow", Packt Publishing, 2016. [Unit6].

Reference Books:

1. Dan W. Patterson, Introduction to Artificial Intelligence, Pearson Education India, 6 January2015

Online Resources:

1. https://nptel.ac.in/courses/106/102/106102220/

2. https://onlinecourses.nptel.ac.in/noc21_ge20/preview

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Course Plan

Course Title : Open Elective-II - Machine Learning with Python	
Course Code : 201AIMLL406	**Semester : VII**
Teaching Scheme : L-T-P : 3-1-0	**Credits : 4**
Evaluation Scheme : ISE - 20 Marks , MSE - 30 Marks	**ESE Marks : 50**

Course Description:

This course is an introduction to the theoretical aspects of the design of algorithms that enable machines to "learn" from examples (i.e., Machine Learning). The course is designed to develop Supervised Learning algorithms like Regressions, Multiclass Classification, Classifiers, Decision Tree, SVM and Clustering.

Course Objectives:
1. To teach students how to handle various data types and datasets in python.
2. To study various machine learning models in python.

Course Outcomes (COs):

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

C406.1	Understand python and be able to handle various datasets in python.
C406.2	Understand basic machine learning algorithms.
C406.3	Apply different classification and clustering algorithms for problem solving.
C406.4	Implement basic machine learning algorithms using python.

Prerequisite:	Python Programming

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	
C406.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	L-2
C406.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	L-2
C406.3	2	2	1	-	-	-	-	-	-	-	-	-	1	-	L-3
C406.4	2	2	1	1	-	-	-	-	-	-	-	-	2	-	L-3

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Content	Hours
Unit 1: Introduction to Python Data Types, Operators, Expression, Indexing & Slicing, Strings, Conditionals, Functions, Control Flow, Nested Loops, Sets & Dictionaries.	5
Unit 2: Introduction to Machine Learning Machine Learning Vs Statistical Modelling, Supervised vs Unsupervised Learning, Supervised Learning Classification, Unsupervised Learning, Reinforcement Learning, Applications, Python libraries suitable for Machine Learning: Pandas, Numpy, Scikit-learn, visualization libraries: matplotlib etc.	6
Unit 3: Regression Simple Linear Regression, Multiple Linear Regression, Non-linear Regression, Model Evaluation in Regression Models, Evaluation Metrics in Regression Models	6
Unit 4: Classification Introduction to Classification, K-Nearest Neighbour, Decision Trees, Logistic Regression, , Logistic regression vs Linear regression, Evaluation Metrics in Classification.	7
Unit 5: Support Vector Machines Linear SVM Classification, Nonlinear SVM Classification , SVM Regression , Decision Function and Predictions : Training Objective , Quadratic Programming , The Dual Problem.	6
Unit 6: Unsupervised Learning : Clustering Intro to Clustering, K-Means Clustering, Hierarchical Clustering, Density-Based Clustering, Content-based recommender systems, Collaborative Filtering.	6

List of Assignments			
Ass. No.	**Name of Assignment**	**S/O**	**Hours**
1	Study of basics of Python	O	1
2	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples)	O	1

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3	Implement functions, classes and objects using python. Demonstrate exception handling.	O	1
4	Implementation of simple Linear Regression	O	1
5	Implementation of Multivariate Linear Regression	O	1
6	Implementation of Multiclass Classification	O	1
7	Implementation of KNN Classifier	O	1
8	Implementation of Logistic Regression for Binary Classification	O	1
9	Implementation of Decision Tree	O	1
10	Implementation of SVM	O	1
11	Implementation of K-means Clustering	O	1
12	Implementation of Density-Based Clustering	O	1
13	Implementation of Hierarchical Clustering	O	1

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note - Minimum of 12 Experiments to be performed from the above list.**

Text Books:
1. Introduction to Machine Learning with Python: A Guide for Data Scientists 1st Edition by Andreas C. Müller, Sarah Guido, O'Reilly, 2016 (Unit-1, Unit-2)
2. Hands–On Machine Learning with Scikit–Learn and TensorFlow 2e: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly, 2017 (Unit-3 , Unit-4 , Unit-5 , Unit-6)

Reference Books:
1. Python Machine Learning - Third Edition, Sebastian Raschka , Vahid Mirjalili, Packt Publishers, 2019.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
2. https://www.edx.org/course/machine-learning-with-python-a-practical-introduct

<div align="center">Course Plan</div>

Course Title : Application Development Laboratory	
Course Code : 201AIMLP407	**Semester : VII**
Teaching Scheme : L-T-P : 2-0-4	**Credits : 4**
Evaluation Scheme : ISE Marks : 50	**ESE-POE Marks : 50**

Course Description:

In this course students will learn about the markup languages HTML, XHTML and the CSS and XSLT standards for formatting and transforming web content, interactive graphics and multimedia content on the web, client-side programming using Javascript, Angular and Node Js. Also contain newer tools like Flask and Postman.

Course Objectives:
1. To introduce students with front end web designing, emerging web technology concepts and tools.
2. To learn database access technologies and state management techniques.
3. To expose students to XAMPP web services, Flask and Postman tools.
4. To describe android architecture and the tools for developing android applications.

Course Outcomes (COs):

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

C407.1	Design web application using MVC and Angular JS
C407.2	Demonstrate use of server side technologies and Explore newer tools for web development
C407.3	Design and develop user Interfaces for the Android platform
C407.4	Design and develop database based android application

Prerequisite:	Object oriented Programming, Basics of HTML and CSS

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	
C407.1	-	-	3	-	2	-	-	-	-	-	-	-	2	-	L-6
C407.2	2	-	-	-	2	-	-	-	-	-	-	-	-	-	L-3
C407.3	-	-	3	-	2	-	-	-	-	-	-	-	2	-	L-6
C407.4	-	-	3	-	2	-	-	-	-	-	-	-	2	-	L-6

Content	Hours
Unit 1: Front End Web Designing HTML and CSS: HTML Design Patterns: HTML Structure, XHTML, DOCTYPE, Header Elements, Conditional Style Sheet, Structural Block Elements, Terminal Block Elements, Multipurpose Block Elements, Inline Elements, Class and ID Attributes, HTML Whitespaces CSS Selector and Inheritance: Type, Class and ID Selector, Position and Group Selectors, Attribute Selectors, Pseudo-element Selectors, Pseudo-class Selectors, Subclass Selector, Inheritance, Visual Inheritance, and Bootstrap	7
Unit 2: Javascript Basics: Introduction to javascript, Basic program of javascript, variables, functions, conditions, loops and repetition, Function, Arrays – DOM, Built-in Objects, Regular Expression, Exceptions, Event handling In Javascript, Validating HTML form data using javascript, Validation- AJAX – Jquery	6
Unit 3: Basics of Angular and Node JS: Angular - Web Application architecture, MVC and MVVM design pattern, Angular architecture, Angular building blocks, Forms implementation. NodeJs architecture, web based applications	4
Unit 4: Embedding a Machine Learning Model into a Web Application Serializing fitted scikit-learn estimator, Setting up an SQLite database for data storage, Developing a web applications with Flask, Deploying the web application to a public server API Endpoint Testing with Postman: Installation, create request, import request, exporting request as code, API Endpoint Testing, Create, Modify and delete the contents, Inspecting and using header information.	4
Unit 5: Android Overview: Overview of Android, History, Android Versions, Android OS stack: Linux kernel, Native Libraries/DVM, Application Framework, Applications, Activity, Fragments, Process and Threads. Android Development Environment Introduction to Android SDK, Android Emulator, Creating a Project, Project Directory Structure, DDMS, Android Manifest File, Permissions. Intents and Layouts: XML, Android View Hierarchies. What Is Intent? Android Intent Messaging via Intent Objects, Types of Intents, Using Intents with Activities, Sending Intents (Telephony, SMS), Broadcast Receivers	4

Unit 6: Input Controls, Input Events, Dialogs:	
Unit 6: Input Controls, Input Events, Dialogs: Input Controls, Menus, Notification and Action Bar, Android Database and App Market: Installing SQLite plugin, DbHelper, The Database Schema and Its Creation, Four Major Operations, Cursors, Example, publish app to the Android Market.	4

List of Experiments			
Ass. No.	**Name of Experiments**	**S/O**	**Hours**
1	Create html pages for website like login, registration and about us pages	O	2
2	Apply and design the created HTML pages using CSS	O	2
3	Write a program demonstrating javascript functions and different validations	O	2
4	Write a program to read and write HTML contents with JQuery	O	2
5	Create a simple Testing Angular application	O	2
6	Write a program demonstrating NodeJs application	O	2
7	Create simple application using Flask	O	2
8	Write a program to create, modify and delete the contents using Postman.	O	2
9	Deploying the web application to a public server	O	2
10	Creating simple project and study of android project structure and installing apk on mobile device/tablet, configuring mobile device/tablet in Android Studio with developer option and running app directly on mobile device/tablet.	O	2
11	Write a program to use of different layouts.	O	2
12	Write a program to use of Intents for SMS and Telephony.	O	2
13	Program to demonstrate Buttons, Text Fields, Checkboxes, Radio Buttons, and Toggle Buttons with their events handler.	O	2
14	Program to demonstrate Touch Mode, Menus with their events handler.	O	2
15	Implement an application that implements Multi-threading.	O	2
16	Write a program to study and use of SQLite database.	O	2

- ❖ **S-STUDY, O-OPERATIONAL**
- ❖ **Note:** Minimum of 15 Experiments to be performed from the above list.

