Shri Vile Parle Kelavani Mandal's

MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE & AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS (AUTONOMOUS)

NAAC Reaccredited 'A' grade, CGPA: 3.57 (February 2016),

Granted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of Indi Best College (2016-17), University of Mumbai

Affiliated to the

UNIVERSITY OF MUMBAI

Program: Master of Science

Subject: Computer Science

Semester: III & IV

Choice Based Credit System (CBCS) with effect from the Academic year 2022-23

A.C. No:

Agenda No:

PROGRAMME SPECIFIC OUTCOMES

On completion of the M.Sc. Computer Science, the learners should be enriched with knowledge and be able to-

PSO1: Train students with widespread knowledge and understanding of advanced theoretical fundamentals in computer science.

PSO2: Ready the students to take up an occupation in the extremely competitive ICT industry with research and development expertise acquired through Internship major project.

PSO3: An aptitude to take on innovative research at the cutting edge of computer science and its associated zones.

PSO4: Cultivate proficiency in innovative areas of computer science - Algorithms, Machine Learning, Cryptography, Natural Language Processing to name a few.

Preamble

This syllabus is an honest attempt to include following ideas, among other things, into practice:

- Bring a new approach to syllabus, not a revision of the existing syllabus.
- Create a unique identity for MSc in Comp Science distinct from similar degrees in other related subjects.
- Offers focus on core Computer Science subjects.
- Incorporate advanced and most recent trends.
- Identify and nurture research temper among students.
- Offer provision for internship with industry.
- Focus, as far as possible, only on open source software.

This syllabus for the semester I and semester II has tried to initiate steps to meet these goals. By extending the syllabus to semester III and semester IV, it is assumed that these goals will be met to a larger extent.

The courses are as follows: -

Semester – III		
Course Title	**Credits**	**Lecture/Week**
Natural Language Processing	4	4
Software Defined Networks	4	4
Big Data Analytics	4	4
Deep Learning	4	4
Practical - Natural Language Processing	2	4
Practical - Social Network Analysis	2	4
Practical - Big Data Analytics	2	4
Practical - Deep Learning	2	4

Semester – IV		
Course Title	**Credits**	**Lecture/Week**
Internship	12	-
Project Implementation	12	4

N.B.- (i) The duration of each theory lecture will be of 60 minutes. A course consists of 4 modules. For each module the number of hours allotted are 15. The total number of lecture hours for each course will thus be 60.

For theory component value of One Credit is equal to 15 learning hours.

(ii) There will be one practical per batch for all but one courses per semester. The duration of each practical will be of 4 hours, i.e. of 240 minutes.

For practical component the value of One Credit is equal to 30 learning hours.

(iii) Thus in a week, a student will study 16 hours of theory and 16 hours of practical for semester III.

Evaluation Pattern

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Details of Continuous Assessment (CA)

25% of the total marks per course:

Continuous Assessment	Details	Marks
Component 1 (CA-1)	Class Test/Research Paper Review/ Assignment/ Presentation/ Mini Project	15 marks
Component 2 (CA-2)	Assignment/ presentation/mini project, etc	10 marks

Minimum 2 component of Continuous Assessment need to be conducted per course.

b) Details of Semester End Examination

75% of the total marks per course. Duration of examination will be two and half hours.

Question Number	Description	Marks	Total Marks
1	Subjective questions based on Unit I (2/3)	16	24
2	Subjective questions based on Unit II (2/3)	16	24
3	Subjective questions based on Unit III (2/3)	16	24
4	Subjective questions based on Unit IV (2/3)	16	24
5	Subjective questions based on Unit I/II/III/IV (Que1 6 and Que2 5 marks Question Compulsory)	11	11
		Total Marks	**75**

Evaluation for practical papers

In the Practical exams, there will be 20% assessment for the journal and laboratory work and 80% as term end component to be conducted as a semester end exam per course. For each course there will be one examiner per batch who will evaluate the practical.

Signature Signature Signature

HOD **Approved by Vice –Principal** **Approved by Principal**

Program: Master of Science (Computer Science)				Semester : III	
Course: Natural Language Processing				Course Code:	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - 25)**	**Term End Examinations (TEE) (Marks-75 in Question Paper)**
4	-	-	4	25	75

Learning Objectives:

- The objective is to review natural language processing concepts and acquire how to apply basic algorithms for building various language Models.