Text Books:
1. Michael Bowers, DionysiosSynodinos and Victor Sumner, "Pro HTML5 and CSS3 Design Patterns", Apress edition (Unit I & II)
2. Amos Q. Haviv, "MEAN Web Development", PACKT PUBLISHING LTD (Unit III)
3. Sebastian Raschka & Vahid Mirjalili, "Python Machine Learning", Packt Publication (Unit IV)
4. Wei-Mag Lee, "Beginning Android application development", (Unit V & VI)

Reference Books:
1. Michael Bowers, DionysiosSynodinos and Victor Sumner, "Pro HTML5 and CSS3 Design Patterns", Apress edition
2. Ethan Brown, "Web Development with Node and Express", Published by O'Reilly Media
3. W. Jason Gilmore, "Learning Android by Marko Gargenta Publisher", O'Reilly Media
4. Wallace Jackson "Android Apps for Absolute Beginners",

Online Resources:
1. https://onlinecourses.swayam2.ac.in/ugc19_lb05/preview
2. https://www.udemy.com/course/machine-learning-learn-by-building-web-apps-in-python

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Course Plan

Course Title : Deep Learning Lab	
Course Code : 201AIMLP408	Semester: VII
Teaching Scheme : L-T-P : 0-0-2	Credits : 1
Evaluation Scheme : ISE : 25	ESE-POE Marks : 25

Course Description:

To solve complex AI based problems by applying the latest techniques and deep learning algorithms. This includes the methods used to optimize Applications ranging from computer vision to natural language processing and decision-making (reinforcement learning) will be demonstrated.

Course Objectives:
1. To learn the principles and practices of supervised learning and deep learning.
2. To learn how to use neural networks.
3. To learn how to use Keras and TensorBoard.
4. To gain knowledge about learning systems TensorFlow this will be introduced with working examples.
5. To learn mathematics and programming for deep learning.

Course Outcomes (COs):

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

C408.1	Understand the fundamentals of tensor to perform mathematical operations.
C408.2	Apply fundamentals of TensorFlow to implement neural networks.
C408.3	Apply basic CNN for image classification.
C408.4	Apply Recurrent Neural Networks.

Prerequisite:	Machine learning

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	
C408.1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	L-2
C408.2	3	3	3	-	-	-	-	-	-	-	-	-	3	-	L-3
C408.3	2	3	3	-	-	-	-	-	-	-	-	-	3	-	L-3
C408.4	2	3	3	-	-	-	-	-	-	-	-	-	3	-	L-3

Sr. No.	Experiment	S/O	Hours
1	Installation of Tensorflow & Keras (Tensorflow (v1.0.0), TFLearn, Keras, and many other pre-installed python libraries (Numpy, pandas)	S	2
2	Data Manipulation (Numpy library) Operations Broadcasting Indexing and slicing	S	2
3	Data Preprocessing Reading the Dataset Handling Missing Data Conversion to the Tensor Format	S	2
4	Linear Algebra Tensors Tensor arithmetic Implementing matrix multiplication	O	2
5	Implement McCulloch Pitts neural network using Tensorflow	O	2
6	Forward pass with matrix multiplication Forward pass with hidden layer (matrix multiplication) Forward pass with matrix multiplication with Keras Forward passes with hidden layer (matrix multiplication) with Keras.	O	2

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7	FCNN with only one neuron and plotting FCNN with one hidden layer and plotting Case study: MNIST digit classification with and without hidden layers.	O	2
8	A simple CNN Make a train and validation dataset of images with vertical and horizontal images Defining the CNN to predict the knowledge from image classification Visualizing the learned CNN Model	O	2
9	MNIST digit classification before and after shuffling Train CNN on Original Data Train CNN on shuffled data	O	2
10	Cifar10 classification with and without normalization CNN as classification model for the Cifar10 dataset CNN as classification model for the Cifar10 dataset	O	2
11	Using a pre-trained Imagenet network to predict images into one of the 1000 Imagenet classes	O	2
12	Implementation of Simple RNN and Implementation of Deep RNN	O	2
13	Case study of RNN shapes in image Captioning Case study of RNN shapes in Text Translation	S	2

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note: Students should implement minimum 12 experiments from above list.**

Text Books:
1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016.
2. Bengio, Yoshua. " Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1, Now Publishers, 2009.
3. Deep Learning, Rajiv Chopra, Khanna Book Publishing, Delhi 2020.

Online Resources:
1. https://nptel.ac.in/courses/106/106/106106184/

2. https://www.coursera.org/specializations/deep-learning

Course Plan

Course Title : Professional Elective-II Laboratory : Internet of Things	
Course Code : 201AIMLP409	**Semester : VII**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE- POE Marks : NA**

Course Description:

      This course aims to develop experiments on Internet of Things which are embedded with sensors, software, and also other technologies to connect and exchange data with other systems and devices over the Internet.

Course Objectives:
1. To learn integration of IoT Devices for real life applications.
2. To apply concepts of IoT to solve real world problems.

Course Outcomes (COs):

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

C409.1	Understand core technology, applications, sensors used and IOT architecture along with the industry perspective.
C409.2	Understand Raspberry's / Arduino working and implementation.
C409.3	Understand various communication protocols used in IoT.
C409.4	Apply various IOT technologies in real-life applications

Prerequisite:	Python, R Programming

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**	
C409.1	2	2	-	-	1	-	-	-	-	-	-	-	-	2	L-2
C409.2	2	1	1	-	1	-	-	-	-	-	-	-	1	2	L-2
C409.3	2	2	1	-	1	-	-	-	-	-	-	-	-	2	L-2
C409.4	1	1	-	1	1	-	-	-	-	-	-	-	-	2	L-3

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List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Study of Arduino/ Raspberry pi devices.	S	2
2	Led Control Using Arduino Board	O	2
3	Potentiometer and IR Sensor Interfacing With Arduino	O	2
4	Controlling Two Actuators Using Arduino	O	2
5	Actuator Controlling Through Cloud	O	2
6	Design a complete IOT architecture for Smart office based on AI technique.	O	2
7	Design a complete IOT architecture for Smart garden based on AI technique.	O	2
8	IoT Based Air Pollution Control System	O	2
9	TDS Sensor Interfacing With Arduino	O	2
10	Actuator Controlling by Mobile Using Arduino	O	2
11	Design a Smart Campus System.	O	2
12	Design of Smart City System	O	2
13	Mini Project on IoT devices (Mandatory Experiment).	O	2

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note:** A minimum of 12 experiments are to be performed from above experiments.

Textbooks:

1. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on Approach), 1st Edition, VPT, 2014

Reference Books:

1. Francis da Costa, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1stEdition, Apress Publications, 2014.

2. CunoPfister, Getting Started with the Internet of Things, O Reilly Media, 2011 .

3. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing, 2015.

Online Resources:

1. NPTEL Course on "Introduction to Internet of Things" by Prof. Sudip Misra, IIT Kharagpur.
https://onlinecourses.nptel.ac.in/noc22_cs96/preview

Course Plan

Course Title: Professional Elective- II Laboratory – Digital Image Processing	
Course Code:201AIMLP410	Semester :VII
Teaching Scheme: L-T-P: 0-0-2	Credits: 1
Evaluation Scheme: ISE marks: 25	ESE – POE Marks: NA

Course Description:

This course is intended for students to learn to implement the digital image processing techniques like image representation, acquisition, geometry, transformation, enhancement, smoothing and sharpening, and image restoration. More advanced topics include degradation models, image filtering, color image processing, and image segmentation are also to be learned and practiced to gain accuracy in machine learning models.

Course Objectives:

1. To learn and understand various image transform used in digital image processing
2. To learn and understand various image enhancement technique used in digital image processing
3. To learn and understand various image restoration technique and methods used in digital image processing
4. To learn and understand various image compression and Segmentation used in digital image processing

Course Outcomes (COs):

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

C410.1	Describe the basic issues and the scope of image processing, and the roles of image processing and systems in a variety of applications.
C410.2	Explore different techniques in image acquisition and color transformation
C410.3	Understand how digital images are represented
C410.4	Explore and apply the concepts of Edge detection, segmentation and object recognition

Prerequisite:	Computer image analysis

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	
C410.1	1	2	1	-	-	-	-	-	-	-	-	2	-	-	L-2
C410.2	2	2	2	-	-	-	-	-	-	-	-	2	-	-	L-2
C410.3	2	2	2	2	-	-	-	-	-	-	-	2	2	-	L-2
C410.4	2	3	2	2	-	-	-	-	-	-	-	2	-	-	L-3

Exp. No.	Name of Experiment	S/O	Hours
	List of Experiments		
1	Study of basics of Image Processing	S	2
2	Implement a program to generate image histogram	O	2
3	Implement fundamental Steps in Digital Image Processing	O	2
4	Implement a program to convert Color image into gray Scale	O	2
5	Implement Image Sampling and Quantization is done to enhance the image.	O	2
6	Mention and explain in detail the Mathematical Tools Used in Digital Image Processing with example.	O	2
7	Implement Histogram Equalization.	O	2
8	Implement Smoothen and Sharpen the image using Spatial filtering.	O	2
9	Implement a model of the Image Degradation/Restoration.	O	2
10	Implement restoration of image in presence of noise.	O	2
10	Implement Edge Detection on an image.	O	2
11	Implement object recognition based on Decision-Theoretic Method.	O	2
12	Write a case study report on sign language recognition.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Text Books:

1. Digital Image. Processing. Third Edition. Rafael C. Gonzalez. University of Tennessee. Richard E. Woods. NledData Interactive. Pearson International Edition.