Course Outcomes:

After completion of the course, learners will be able to:

CO1: Summarize basic concepts of Natural Language Processing & implement Word Level Analysis

CO2: Interpret and implement part-of-speech tagging.

CO3: Deduce the Semantic Analysis & Pragmatics.

CO4: Apply and design a model for of regional or international languages and real-world problems such as machine translation, text categorization, text summarization and information extraction.

Outline of Syllabus: (per session plan)

Module	Description	No of hours
1	Introduction to Natural Language Processing & Word Level Analysis	15
2	Vector Semantics, Part-of-Speech Tagging	15
3	Dimension reduction, Topic Modelling & Information Extraction	15
4	Machine translation and Word Senses	15
	Total	**60**

Module	Natural Language Processing	No. of Hours/Credits 60/4
1	**Introduction to Natural Language Processing & Word Level Analysis**	**15**
	History of NLP, Generic NLP system, levels of NLP, Knowledge in language processing, Ambiguity in Natural language, stages in NLP, challenges of NLP, Applications of NLP. Morphology analysis–survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST) Morphological parsing with FST, Lexicon free FST Porter stemmer. N-gram language model - Unigram Language Model, Bigram, Trigram, N-gram, Advanced smoothing for language modelling, Empirical Comparison of Smoothing Techniques	
2	**Vector Semantics, Part-of-Speech Tagging**	**15**
	Vector semantics and embeddings – Lexical Semantics, Vector semantics, Words and vectors, Cosine of measuring similarity, TF-IDF – Weighing Terms in the vector, Word2Vec, GloVe Part-Of-Speech tagging (POS)- Tag set for English (Penn Treebank), Rule based POS tagging, Stochastic POS tagging, Issues –Multiple tags & words, Unknown words. Introduction to CFG, Sequence labelling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF), Bidirectional Encoder Representations from Transformers (BERT).	
3	**Dimension reduction, Topic Modelling & Information Extraction**	**15**
	Dimension Reduction and Topic Modelling – Latent Semantic Indexing (LSI) Latent Semantic Analysis (LSA), Latent Dirichlet Allocation (LSA) Information Extraction, chunking, Developing and evaluating chunkers, recursion in linguistic structure, Named Entity Recognition, Relation Extraction	
4	**Machine translation and Word Senses**	**15**
	Need of MT, Problems of Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge Based MT System, Statistical Machine Translation (SMT), Parameter learning in SMT (IBM models) using EM), Encoder-decoder architecture, Neural Machine Translation Word Senses, Relations between Senses and WordNet	

RECOMMENDED READING:

Text Books:

1. Daniel Jurafsky, James H. Martin ―Speech and Language Processing, Second Edition, Prentice Hall, 2008.
2. Natural Language Processing with Python‖, Steven Bird, Ewan Klein, and Edward Loper, 2nd Edition, O'Reilly, 2016.

Reference Books

1. Christopher D.Manning and Hinrich Schutze, ― Foundations of Statistical Natural Language Processing ―, MIT Press, 1999
2. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
3. Daniel M Bikel and Imed Zitouni ― Multilingual natural language processing applications‖ Pearson,
   2013
4. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) ― The Handbook of
5. Computational Linguistics and Natural Language Processing ― ISBN: 978-1-118-
   Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly

PRACTICAL: 2 Credit	**4 Lecture/Week**	**60 Hours**
Sr. No.	**Topic.**	
1	Pre-processing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)	
2	Morphological Analysis	
3	N-gram model	
4	POS tagging	
5	Chunking	
6	Named Entity Recognition	
7	Case Study/ Mini Project based on use of WordNet	
8	Implementing NLP model using BERT	
9	Implement miniature of anyone of the following model 1. Sentiment Analysis 2. Customer Support Bot 4. Text Summarization 5. Machine Translation	

Program: Master of Science (Computer Science)				Semester: III	
Course: Software Defined Networks				Course Code: New code	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - 25)**	**Term End Examinations (TEE) (Marks-75 in Question Paper)**
4	-	-	4	25	75

Learning Objectives:

- To advance conceptual cognizance of Software Defined Networks (SDN) and the study of industrial deployment use-cases of SDN.

Course Outcomes:

After completion of the course, learners will be able to:

CO1: Deliberate basic concepts of Networking & to get accustomed with Software Defined Networks.
CO2: Infer the role of Open Flow protocol and SDN Controllers.
CO3: To model and solve industry applications based on SDN.
CO4: Apply network virtualisation for industry standard solutions.