Reference Books:
1. Digital Image Processing Using MATLAB
2. Principles of Digital Image Processing, Core Algorithms Wilhelm
3. Fundamentals of Digital Image Processing by Sanjay Sharma

Online Resources:

1. https://www.coursera.org/courses?query=image%20processing
2. https://onlinecourses.nptel.ac.in/noc19_ee55/preview

<div align="center">**Course Plan**</div>

Course Title: Professional Elective- II Laboratory – Pattern Recognition	
Course Code:201AIMLP411	Semester: VII
Teaching Scheme: L-T-P: 0-0-2	Credits:1
Evaluation Scheme: ISE: 25	ESE-POE Marks: NA

Course Description:

This course focuses on different pattern recognition techniques to automatically recognize the patterns and regularities in data. This course covers different recognition methods, feature selection and extraction, visual recognition, and recent advancements in pattern recognition.

Course Objectives:

1. To learn the fundamentals of eigen values and eigen vectors, the rank of a matrix and SVD.

2. To learn different pattern recognition algorithms to identify patterns in data.

3. To learn feature selection, extraction and criteria functions.

4. To make the students to apply recognition methods to real life datasets.

Course Outcomes (COs):

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

C411.1	Understand the fundamentals of eigen values and eigen vectors rank of matrix and SVD.
C411.2	Apply different algorithms of recognition.
C411.3	Analyze feature selection, extraction and criteria functions.
C411.4	Apply pattern recognition methods to real life data sets.

Prerequisite:	Image processing

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	
C411.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	L-2
C411.2	1	2	2	-	2	-	-	-	-	-	-	2	-	-	L-3
C411.3	1	3	3	2	2	-	-	-	-	-	-	2	2	-	L-4
C411.4	1	2	2	-	2	-	-	-	-	-	2	2	2	-	L-3

Sr. No.	List of Experiments	S/O	Hours
1	Eigen values and eigen vectors Rank of matrix and SVD – Calculation of the SVD from Scratch.	O	2
2	Implementation of Bayes Theorem for Classification -Naive Bayes Classifier & Bayes Optimal Classifier.	O	2
3	Implementation of a simple Hidden Markov Model (HMM) using Sample data set.	O	2
4	Implementation of Principal component analysis.	O	2
5	Algorithms for clustering: K -Means, Hierarchical methods.	O	2
6	Implementation of Branch and Bound algorithm.	O	2
7	Cauchy Schwartz inequality- Implementation of Vector Norms and Inequalities.	O	2
8	Feature selection criteria function.	O	2
9	Sources Human visual recognition system, Recognition methods.	O	2

10	Implementation of covariance, Covariance Matrix and their properties.	O	2
11	Create simple dashboard & Data visualization using PowerBI.	O	2
12	Implementation of Fuzzy C-Means Algorithm (FCM).	O	2

S-STUDY, O-OPERATIONAL

Note: All experiments from above list are to be performed. Python or R programming language can be used for implementation and all experiments to be executed by taking free public datasets from standard dataset websites.

Text Books:

1. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006.
2. O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.
3. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009

Reference Books:

1. Pattern Classification by Richard O. Duda , Peter E. Hart, David G. Stork, Wiley, 1973.
2. P.A Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, Prentice-Hall International, Englewood Cliffs, NJ, 1980.
3. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Ed. Academic Press, New York, 1990.

Online Resources:
1. https://nptel.ac.in/courses/106/106/106106046/

Course Plan

Course Title : Internship	
Course Code : 201AIMLP412	Semester : VII
Teaching Scheme : L-T-P : 0-1-0	Credits : 4
Evaluation Scheme : ISE Marks : 100	ESE-POE- Marks : NA

Course Description:

An internship is an impactful strategy for creating a future talent pool for the industry. The internship (a form of experiential learning) program helps fresh pass–outs in gaining professional know-how and benefits corporate sectors. The internship also enhances the student's employability skills passing out from Technical Institutions.

Course Objectives:
1. To expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence create competent professionals in the industry.
2. To provide possible opportunities to learn, understand and sharpen the real-time technical/managerial skills required at the job.
3. To get exposed to the current technological developments relevant to the subject area of training.
4. To learn to apply Technical knowledge in real industrial situations

Internship evaluation:

The students are expected to undergo 4 to 6 weeks Internship 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 will be as under:-

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

Faculty mentor includes "Presentation and Submission of Report", to the Department 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) The Industry experts/ supervisor are expected to assign the work worth minimum 100 to 120 hours for 4 weeks duration and should monitor and evaluate periodically.

4) At the completion of Internship work, the student is expected to prepare a report on the work done and get it certified from the industry expert.

Following is the distribution of internship evaluation of 30 marks.

Sr. No.	Criteria	30 Marks Distribution
1	Presentation	5
2	Communication	5
3	Technical Domain and Key takeaways from internship	10
4	Questions and Answers	5
5	Report	5

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Course Plan

Course Title: Project-III	
Course Code: 201AIMLP413	Semester :VII
Teaching Scheme:L-T-P:0-0-4	Credits: 2
Evaluation Scheme: ISE Marks: 50	POE Marks: 50

Course Description:

Final Year Projects represent the culmination of study towards the Bachelor of Engineering degree. Projects offer the opportunity to apply and extend material learned throughout the program. Students are supposed to find out a suitable project and prepare a detailed plan of the same. This will be the first part of the mega project, where students have to achieve the below mentioned objectives. Assessment is by means of a seminar presentation, submission of a thesis, and a demonstration of work undertaken.

Course Objectives:
1. To identify the area of project work
2. To recognize the need and ability to engage in lifelong learning
3. To learn functions effectively on teams and to communicate effectively
4. To prepare the technical report.

Course Outcomes (COs):

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

C413.1	Explain the need of a software project for the society
C413.2	Identify requirement analysis like functional and technical requirements for the project
C413.3	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
C413.4	Able to demonstrate analysis and design.
C413.5	Prepare the technical report consisting of Requirement specification, Analysis and Design of Project

Prerequisite:	Software Engineering, Machine Learning, Deep 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	
C413.1	-	-	-	-	-	1	1	-	2	-	-	-	-	-	L-2
C413.2	2	3	-	-	-	-	-	-	2	-	2	2	-	-	L-2
C413.3	2		2	-	2	-	-	-	2	3	2	2	2	-	L-2
C413.4	2	2	2	-	-	-	-	-	2	3	-	2	2	-	L-3
C413.5	2	1	1	-	-	-	-	-	3	3	-	2	2	-	L-4

Contents
1. The project work is to be carried out in two semesters of Final Year Computer Science and Engineering (Artificial Intelligence and Machine Learning).
2. The project should be undertaken preferably by a group of 5 students who will jointly work and implement the project in the two semesters.
3. In Semester VII, the group will select a project with the approval of the Guide (staff member) and submit the Name of the project with a synopsis of the proposed work of 8 to 10 pages before the second week of the semester. The group is expected to complete detailed system design, analysis, data flow and 50% of Project work at the end of semester –VII as a part of the term work submission in the form of a joint report.
4. The term work assessment will be done jointly by teachers appointed by Head of the Department and Project Coordinator. It should be based on Project Rubrics.
5. The oral examination will be conducted by an internal and external examiner.
6. Participation is must in Inter/Intra College Project Competitions / Publication of research papers

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Project Calendar

Sr. No.	Task	Period
1	Project Topic Selection	2nd week
2	Requirement Analysis and Synopsis Presentation	5th week
3	Design of Project	8th week
4	Coding of 50 % Project work	12th week
5	Project Report –I	14th week (Before Term end)

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.
4. Students should participate in Inter/Intra College Project Competitions.
5. Students should publish review papers based on their project title.
6. Report / Research paper should be **Plagiarism Free.**

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Course Plan

Course Title: Applications of AI-ML	
Course Code: 201AIMLL414	Semester: VIII
Teaching Scheme: L-T-P: 3-0-0	Credits: 3
Evaluation Scheme: ISE+MSE Marks: 20+30	ESE Mark: 50

Course Description:

　　AI is a part of computer science based on theoretical and applied principles of that field. This course is an introduction to the theoretical aspects of the design and implementation of applications of AI as well as ML. AI consists of understanding and implementing the basic application oriented principles and concepts of AI using an appropriate technique. AI-ML applications include the use of computers to do reasoning, pattern recognition, Image and Text processing learning or some other form of inference.

Course Objectives:

1. To give deep knowledge of Artificial Intelligence & Machine Learning and how AI ML can be applied in various fields to make the life easy.
2. To develop professional skills that prepares them to recognize emotions using human face and body language.
3. To develop a self-driven system that can make student's industry ready.

Course Outcomes (COs):

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

C414.1	Develop an understanding of cloud based applications of Artificial Intelligence (AI) and Machine Learning methods and describe their foundations.
C414.2	Understand development of systems that process unstructured, uncurated data automatically using artificial intelligence (AI) frameworks and platforms.
C414.3	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems and other machine learning models.
C414.4	Apply different methods to analyze Image, Text and video processing techniques.
C414.5	Implement AI frameworks and platforms to improve business, organizational, and Technology outcomes.