Outline of Syllabus: (per session plan)

Module	Description	No of hours
1	**Introduction to Software Defined Networking**	15
2	**The Open Flow Specifications**	15
3	**Data centres**	15
4	**Network Functions Virtualization (NFV) and SDN**	15
	Total	**60**

Module	Software Defined Networks	No. of Hours/Credits 60/4
1	**Introduction to Software Defined Networking**	15
	Challenges of traditional networks, Traditional Switch Architecture - Control, Data and management Planes, Introduction to SDN, Need of SDN, History of SDN, Fundamental characteristics of SDN (Plane Separation, Simplified Device and Centralized control, How SDN Works – Centralized and Distributed Control and Date Planes, Network Automation and Virtualization, and Openness), SDN Operation/Architecture, SDN API‟s (Northbound API‟s, Southbound API‟s, East/West API‟s), ONF, SDN Devices and SDN Applications.	
2	**The Open Flow Specifications**	15
	Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts, OpenFlow Overview, The OpenFlow Switch, The OpenFlow Controller, OpenFlow Ports, Message Types, Pipeline Processing, Flow Tables, Matching, Instructions, Action Set and List, OpenFlow Protocol, Proactive and Reactive Flow, Timers, OpenFlow Limitations, OpenFlow Advantages and Disadvantages, Open v Switch Features	
3	**Data centres**	15
	Data Centre Definition, Data Centre Demands (Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering and Path Efficiency), Tunnelling Technologies for the Data Centre, SDN Use Cases in the Data Centre, Comparison of Open SDN, Overlays, and APIs, Real-World Data Centre Implementations, SDN use case in Data centres. Multitenant and Virtualized Multitenant Data Centre – SDN Solutions for the Data Centre Network – VLANs – EVPN – VxLAN – NVGRE	
4	**Network Functions Virtualization (NFV) and SDN** Definition of NFV, SDN Vs NFV, In-line network functions, Benefits of Network Functions Virtualization, Challenges for Network Functions Virtualization, Leading NFV Vendors, Comparison of NFV and NV. Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, Optical Networks, SDN vs P2P/Overlay Networks.	15

RECOMMENDED READING:

TEXT BOOKS:

1. Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, ―SDN: Software Defined Networks, O'Reilly Media, 2013.

REFERENCES:

1. Siamak Azodolmolky, ―Software Defined Networking with Open Flow, Packet Publishing, 2013.
2. Vivek Tiwari, ―SDN and Open Flow for Beginners‖, Amazon Digital Services, Inc., 2013.
3. Fei Hu, Editor, ―Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.
4. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015

PRACTICAL: 2 Credit	**4 Lecture/Week**	**60 Hours**
Sr. No.	**Topic.**	
1	Implement Inter-VLAN Routing.	
2	OSPF/BGP/NAT Implementations.	
3	Phase I: Set up Mininet network emulation environment using Virtual Box and Mininet. Demonstrate the basic commands in Mininet and emulate different custom network topology (Simple, Linear, and Tree). View flow tables.	
4	Phase II: Study open source POX and Floodlight controller. Install controller and run custom topology using remote controller like POX and floodlight controller. Identify inserted flows by the controllers	
5	Phase III: Create a SDN environment on Mininet and configure a switch to provide a firewall functionality using POX controller. Ref: https://github.com/mininet/openflow-tutorial/wiki/Create- Firewall	
6	Phase IV: Build your own Internet Router using Mininet as an Emulator and POX controller. Write a simple router with a static routing table. The router will receive raw Ethernet frames. It will process the packets just like a real router, and then forward them to the correct outgoing interface. Make sure you receive the Ethernet frame and create the forwarding logic so packets go to the correct interface. Ref: https://github.com/mininet/mininet/wiki/SimpleRouter	
7	Phase V: Emulate a Data Centre and manage it via a Cloud Network Controller: create a multi-rooted tree-like (Clos) topology in Mininet to emulate a data centre.	
8	(using Practical 7) Your second task is to implement specific SDN applications on top of the network controller in order to orchestrate multiple network tenants within a data centre environment, in the context of network virtualization and management. Ref:https://opencourses.uoc.gr/courses/pluginfile.php/13576/mod_resource/content/2/exercise5.pdf	

Program: Master of Science (Computer Science)				Semester : III	
Course: Big Data Analytics				Course Code:	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - 25)**	**Term End Examinations (TEE) (Marks-75 in Question Paper)**
4	-	-	4	25	75

Learning Objectives:

To provide an overview and understanding of big data, different forms of big data and tools to analyse big data.