Prerequisite:	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	
C414.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	L-2
C414.2	3	2	-	-	-	-	-	-	-	-	-	-	1	-	L-2
C414.3	3	3	3	-	-	-	-	-	-	-	-	-	2	-	L-3
C414.4	3	3	3	-	-	-	-	-	-	-	-	-	2	-	L-3
C414.5	3	3	3	-	-	-	-	-	-	-	-	-	2	-	L-3

Content	Hours
Unit 1: AI with IoT & Cloud IOT reference model – IOT platforms – IOT verticals – Big data and IOT- Infusion of AI, industry standard for data mining – AI and IOT platforms. AI Platforms-Azure ML, Google AI, Swift AI.	06
Unit 2: AI based Object Detection & Recognition Emotion Recognition using human face and body language, AI based system to predict diseases early, AI based biometric system.	06
Unit 3: Image Processing Image Processing Image Processing and Pattern Recognition, Application in Bio-informatics, Applications in healthcare.	07
Unit 4: Text Mining Introduction to text mining, Methods and techniques of text mining, Application of text mining, Linguistic aspects of natural language processing.	07
Unit 5: AIML For business A.I. And Quantum Computing, Applications of Artificial Intelligence (AI) in business, ML in Social Problems handling, Application in retails and finance.	06

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Unit 6: Case Study	
1. Handwriting detection 2. Application in Digital Forensics. 3. Heart/ Cancer disease detection.	06

Text Books:

1. Dr. Nilakshi Jain, Artificial Intelligence: Making a System Intelligent, John Wiley &Sons.
2. Anindita Das, Artificial Intelligence & Soft Computing for Beginners, 3rd Edition-2018, Shroff Publisher
3. Ethem Alpaydin, Introduction to Machine Learning, Second Edition, 2010, Prentice Hall of India.
4. Sunila Gollapudi, Practical Machine Learning, Packt Publishing Ltd

Reference Books:

1. Dan W. Patterson, Introduction to Artificial Intelligence, Pearson Education India, 6 January2015.
2. Tom M. Mitchell, Machine Learning, International Edition 1997, McGraw Hill Education

Online Resources:

1. https://nptel.ac.in/courses/106/102/106102220/
2. https://onlinecourses.nptel.ac.in/noc21_ge20/preview
3. https://www.coursera.org/learn/machine-learning
4. https://nptel.ac.in/courses/106106139

Course Plan

Course Title : Data Visualization	
Course Code : 201AIMLL415	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 helps students to understand different visualization techniques. It also helps to study visualization tools and libraries. This will help to learn the nature of data across different domains and the concepts and skills of data visualization by understanding, questioning, and problematizing how data are generated, analyzed, and used. It will be able to apply its concepts and skills to visualize your own data, interpret the findings, and examine the impacts of data-driven decision.

Course Objectives:

1. To study different visualization techniques.
2. To learn basic libraries and tools to represent data in visual form.

Course Outcomes (COs):

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

C415.1	Apply data visualizations in order to derive more meaning out of data
C415.2	Understand python visualization libraries
C415.3	Apply data visualization on different types of data
C415.4	Perceive hidden meanings from data using data visualization.

Prerequisite:	Python, R Programming

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	
C415.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	L-3
C415.2	2	1	1	-	-	-	-	-	-	-	-	-	1	-	L-2
C415.3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	L-3
C415.4	1	1	-	1	-	-	-	-	-	-	-	-	-	-	L-2

Content	Hours
Unit 1: The Computer and the Human Overview of Visualization, 2-D Graphics, SVG example, 2-D Drawing, 3-D Graphics, Photorealism, Non-Photorealism, the human retina: Perceiving Two Dimensions, Perceiving Perspective	5
Unit 2: Visualization tools Line plots, area plots, histogram, bar charts, pie charts, scatter plots, bubble plots, waffle charts, word clouds,	6
Unit 3: Visualization of numerical data Introduction, Data, Mapping, Charts, Glyphs, parallel coordinates, Parallel coordinates, Stacked graphs, Tufte's Design Rules, Using Color	7
Unit 4: Visualization of non-numerical data Graphs and Networks, Embedding Planar Graphs, Graph Visualization, Tree Maps, Principal Component Analysis, Multidimensional Scaling	6
Unit 5: Python visualization libraries matplotlib, pandas, seaborn, ggplot, plotly	6
Unit 6: Time Series Data Analysis Time Series Data Analysis: Date and Time Data Types and Tools, Time series Basics, date Ranges, Frequencies and Shifting, Time Zone Handling, Periods and Periods Arithmetic, Resampling and Frequency conversion, Moving Window Functions.	6

Text Books:
1. Taming Python by Programming, Jeeva Jose, Khanna Book Publishing House.
2. Data Visualization with Python and JavaScript: Scrape, Clean, Explore & Transform Your Data, Kyran Dale, O'Reilly, 2016.
3. Introduction to Computing & Problem Solving with Python, Jeeva Jose, Khanna Publishing House.

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Reference Books:
1. Data Visualization with Python: Create an impact with meaningful data insights using interactive and engaging visuals, Mario Döbler , Packt Publishers, 2019.
2. Mastering Python Data Visualization, Kirthi Raman, Packt Publishers, 2015

Online Resources:

1. Data Science for Engineers, Prof. Raghunathan Rengaswamy Prof. Shankar Narsimhan, IIT Madras
https://onlinecourses.nptel.ac.in/noc20_cs72/preview

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Course Plan

Course Title : Professional Elective-III – High Performance Computing with AI	
Course Code : 201AIMLL416	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 is about the basic algorithmic techniques you'll need to do so. The practical aspect of this course is implementing the algorithms and techniques you'll learn to run on real parallel and distributed systems, so you can check whether what appears to work well in theory also translates into practice.

Course Objectives:
1. To teach the basic concepts of parallel computing
2. To equip students with knowledge to write parallel programs using industry-standard parallel programming frameworks.

Course Outcomes (COs):

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

C416.1	Comprehend parallel algorithm design and taxonomy of parallel architecture (K2)
C416.2	Understand OpenMP and MPI directives and libraries to implement parallel program (K2)
C416.3	Develop different parallel programs (K3)
C416.4	Analyze performance of parallel algorithms designed using Open MP. MPI and CUDA (K4)

Prerequisite:	Computer Architecture , Computer Algorithm

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	
C416.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	L-2
C416.2	2	1	1	-	-	-	-	-	-	-	-	-	1	-	L-2
C416.3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	L-3
C416.4	1	1	-	1	-	-	-	-	-	-	-	-	-	-	L-4

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Content	Hours
Unit 1: Parallel Computing Need of ever-increasing performance, Building parallel systems, Need to write parallel programs , Analyze parallel programs	5
Unit 2: Parallel Systems The von Neumann architecture, Processes, multitasking, and threads SIMD systems, MIMD systems, Interconnection networks, Performance, Speedup and efficiency, Amdahl's law, Scalability	6
Unit 3: Shared-Memory Programming with OpenMP Shared memory programming, Parallel for loop, critical section, Writing OpenMP Programs, Compiling and running OpenMP programs, The reduction clause, The parallel for Directive	6
Unit 4: Distributed-Memory Programming with MPI Compilation and execution of MPI Programs , MPI Init and MPI Finalize, Communicators, MPI Comm size and MPI Comm rank, SPMD programs, Communication, MPI Send, MPI Recv, Message matching, Tree-structured communication , MPI All-reduce, Broadcast, Scatter, Gather, All-gather	7
Unit 5: Programming with CUDA GPGPU Architecture of NVIDIA, CUDA Model, Programming in CUDA, Examples	6
Unit 6: Application Scalability HPC Application Development, Parallel Computing libraries in python, Comparison of Serial and parallel examples.	6

Text Books:
1. An Introduction to Parallel Programming, Peter S. Pacheco, Morgan Kaufmann Publications 2011.
2. Parallel programming in C with MPI and OpenMP, Michael J Quinn, Tata McGraw Hill , 2003.
3. Programming Massively Parallel Processors, David B. Kirk and Wen-mei W. Hwu , Morgan Kaufmann , 2nd Edition , 2010.

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Reference Books:
1. Introduction to Parallel Computing, Ananth Grama, George Karypis, Vipin Kumar & Anshul Gupta, Pearson Education Limited , Second Edition , 2003.
2. Multi-core Programming, Shameem Akhter and Jason Roberts, Intel Press , 2006.
3. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs , Shane Cook , Elsevier Inc , First Edition , 2013.

Online Resources:

1. Introduction to parallel programming with OpenMP and MPI, by Yogish Sabharwal, IIT Delhi.
   https://onlinecourses.nptel.ac.in/noc22_cs21/preview

2. GPU architecture and programming , by Prof. Dey , IIT Kharagpur.
   https://onlinecourses.nptel.ac.in/noc21_cs46/preview

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Course Plan

Course Title : Professional Elective III- Natural Language Processing	
Course Code : 201AIMLL417	Semester : VIII
Teaching Scheme : L-T-P : 3-0-0	Credits : 3
Evaluation Scheme : ISE : 20 + MSE : 30	ESE Marks : 50

Course Description:

Natural Language Processing (NLP) is a rapidly developing field that aims to allow machines to break down and interpret human language. It combines the power of linguistics and computer science and takes advantage of machine learning techniques to learn the rules and structure of language and build intelligent systems that can understand, analyze and generate natural language text.