Course Outcomes:

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

CO1: Recognize big data, characteristics and its sources.
CO2: Summarize big data storage techniques and apply programming paradigm for big data.
CO3: Analyse techniques to identify similar items and its applications.
CO4: Recommend different data stream algorithms.
CO5: Appraise advanced algorithm for managing large datasets.
CO6: Assess various link analysis and recommender system techniques.

Outline of Syllabus: (per session plan)

Module	Description	No of hours
1	Introduction to bigdata, MapReduce & NoSQL	15
2	Finding similar items	15
3	Mining Data Streams & Frequent Itemset	15
4	Link Analysis & Recommendation System	15
	Total	**60**

Module	Big Data Analytics	No. of Hours/Credits 60/4
1	**Introduction to bigdata, MapReduce & NoSQL**	15
	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Case Study of Big Data Solutions. Distributed file system, Introduction to Map Reduce: The map tasks, Grouping by key, The reduce tasks, Combiners, Details of MapReduce Execution, Coping with node failures. Algorithms Using MapReduce: Matrix-Vector Multiplication, Computing Selections and Projections, Union, Intersection, and Difference, Natural Join. Introduction to NoSQL, NoSQL business drivers, CAP Theorem NoSQL data architecture patters: key-value stores, graph stores, column family (Bigtable)stores, document stores, NoSQL system to handle big data problems.	
2	**Finding Similar items**	15
	Finding Similar Items, Applications of Near-Neighbour Search, Similarity of documents, Collaborative filtering as a similar-sets problem, Distance Measures: Definition of a Distance Measure , Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance, k-Shingles, Choosing the Shingle Size, Hashing Shingles, Shingles built from Words. Similarity-Preserving Summaries of Sets, Locality Sensitive hashing for documents, Application of LSH.	
3	**Mining Data Streams & Frequent Itemset**	15
	Introduction to streams concepts – Stream data model and architecture, Stream computing, Sampling data in a stream, Filtering streams, Counting distinct elements in a stream, Estimating moments, Counting oneness in a Window, Decaying window. Handling Larger Datasets in Main Memory, Algorithm of Park, Chen, and Yu, The Multistage Algorithm, The Multihash Algorithm	
4	**Link Analysis and Recommendation system**	15
	Link analysis: PageRank, Efficient Computation of PageRank, Topic-Sensitive PageRank, Link Spam, Hubs and authorities Recommendation Systems: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality reduction	

RECOMMENDED READING:

Text Books:

1. Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012.
2. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly “Making Sense of NoSQL” – A guide for managers and the rest of us, Manning Press

Reference Books

1. Big Data for Dummies, J. Hurwitz, et al., Wiley, 2013
2. Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data, Paul C. Zikopoulos, Chris Eaton, Dirk deRoos, Thomas Deutsch, George Lapis, McGraw-Hill, 2012.
3. Big data: The next frontier for innovation, competition, and productivity, James Manyika ,Michael Chui, Brad Brown, Jacques Bughin, Richard Dobbs, Charles Roxburgh, Angela Hung Byers, McKinsey Global Institute May 2011.
4. Big Data Glossary, Pete Warden, O’Reilly, 2011.
5. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, David Loshin, Morgan Kaufmann Publishers, 2013

PRACTICAL: 2 Credit	**4 Lecture/Week**	**60 Hours**

Sr. No.	**Topic.**
1.	Write a map-reduce program to count the number of occurrences of each word in the given dataset. (A word is defined as any string of alphabetic characters appearing between non-alphabetic characters like nature's is two words. The count should be case-insensitive. If a word occurs multiple times in a line, all should be counted)
2.	Practical on NoSQL
3.	Write a map-reduce program to find matrix-vector multiplication
4.	Write a program to construct different types of k-shingles for given document.
5.	Implement min hashing and LSH.
6.	Implement bloom’s filter.
7.	Implement flajolet-martin algorithm to count distinct elements.
8.	Compute the n-moment for a given stream where n is given.
9.	Implement frequent Itemset algorithm
10.	Implement PageRank Algorithm
11.	Implement basic collaborative filtering

Program: Master of Science (Computer Science)				Semester : III	
Course: Deep Learning				Course Code:	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - 25)**	**Term End Examinations (TEE) (Marks-75 in Question Paper)**
4	-	-	4	25	75

Learning Objectives:

- To summarize the basic concepts of deep neural network, demonstrate various deep neural networks and develop applications based on deep neural network.