Course Objectives:

1. To introduce the fundamentals of language and the tools that are available to efficiently study and analyze large collections of text.
2. To Gain a foundational understanding about the methods and evaluation metrics for various natural language processing tasks.
3. To learn how to evaluate the strengths and weaknesses of various NLP technologies and frameworks.
4. To Gain practical experience in the NLP toolkits available.

Course Outcomes (COs):

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

C417.1	Understand language and the tools that are available to efficiently study and analyze large collections of text.
C417.2	Analyze and discuss the effects of electronic communication on our language
C417.3	Remember natural language processing with manual and automated approaches.
C417.4	Understand computational frameworks for natural language processing.

Prerequisite:	Machine learning, Deep 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	
C417.1	3	3	2	-	-	-	-	-	-	-	-	-	2	-	L-2
C417.2	3	2	2	-	-	-	-	-	-	-	-	-	2	-	L-4
C417.3	2	3	2	-	-	-	-	-	-	-	-	-	3	-	L-1
C417.4	3	3	3	-	-	-	-	-	-	-	-	-	2	-	L-2

Content	Hours
Unit 1: Introduction A computational framework for natural language, description of English or an Indian language in the framework, lexicon, algorithms and data structures for implementation of the framework, Finite state automata, the different analysis levels used for NLP (morphological, syntactic, semantic, pragmatic, Recursive and augmented transition networks. Applications like machine translations.	06
Unit 2: Word Level Analysis Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and correction, Words and Word classes, Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar, Constituency, Parsing-Probabilistic Parsing. Machine readable dictionaries and lexical databases, RTN, ATN. Module	06
Unit 3: Semantic Analysis Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation. Discourse Processing: cohesion, Reference Resolution, Discourse Coherence and Structure. Knowledge Representation, reasoning. Module	06

Unit 4: Natural Language Generation (NLG) Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG. Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, Translation involving Indian Languages.	07
Unit 5: Information retrieval and lexical resources Information Retrieval Design features of Information Retrieval Systems, Classical, Non-classical, Alternative Models of Information Retrieval, valuation Lexical Resources: World Net, Frame Net, Stemmers, POS Tagger.	06
Unit 6: Dialogue Systems IR based question answering system – Entity linking – Knowledge based Q&A – Language models for Q&A – Evaluation of systems – Chatbots – Human dialogue – Frame based dialogue – Dialogue state architecture – Evaluating dialogue systems.	06

Text Books:

1. Natural Language Understanding by James Allen, Pearson Education, 2002.
2. NLP: A Paninian Perspective by Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal, Prentice Hall, 2016.
3. Meaning and Grammar by G. Chirchia and S. McConnell Ginet, MIT Press, 1990.
4. Natural Language Processing with TensorFlow, Thushan Ganegedara, Packt, 2018

Reference Books:
1. An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition by Daniel Jurafsky and James H. Martin, Pearson Education, 2006.
2. Natural language processing in Prolog by Gazdar, & Mellish, Addison-Wesley

Online Resources:

1. https://www.coursera.org/specializations/natural-language-processing

Course Plan

Course Title : Professional Elective-III : Data Mining and Business Intelligence	
Course Code : 201AIMLL418	Semester : VIII
Teaching Scheme : L-T-P : 3-0-0	Credits : 3
Evaluation Scheme : ISE + MSE :Marks : 20 + 30	ESE- Marks : 50

Course Description

Data Mining studies algorithms and computational paradigms that allow computers to find patterns and regularities in databases, perform prediction and forecasting, and generally improve their performance through interaction with data. The knowledge discovery process includes data selection, cleaning, coding, using different statistical and machine learning techniques, and visualization of the generated structures. The course will cover all these issues and will illustrate the whole process by examples. Special emphasis will be given to the Machine Learning methods as they provide the real knowledge discovery tools. Important related technologies, as data warehousing and on-line analytical processing (OLAP) will be also discussed.

Course Objectives:

- To learn data mining Concepts
- To apply data preprocessing techniques and tools to solve business problems.
- To study data mining techniques and algorithm in business analytics.

Course Outcomes (COs):

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

C418.1	Define the concepts of data warehousing, data mining and data preprocessing
C418.2	Apply the concepts of classification of predication of data
C418.3	Apply the concepts of association rule mining
C418.4	Apply the concepts of Business Intelligence Data Mining
C418.5	Develop a prediction model using data mining tools

Prerequisite:	Database Engineering

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	
C418.1	2	-	3	2	-	-	-	-	-	-	-	-	-	-	L-2
C418.2	2	2	2	2	-	-	-	-	-	-	-	-	-	-	L-3
C418.3	2	-	2	1	-	-	-	-	-	-	-	-	-	-	L-3
C418.4	2	3	2	-	-	-	-	-	-	-	-	-	-	-	L-3
C418.5	2	-	2	2	-	-	-	-	-	-	-	-	-	-	L-3

Content	Hours
Unit 1: Data Mining basics Data Warehouse and OLAP, Data Warehouse and DBMS, Multidimensional data model, OLAP operations, OLAP Queries, Basic Data Mining Tasks, Data Mining Versus Knowledge Discovery in Data Bases, Data Mining Issues, Data Mining Matrices, Social Implications of Data Mining, Data Mining from Data Base Perspective.	6
Unit 2: Data Mining Techniques and Classifications Data Mining Techniques – a Statistical Perspective on data mining, Similarity Measures, Decision Trees, Neural Networks, Genetic Algorithms. Classification: Introduction, Statistical – Based Algorithms, Distance Based Algorithms.	6
Unit 3: Clustering Tree Based Algorithms, Neural Network Based Algorithms, Rule Based Algorithms, and Combining Techniques: Introduction, Similarity and Distance Measures, Partitioning Methods, Hierarchical methods, Density-Based Methods, Grid- Based Methods – Model-Based Clustering Methods, Clustering High- Dimensional Data, Constraint- Based Cluster Analysis, and Outlier Analysis.	6
Unit 4: Association Rules Association Rules: Introduction - Large Item Sets, Basic Algorithms, Parallel& Distributed Algorithms, Comparing Approaches, Incremental Rules, Advanced Association Rules Techniques, Measuring the Quality of Rules.	6

Unit 5: Business Intelligence: Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics. BI Life Cycle. Data for BI - Data Issues and Data Quality for BI. BI Implementation - Key Drivers, Key Performance Indicators and Performance Metrics, BI Architecture/Framework, Best Practices, Business Decision Making, Styles of BI-vent-Driven alerts - A cyclic process of Intelligence Creation. The value of Business Intelligence-Value driven & Information use.	6
Unit 6:Data Mining Tool for Business Intelligence Loading the data (Simple) - Filtering attributes (Simple) - Selecting attributes (Intermediate) – Training a classifier (Simple) - Building your own classifier (Advanced) - Tree visualization (Intermediate) - Testing and evaluating your models (Simple)Regression models (Simple) - Association rules (Intermediate) - Clustering (Simple) - Reusing models (Intermediate) - Data mining in direct marketing (Simple) - Using Weka for stock value forecasting (Advanced).	6

Text Book:

1. Jiawei Han &Micheline Kamber, "Data Mining Concepts & Techniques", 2011, 3rd Edition.
2. Ian H. Witten and Eibe Frank – Data Mining Practical Machine Learning Tools and Techniques, Morgan Kaufmann Publication – 2016 4th Edition.
3. Rajiv Sabherwal "Business Intelligence" Wiley Publications, 2012.

Reference Books:

1. Margaret H.Dunbam, "Data Mining Introductory and Advanced Topics", Pearson Education 2003.
2. Arun K. Pujari – Data Mining Techniques, Universities Press (India) Pvt. Ltd., 2013 Kindle Edition.

Online Reference:

1. NPTEL & MOOC courses on Data Mining
https://nptel.ac.in/courses/106105174/

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SEM-VIII (Academic Year -2023-24)

Course Plan

Course Title: Professional Elective IV - Embedded Deep Learning	
Course Code: 201AIMLL419	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 covers algorithmic and hardware implementation techniques to enable embedded deep learning. It describes synergetic design approaches on the application, algorithmic, computer architecture and circuit-level that will help in achieving the goal of reducing the computational cost of deep learning algorithms.

Course Objectives:

1. To give a wide overview of a series of effective solutions for energy-efficient neural networks on battery constrained wearable devices
2. To optimize the neural networks for embedded deployment on all levels of the design hierarchy
3. To elaborate on how to design efficient Convolution Neural Network processors, exploiting parallelism and data-reuse, sparse operations, and low-precision computations

Course Outcomes (COs):

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

C419.1	Understand the basic training and inference techniques of a neural network.
C419.2	Implement neural networks using machine learning tools
C419.3	Implement neural networks on customized hardware, such as FPGA
C419.4	Design and develop Embedded system automation based on that have machine learning computation and control capacity.

Prerequisite:	Deep Learning

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	
C419.1	1	2	1	-	-	-	-	-	-	-	-	2	-	-	L-2
C419.2	2	2	2	-	-	-	-	-	-	-	-	2	-	-	L-2
C419.3	2	3	2	2	1	-	-	-	-	-	-	2	2	-	L-2
C419.4	2	3	2	2	1	-	-	-	-	-	-	2	2	-	L-3

Content	Hours
Unit 1: Embedded Deep Neural Networks Introduction, Machine Learning, Deep Learning, Challenges for Deep Neural Networks	06
Unit 2: Optimized Hierarchical Cascaded Processing Introduction, Hierarchical Cascaded Systems – Two –Stage Wake-up Systems, Cost-precision, model of Hierarchical Classifiers, General Proof of Concept- System Description, Input Statistics	07
Unit 3: Hardware Algorithm Co-Optimizations Introduction, Energy Gain in Low Precision Neural Networks, Test- Time Fixed – Point Neural Networks	05
Unit 4: Circuit Techniques for Approximate Computing Introduction, Techniques- Resilience Identification and Quality Management, Approximate Circuits , Architectures	06
Unit 5: ENVISION : Energy – Scalable Sparse Convolutional Network Processing Neural Network Acceleration, Processor Datapath, On-Chip Memory Architecture, Hardware Support for Exploiting Network Sparsity.	07
Unit 6: BINAREYE: Digital And Mixed Signal Always –On Binary Neural Network Processing Introduction, Binary Neural Networks, Binary Neural Networks applications, A Programmable Input-to-Label Accelerator Architecture, BinarEYE : A digital SX implementation.	05

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Ass. No.	Name of Assignments	S/O	Hours
	List of Assignments		
1	Basics of Deep Learning	S	1
2	Explain Convolutional Neural Networks with example.	S	1
3	Explain Two –Stage Wake-up Systems in Hierarchical Cascaded Systems with example.	S	1
4	Explain model of Hierarchical Classifiers with example	S	1
5	How to Gain energy in Low Precision in Neural Networks? Explain with example.	S	1
6	Explain Test- Time Fixed – Point Neural Networks with example.	S	1
7	Explain Neural Network Acceleration for Sparse Convolutional Network Processing.	S	1
8	Explain On-Chip Memory Architecture in detail. How it can be applied in CNN?	S	1
9	Explain Hardware Support for Exploiting Network Sparsity.	S	1
10	Explain Binary Neural Networks with example.	S	1
11	Explain Programmable Input-to-Label Accelerator Architecture.	S	1
12	Accuracy Measures in embedded deep learning	S	1
13	Case studies on embedded deep learning	S	1

Note: Minimum 12 Assignments should be solved from above list.

Text Books:
1. Embedded Deep Learning, Algorithms, Architectures And Circuits for Always –On Neural Network Processing, Springer.

Reference Books:
1. Fundamentals of Deep Learning, Chapter 6. Embedding and Representational Learning, by Nikhil Buduma.

Online Resources:
https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Course Plan

Course Title: Professional Elective- IV - Computer Vision	
Course Code: 201AIMLL420	Semester: VIII
Teaching Scheme: L-T-P: 3-1-0	Credits: 4
Evaluation Scheme: ISE + MSE Marks: 20 + 30	ESE Marks: 50

Course Description:

Computer vision tasks include methods for acquiring, processing, analyzing and understanding digital images, and extraction of high-dimensional data from the real world in order to produce numerical or symbolic information data sets.

Course Objectives:

1. To review different image processing techniques for computer vision.
2. To study shape and region analysis.
3. To learn Hough, Transform and its applications to detect lines, circles, ellipses.
4. To introduce three-dimensional image analysis techniques.

Course Outcomes (COs):

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

C420.1	To understand & review image processing techniques for computer vision.
C420.2	Understand the concept of shape and region analysis.
C420.3	Analyze the Hough, Transform and its applications to detect lines, circles, ellipses.
C420.4	Explore the three-dimensional image analysis techniques.
C420.5	To apply computer vision algorithms to real life applications.

Prerequisite:	Image Processing

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	
C420.1	2	2	-	1	-	-	-	-	-	-	-	2	-	-	L-2
C420.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	L-2
C420.3	1	3	-	2	-	-	-	-	-	-	-	-	-	-	L-4
C420.4	2	2	-	2	-	-	-	-	-	-	-	-	2	1	L-2
C420.5	1	2	3	2	2	-	-	-	-	-	-	3	2	1	L-3

Content	Hours
Unit 1: IMAGE PROCESSING FOUNDATIONS Review of image processing techniques – classical filtering operations – thresholding techniques– edge detection techniques – corner and interest point detection mathematical morphology –texture	5
Unit 2: SHAPES AND REGIONS Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – Centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments	6
Unit 3: HOUGH TRANSFORM Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.	6
Unit 4: 3D VISION Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction –	7

Unit 5: 3D MOTION Introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – Spline-based motion – optical flow – layered motion.		6
Unit 6: APPLICATIONS Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians		6

List of Assignments			
Ass. No.	**Name of Assignment**	**S/O**	**Hours**
1	Review of image processing techniques and classical filtering operations.	S	1
2	To implement image segmentation by thresholding and edge detection techniques.	O	1
3	Binary shape analysis – Analysis of biomedical image.	S	1
4	Deformable shape analysis	S	1
5	Boundary length measures & Boundary descriptors	S	1
6	To implement RANSAC for straight line detection.	O	1
7	To implement Generalized Hough Transform (GHT)	O	1
8	Different Methods for 3D vision	S	1
9	Spline-based motion- SplineBased Motion Planning for Automated Driving	S	1
10	Optical flow – layered motion	S	1
11	Surveillance – foreground-background separation – particle filters	S	1
12	Analysis of In-vehicle vision system	S	1
13	Case study	S	1

❖ **S-STUDY, O-OPERATIONAL**

Text Books:

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, PacktPublishing, 2012.

2. E. R. Davies, ―Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.

3. Jan Erik Solem, ―Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.

Reference Books:

1. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.

2. R. Szeliski, ―Computer Vision: Algorithms and Applications, Springer 2011.

3. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

Online Resources:

1. https://nptel.ac.in/courses/106106145

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Course Plan

Course Title :Professional Elective – IV - Optimization Techniques in Machine Learning	
Course Code : 201AIMLL421	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 offers a holistic introduction to the fundamentals of mathematical optimization for machine learning and deep learning. Using a range of real datasets and basic Python libraries for data manipulation, vector/matrix algebra, and automatic differentiation. Fundamental optimization algorithms for popular machine learning / deep learning models

Course Objectives:
1. To study and analyze how to deal with changing data.
2. To identify and interpret potential unintended effects in your project.
3. To explore and define procedures to operationalize and maintain your applied machine learning model.

Course Outcomes (COs):

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

C421.1	Understand and analyze how to deal with changing data.
C421.2	Understand and interpret potential unintended effects in their project.
C421.3	Understand and define procedures to operationalize and maintain the applied machine learning model.
C421.4	Understand how to optimize the use of Machine Learning in real-life problems.

Prerequisite:	Linear Algebra and Vector Calculus, Python 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	
C421.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	L-4
C421.2	2	1	1	-	-	-	-	-	-	-	-	-	1	-	L-2
C421.3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	L-2
C421.4	1	1	-	1	-	-	-	-	-	-	-	-	-	-	L-2

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Content	Hours
Unit 1: Fundamentals of Convex Analysis Mathematical optimization, Convex optimization, Nonlinear optimization, Convex sets: Affine and convex sets , Convex functions : The conjugate function , Quasiconvex functions , Log-concave and log-convex functions	5
Unit 2: First-Order Methods Gradient Descent, Conjugate Gradient, Momentum, Nesterov Momentum, Adagrad, RMSProp, Adadelta, Adam, Hypergradient Descent	6
Unit 3: Cutting-plane Methods in Machine Learning Introduction to Cutting-plane Methods , Bundle Methods , Combinatorial Optimization , Regularized Risk Minimization , Bundle Method for Regularized Risk Minimization , BMRM Algorithm Accelerated by Line-search , Multiple Kernel Learning , Convex Multiple Kernel Learning, Min-Max Formulation of Multiple Kernel Learning.	7
Unit 4: Second-Order Methods Newton's Method, Secant Method, Quasi-Newton Methods, Direct Methods : Cyclic Coordinate Search, Generalized Pattern Search , Nelder-Mead Simplex Method	6
Unit 5: Projected Newton-type Methods in Machine Learning Projected Newton-type Methods, Building a Quadratic Model, Two-Metric Projection Methods, Inexact Projection Methods : Spectral Projected Gradient , SPG-based Inexact Projected Newton, Proximal Newton-like Methods	6
Unit 6: Interior-Point Methods in Machine Learning Introduction, Interior-Point Methods: Background, Interior-Point Methods for Machine Learning, Accelerating Interior-Point Methods	6

List of Assignments			
Ass. No.	**Name of Assignment**	**S/O**	**Hours**
1	Analyze how to solve Mathematical Optimization problems.	S	1
2	Analyze how to solve Convex Optimization problems.	S	1

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3	Describe the Local Optimization and Global Optimization in Nonlinear optimization.	S	1
4	Lines and line segments , Affine sets , Convex sets , Cones	S	1
5	Definition and examples of conjugate function	S	1
6	Definition and examples of Quasiconvex functions	S	1
7	Implement Conjugate Gradient using Python	O	1
8	Implement Momentum and Nesterov Momentum	O	1
9	Implement Newton's Method using Python	O	1
10	Implement Quasi-Newton Methods Python	O	1
11	Analyze Projected Newton-type Methods	S	1
12	Analyze Interior-Point Methods for Machine Learning	S	1

❖ **S-STUDY, O-OPERATIONAL**

Text Books:
1. S. Boyd and L. Vanden berghe, "Convex Optimization," Cambridge University Press, 2004. (Unit -1)
2. Algorithms for Optimization by Mykel J. Kochenderfer and Tim A. Wheeler, MIT Press, 2019.(Unit -2 , Unit-4)
3. Optimization for Machine Learning, Suvrit Sra, Sebastian Nowozin and Stephen J. Wright, MIT Press, 2011. (unit- 3 , unit- 5 , unit- 6)

Reference Books:
1. Optimization in Machine Learning and Applications, Suresh Chandra Satapathy, Anand J. Kulkarni, Springer, 2019.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee59/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs64/preview

Course Plan

Course Title : Applications of AI-ML Laboratory	
Course Code : 201AIMLP422	Semester : VIII
Teaching Scheme : L-T-P : 0-0-2	Credits :1
Evaluation Scheme : ISE Marks : 25	ESE-POE Marks : 25

Course Description:

To solve complex AI application based problems by applying the latest techniques and libraries. AI-ML applications include the use of computers to do reasoning, pattern recognition, Image and Text processing learning or some other form of inference.