Course Outcomes:

After completion of the course, learners will be able to:

CO1: Identify the data types of Deep Neural Network
CO2: Implement regularization on a Deep Neural Network
CO3: Design auto-encoders and implement auto-encoders in applications
CO4: Represent a recurrent neural network
CO5: Interpret the architecture of Convolution Neural Network
CO6: Implement Convolution Neural Network in image classification
CO7: Discuss and compare open issues and trends in deep learning

Outline of Syllabus: (per session plan)

Module	Description	No of hours
1	Deep Neural Networks	15
2	Autoencoders and Recurrent Neural Network	15
3	Convolution Neural Network	15
4	Improving Deep Neural Network and Applications of Deep Learning	15
	Total	**60**

Module	Deep Learning	No. of Hours/Credits 60/4
1	**Deep Neural Networks**	**15**
	Introduction to Deep Learning: Data types useful for deep learning, problems that can be solved using DL, basic structure of deep neural networks models. Training a Deep Neural Network, Reusing pre-trained layers, L1 and L2 Regularization, Optimizers for Deep Neural Network – Adagrad, Adadelta, Adam, Types of Deep Learning Algorithms	
2	**Autoencoders and Recurrent Neural Network**	**15**
	Autoencoders and its relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders. Recurrent Neural Network – Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Long-Short Term Memory (LSTM), Gated Recurrent Units (GRU)	
3	**Convolution Neural Network**	**15**
	Computer Vision, Edge Detection, Strided Convolutions, Convolutions Over Volume, One Layer of a Convolutional Network, Simple Convolutional Network Example, Pooling Layers, CNN Example, ResNets, Inception Networks, Transfer Learning, Data Augmentation, State of Computer Vision, Object Localization, Landmark Detection, Object Detection	
4	**Improving Deep Neural Network and Applications of Deep Learning**	**15**
	Dropout, Early stopping, Dataset augmentation, Better activation functions, Better weight initialization methods, Batch Normalization. Applications: Face Recognition, One Shot Learning, Siamese Network, Triplet Loss, Face Verification and Binary Classification, Neural style transfer, Deep ConvNets learning, Cost Function, Content Cost Function, Style Cost Function, 1D and 3D Generalizations, Case Studies	

RECOMMENDED READING:

Text Books:

1. Adam Gibson, Josh Pattern, "Deep Learning A Practitioner's Approach", 1st Edition, O"Reilly, 2017.
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", 1st Edition, MIT Press, 2016
3. Jeff Heaton, "Artificial Intelligence For Humans: Vol. 3 Deep Learning and Neural Network", Lightning Source Inc, 2015

4. N D Lewis, “Deep Learning made easy with R: A Gentle Introduction for Data Science”, 1st Edition, Createspace Independent Pub 2016.

Reference Books

1. Duda, R.O., Hart, P.E., and Stork, D.G., Pattern Classification, 2nd Edition Wiley 2000
2. Theodoridis, S. and Koutroumbas, K., Pattern Recognition. 4th Edition, Academic Press Elsevier 2009
3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach, 3rd Edition Prentice Hall Series in Artificial Intelligence 2010
4. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press, 1995
5. Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition Springer 2010

PRACTICAL: 2 Credit	**4 Lecture/Week**	**60 Hours**

Sr. No.	**Topic.**
1	Representative power of a neural network
2	Tuning of weights and biases using Gradient Descent
3	Demonstration of Adagrad / Adadelta optimizaer
4	L1 & L2 Regularization Technique
5	Demonstration of Vanishing and Exploding Gradient Descent
6	Implementing Autoencoders
7	Implementing RNN in any one application domain
8	Image Classification using CNN
9	Dropout / Early-stopping Regularization Technique
10	Batch Normalization
11	Demonstration of any one real-life application of Deep Neural Network

Program: M.Sc.- Computer Science		Semester : IV	
Course: Internship		Course Code:	
Teaching Scheme		Evaluation Scheme	
Learner Effort (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - 300)	
-	12		

Learning Objectives:

Demonstrate expertise and integrate foundational concepts in software, project, management, and/or team skills during the design, development, test, and/or delivery activities in a computing-related industry setting.