Course Objectives:

1. To study AI techniques for generating efficient, intelligent behavior in different application such as gaming.
2. To study how AI is transforming the practice of medicine. The students should learn the practical experience in applying machine learning to concrete problems in medicine.
3. To explore the evolution of AI-driven online wealth management platforms, robo-advisors, and learn how they work and why they're successful.

Course Outcomes (COs):

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

C422.1	Apply various pre-processing techniques on different datasets.
C422.2	Construct Machine learning programs for application based on supervised, unsupervised and Semi supervised learning models.
C422.3	Develop prediction model for applications of AIML with different libraries.
C422.4	Identify and Apply Artificial Intelligence & machine learning concepts to solve real world problems.

Prerequisite:	Machine Learning, Deep Learning

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	
C422.1	3	3	2	-	-	-	-	-	-	-	-	-	2	-	L-3
C422.2	2	3	3	-	-	-	-	-	-	-	-	-	3	-	L-6
C422.3	2	3	3	-	-	-	-	-	-	-	-	-	3	-	L-6
C422.4	3	3	2	-	-	-	-	-	-	-	-	-	3	-	L-2

List of Assignments			
Ass. No.	**Name of Assignment**	**S/O**	**Hours**
1	Write a program to predicting user's next location.	O	2
2	Write a program to detecting YouTube comment spam.	O	2
3	Write a program to identifying the genre of a song.	O	2
4	Write a program to shock front classification.	O	2
5	Write a program to develop a Human Face Recognition.	O	2
6	Write a program to develop Speech Recognition System.	O	2
7	Write a program to develop a system for Email Spam and Malware filtering.	O	2
8	Building and training a model for medical image diagnosis.	O	2
9	Implement path finding algorithms for AI agents.	O	2
10	Study of Virtual personal assistant.	S	2
11	Study of Medical diagnosis.	S	2
12	Study of Intelligent robots.	S	2

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note: All Experiments are compulsory**

Text Books:

1. Dr. Nilakshi Jain, Artificial Intelligence: Making a System Intelligent, John Wiley &Sons.
2. Artificial Intelligence & Soft Computing for Beginners, 3rd Edition-2018, byAnindita Das, Shroff Publisher Publisher.
3. Introduction to Machine Learning, Ethem Alpaydin, Second Edition, 2010, Prentice Hall of India.
4. Practical Machine Learning Sunila Gollapudi Packt Publishing Ltd

Reference Books:

1. Dan W. Patterson, Introduction to Artificial Intelligence, Pearson Education India, 6 January2015.
2. Machine Learning by Tom M. Mitchell, International Edition 1997, McGraw Hill Education

Online Resources:

1. https://github.com/atinesh-s/Coursera-Machine-Learning-Stanford
2. https://github.com/Kulbear/deep-learning-coursera

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Course Plan
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Course Title : Data Visualization Laboratory	
Course Code : 201AIMLP423	**Semester : VIII**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE- POE Marks : 25**

Course Description:

This course helps students to represent any type of data in visual form. It will help to learn different visualization libraries and learn the nature of data across different domains and the concepts and skills of data visualization by understanding, questioning, and problematizing how data are generated, analyzed, and used. It will be able to apply its concepts and skills to visualize your own data, interpret the findings, and examine the impacts of data-driven decision.

Course Objectives:
1. To visualize the data in suitable form for the users.
2. To learn basic libraries and tools to represent data in visual form.

Course Outcomes (COs):

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

C423.1	Understand basic python visualization tools.
C423.2	Apply knowledge of tools to generate different type of charts and graphs.
C423.3	Apply visualization on numeric data.
C423.4	Apply visualization on non-numeric data.

Prerequisite:	Python, R Programming

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	
C423.1	2	2	-	-	1	-	-	-	-	-	-	-	-	-	L-2
C423.2	2	1	1	-	1	-	-	-	-	-	-	-	1	-	L-3
C423.3	2	2	1	-	1	-	-	-	-	-	-	-	-	-	L-3
C423.4	1	1	-	1	1	-	-	-	-	-	-	-	1	-	L-3

List of Experiments			
Exp. No.	**Name of Experiment**	**S/O**	**Hours**
1	Understanding the basic python visualization tools	O	2
2	Implement Histogram of an image	O	2
3	Implement Bar chart, Pie charts and graphs.	O	2
4	Implement scatter plots, bubble plots, waffle charts.	O	2
5	Implement Line plot on Data.	O	2
6	Implement Area plot on Data.	O	2
7	Implement visualization of numerical data	O	2
8	Implement visualization of non-numerical data	O	2
9	Implement basic functions of matplotlib, pandas.	O	2
10	Implement basic functions of seaborn	O	2
11	Implement basic functions of ggplot, pyplot.	O	2
12	Practical based on Time Series Data Analysis	O	2

❖ **S-STUDY, O-OPERATIONAL**

Text Books:
1. Taming Python by Programming, Jeeva Jose, Khanna Book Publishing House.
2. Data Visualization with Python and JavaScript: Scrape, Clean, Explore & Transform Your Data, Kyran Dale, O'Reilly, 2016.

Reference Books:
1. Data Visualization with Python: Create an impact with meaningful data insights using interactive and engaging visuals, Mario Döbler , Packt Publishers, 2019.
2. Mastering Python Data Visualization, Kirthi Raman, Packt Publishers, 2015

Online Resources:

1. Data Science for Engineers, Prof. Raghunathan Rengaswamy Prof. Shankar Narsimhan, IIT Madras - https://onlinecourses.nptel.ac.in/noc20_cs72/preview

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

(An Autonomous Institute) B. Tech. Curriculum
B. Tech. Computer Science & Engineering (AI-ML)

SEM-VIII (Academic Year -2023-24)

Course Plan

Course Title : Professional Elective-III Laboratory – High Performance Computing with AI	
Course Code : 201AIMLP424	**Semester : VIII**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE-POE Marks : NA**

Course Description:

This course focuses on optimization of serial code by using parallel programming paradigms such as OpenMP, MPI and CUDA. It also discuses speedup and scalability of serial/parallel programs. It covers profiling of a code.

Course Objectives:

1. To introduce software tools and techniques needed to implement parallel programs.
2. To demonstrate different parallel programming paradigms.

Course Outcomes (COs):

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

C424.1	Write parallel algorithm design and taxonomy of parallel architecture.
C424.2	Understand OpenMP and MPI directives and libraries to implement parallel program.
C424.3	Develop different parallel programs.
C424.4	Analyze performance of parallel algorithms designed using Open MP. MPI and CUDA.

Prerequisite:	Computer Architecture , C , C++

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	
C424.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	L-3
C424.2	2	1	1	-	-	-	-	-	-	-	-	-	1	-	L-2
C424.3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	L-3
C424.4	1	1	-	1	-	-	-	-	-	-	-	-	-	-	L-4

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Exp. No.	Name of Experiment	S/O	Hours
	List of Experiments		
1	Study of Processor architecture and networking.	S	2
2	Analytical modeling of sequential algorithm.	O	2
3	Feasibility study of parallel approach.	O	2
4	Implement vector addition using Open MP Programming.	O	2
5	Implement matrix multiplication using Open MP Programming.	O	2
6	Implement vector addition using MPI Programming	O	2
7	Implement matrix multiplication using MPI Programming	O	2
8	Implement vector addition using CUDA Programming.	O	2
9	Implement matrix multiplication using CUDA Programming.	O	2
10	Implement a vector addition program using OpenACC	O	2
11	Implement numeric functionality using CuPy	O	2
12	Study of advanced parallel tools like Digits, CuDNN	S	2
13	Develop an application using parallel programming paradigms	O	2

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note: Minimum 12 experiments should be performed based on above list.**

Text Books:
1. An Introduction to Parallel Programming, Peter S. Pacheco, Morgan Kaufmann Publications 2011.
2. Parallel programming in C with MPI and OpenMP , Michael J Quinn , Tata McGraw Hill , 2003.
3. Programming Massively Parallel Processors, David B. Kirk and Wen-mei W. Hwu , Morgan Kaufmann , 2nd Edition , 2010.

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Reference Books:

1. Introduction to Parallel Computing, Ananth Grama, George Karypis, Vipin Kumar & Anshul Gupta, Pearson Education Limited, Second Edition , 2003.
2. Multi-core Programming, Shameem Akhter and Jason Roberts, Intel Press , 2006.
3. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs , Shane Cook , Elsevier Inc , First Edition , 2013.

Online Resources:

1. Introduction to parallel programming with OpenMP and MPI, by Yogish Sabharwal, IIT Delhi.
   https://onlinecourses.nptel.ac.in/noc22_cs21/preview

2. GPU architecture and programming, by Prof. Dey , IIT Kharkpur.
   https://onlinecourses.nptel.ac.in/noc21_cs46/preview

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(An Autonomous Institute) B. Tech. Curriculum
B. Tech. Computer Science & Engineering (AI-ML)

SEM-VIII (Academic Year -2023-24)

Course Plan

Course Title : Professional Elective III Laboratory - Natural Language Processing	
Course Code : 201AIMLP425	Semester : VIII
Teaching Scheme : L-T-P : 0-0-2	Credits : 1
Evaluation Scheme : ISE Marks : 25	ESE-POE Marks : NA

Course Description:

To demonstrate a Natural Language Processing model using fundamental deep learning algorithms. Also, to build applications based on speech processing and natural language processing.

Course Objectives:
1. Be competent with fundamental concepts for natural language processing.
2. To study technologies involved in developing speech and language applications.
3. To demonstrate use of deep learning for building applications in natural language processing

Course Outcomes (COs):

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

C**425.1**	Describe ways to represent speech and words.
C**425.2**	Demonstrate the working of sequence models for text.
C**425.3**	Adapt a dialogue system to a specific domain.
C**425.4**	Execute trials of language systems.

Prerequisite:	Deep Learning

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	
C**425.1**	3	2	2	-	-	-	-	-	-	-	-	-	2	-	L-2
C**425.2**	2	2	3	-	-	-	-	-	-	-	-	-	2	-	L-3
C**425.3**	2	2	3	-	-	-	-	-	-	-	-	-	3	-	L-2
C**425.4**	3	3	3	-	-	-	-	-	-	-	-	-	3	-	L-4

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SEM-VIII (Academic Year -2023-24)

List of Experiments
Exp. No.	**Name of Experiments**	**S/O**	**Hours**
1	Text preprocessing – Tokenization, handling special chars, Stemming, Lemmatization.	O	2
2	Implement a program to perform word generation.	O	2
3	Implement programs related to morphology, N-Grams, N-Grams Smoothing.	O	2
4	Implementation of Hidden Markov Models.	O	2
5	Creating/using Word2vec and Glov2vec models and testing their performance.	O	2
6	Implement a program to perform automatic word analysis.	O	2
7	Machine translation from German to English/ or Indian language to English.	O	2
8	Program to build POS Tagger, Chunker.	O	2
9	Case Study: i) Language translation ii)Digital phone calls iii) Data analysis iv) Text analytics	S	2
10	Creating a Chabot like a hostel help desk.	O	2
11	Case Study: Alexa speech enabled application development	S	2
12	Google voice API based speech transcription.	O	2

❖ **S-STUDY, O-OPERATIONAL**

Text Books:

1. Natural Language Processing with TensorFlow, Thushan Ganegedara, Packt, 2018

Online Resources:

1. https://www.coursera.org/specializations/natural-language-processing

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Course Plan

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Course Title : Professional Elective-III Laboratory : Data Mining and Business Intelligence	
Course Code : 201AIMLP426	**Semester : VIII**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE-POE : -NA**

Course Description

It covers implementation of Data Mining algorithms related to prediction and forecasting, and generally improve their performance through interaction with data. Special emphasis will be given to the Machine Learning methods as they provide the real knowledge discovery tools. The related technologies such as data warehousing and on-line analytical processing (OLAP) will be also discussed. Weka can be used to solve data mining problems.

Course Objectives:

- To apply data preprocessing techniques and tools to solve business problems.
- To study data mining techniques and algorithm in business analytics.

Course Outcomes (COs):

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

C426.1	Apply the concepts of classification of predication of data
C426.2	Apply the concepts of association rule mining
C426.3	Apply the concepts of Business Intelligence Data Mining
C426.4	Develop a prediction model using data mining tools

Prerequisite:	Database Engineering

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**	
C426.1	2	-	3	2	3	2	-	-	-	-	-	-	-	-	L-3
C426.2	2	2	2	2	2	-	-	-	-	-	-	-	-	-	L-3
C426.3	2	-	2	1	2	3	-	-	-	-	-	-	-	-	L-3
C426.4	2	3	2	-	2	2	-	-	-	-	-	-	-	-	L-3

List of Experiments

Exp. No.	Name of Experiments	S/O	Hours
1	Basics of Information Retrieval	S	2
2	Implementation of Decision Tree Algorithm	O	2
3	Implementation of Support Vector Machine algorithm	O	2
4	Implement OLAP Queries	O	2
5	Implementation of Association Rule Mining	O	2
6	Implementation of K means Clustering Algorithm	O	2
7	Implementation of K Nearest Neighbor Algorithm	O	2
8	Build a BI Framework for Decision Making using Weka	O	2
9	Build a BI Framework to display graphs using Weka	O	2
10	Installation of Weka	O	2
11	Use of Weka tool for prediction	O	2
12	Use of Weka tool for Outlier detection	O	2
13	Use of Tableau for data mining	O	2
14	Use of PowerBI for data mining	O	2

❖ **S-STUDY, O-OPERATIONAL**

❖ **Note: Solve any 12 Experiments from above lists.**

Text Book:

1. Jiawei Han & Micheline Kamber, "Data Mining Concepts & Techniques", 2011, 3rd Edition.
2. Ian H. Witten and Eibe Frank – Data Mining Practical Machine Learning Tools and Techniques, Morgan Kaufmann Publication – 2016 4th Edition.
3. Rajiv Sabherwal "Business Intelligence" Wiley Publications, 2012.

Reference Books:

1. Margaret H.Dunbam, "Data Mining Introductory and Advanced Topics", Pearson Education 2003.
2. Arun K. Pujari – Data Mining Techniques, Universities Press (India) Pvt. Ltd., 2013 Kindle Edition.

Online Resources:

1. Data Mining by Prof. Pabitra Mitra, IIT Kharagpur
https://nptel.ac.in/courses/106105174/

Course Plan

Course Title: Project–IV	
Course Code: 201AIMLP427	**Semester :VIII**
Teaching Scheme:L-T-P:0-0-4	**Credits: 2**
Evaluation Scheme: ISE Marks: 50	**POE Marks: 50**

Course Description:

This course covers theoretical and practical concepts needed to develop a real world software system. The course includes practicing the abilities pertaining to the planning, analysis, design, and implementation and testing of software applications. The project - IV is the final part of the work on the dissertation and presents its practical part. During the implementation of the project, undergraduates work out on the results of scientific research obtained at the previous stages of work on the dissertation. Final project allows the student to gain professional skills and experience in research activities.

Course Objectives:

1. To learn to design and develop usable User Interface
2. To analyze and apply emerging technologies in development of a project
3. To test the modules in Project
4. To demonstrate working of project

Course Outcomes (COs):

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

C427.1	Design and develop usable User Interface
C427.2	Analyze and apply emerging technologies in development of a project
C427.3	Test the modules in Project
C427.4	Demonstrate working of the project

Prerequisite:	Software Engineering, Machine Learning

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	
C427.1	2	-	2	-	-	-	-	1	2	2	-	-	-	-	L-2
C427.2	2	2	-	-	2	-	-	1	2	-	2	-	-	-	L-2
C427.3	2	-	-	2	-	-	-	-	3	3	2	-	2	-	L-2
C427.4	2	2	-	-	2	-	-	-	2	2	-	-	2	2	L-3

| Contents |
| --- |
| The group will continue to work on the project selected during the semester VII and submit the completed Project work to the department at the end of semester VIII as mentioned below:

1. The workable project.
2. The project report in the bound journal complete in all respect with the following: -
    i. Problem specifications
    ii. System definition – requirement analysis.
    iii. System design – dataflow diagrams, database design
    iv. System implementation – algorithm, code documentation
    v. Result analysis, Test results and test report.
    vi. In case of object oriented approach – appropriate process be followed.
3. External Oral Examination will be jointly assessed by a panel of teachers appointed by the head of the Institution.
4. POE examination will be conducted by internal and external examiners.
5. Students in regular track must meet the project guide every week in offline mode. |

Project Calendar

Sr. No.	Task	Period
1	Project Coding	2nd week
2	Testing	5th week
3	Deployment of Project	8th week
4	Documentation	14th week

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 based on Project Rubrics.
3. Care should be taken to avoid copying and outsourcing of the project work.
4. Students should participate in Inter College Project Competitions.
5. Students should publish research papers in conferences/ journals based on their project work.
6. Report / Research Paper should be **Plagiarism free.**

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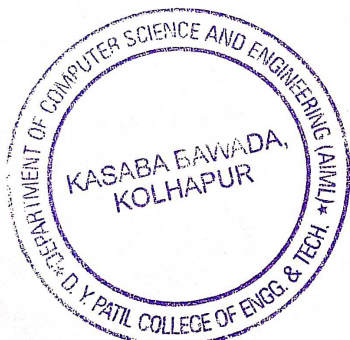
HEAD OF DEPARTMENT
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