Course Outcomes:

After completion of the course the learners will:
CO1: Apply and Integrate theory and practice.
CO2: Develop communication, interpersonal and other critical skills in the job
CO3: Develop work competencies for a specific profession or occupation.
CO4: Apply higher order thinking skills, such as critical thinking, analysis, synthesis, evaluation, and complex problem solving, to "real world" situations

- Students need to complete Internship in any of the industry which includes networks, software developer, android development, security, data science and not limited to.
- They are expected to complete at least 480 hours.
- They need to submit appointment / internship letter along with necessary documents.
- Tutoring / lecturing / demonstrator is not considered for internship.
- Every week they need to report to college and present the work which he/she did in the organization in the form of PPT.

EVALUATION AND INTERNSHIP REPORT GUIDELINES

All students are required to submit a report at the end of their internship. The report must be at least 12 pages in length (not including the cover page). The report should be written in your own words. One should treat the report as a professional, scholarly document. This means proper citations must be given if text is taken from a company website, trade brochures, or any other public sources. The report will count towards 20% of the internship grade. All reports must be approved by the student's supervisor. Students can either have the supervisor sign off on a hard copy version of the report or can forward an e-mail to their advisor from the supervisor stating that the report has been read and approved. The report must be submitted to the student's advisor within two weeks after finishing their internship. Failure to submit the report on time could affect the approval of a future internship.

The report should follow the following format:

TABLE OF CONTENTS

1. Cover Page

The following information must be provided on the first page. It should be centered in the middle of the page:

§ Name

§ Student ID Number

§ Internship Semester and Year

§ Employer and Employer Location

§ Supervisor Name and E-mail

2. Abstract

An abstract is not introduction; it is a brief (50-70 words) summary of your report.

3. Introduction

Explain which company you interned with, where the facility was located, what the business of the company is, the area you worked in and the main emphasis of your internship.

4. Discussion of Projects

Discuss in detail the areas of responsibility you had to deal with during your internship. Although this is an overview of your internship experience, include technical details about the projects you

worked on. How many lines of code? What technologies, languages, tools, systems were used? Discuss the significance of your efforts relative to the company's operations.

5. Summary and Conclusions

Summarize your work and learning experience. Explain how the internship either reinforced or changed your career goals. Discuss any new perspectives you obtained because of this experience. Elaborate on the benefits you realized from the internship. Did you face any challenges or difficulties in your assignments? How did you solve these issues? In what ways did you apply what you have learned in your graduate courses to the internship?

Evaluation Scheme

Internship Evaluation Components	Description	Credits	Contents of Evaluation
1	Joint Evaluation by the Industry mentor and the faculty coordinator on: -The Project Work	6	There will be two components of evaluation: (i)Joint evaluation by the Industry

	accomplished, and - The overall learning outcomes of the Internship		mentor and the faculty mentor to be coordinated by faculty members. (ii) Faculty mentor will write a Subjective Feedback Report in support of grade awarded. The report can be common or be submitted separately. Note: If the industry mentor does not have the liberty to write grades or subjective report on the student's work due to the policy of his/her organization then faculty mentor has to submit the evaluation for full components.	
2	Report Writing and Viva Voce	3	The components of evaluation will be: - Problem formulation, Technique and Tools used in solving the problem, Execution of project -Written expression -Any additional component, as considered important by a department	
3	Presentation and evaluation of domain knowledge in the area of internship	3	The components of evaluation will be: - Style and Effectiveness of presentation -Oral Expression -Domain Knowledge -Any additional component, as considered important by a department	

Following points can be considered for evaluation

1. Demonstrates student learning during the internship
2. Demonstrates professional and acceptable non-verbal behaviour
3. Appropriate use of AV aids
4. Confidence as a presenter
5. Presentation is eye catching and conveys the focus of the internship immediately
6. Concise but Complete description of entire internship
7. Elements are logically arranged / presented
8. Graphics are visually appealing and professional
9. Communication skills
10. Maintains eye contact
11. Internship viva voce
12. Understands the question(s) asked
13. Ability to answer without third-party support with appropriate and adequate information
14. Promptly gives correct answers
15. Demonstrates confidence while answering
16. Accepts others' views, her mistakes and listens to others' suggestions and/or critique
17. Overall impression left by intern

Program: Master of Science (Computer Science)			Semester: IV
Course: Project Implementation			**Course Code:**
Teaching Scheme		**Evaluation Scheme**	
Learner Effort (Total Hours)	**Credit**	**Continuous Assessment and Evaluation (CAE)**	**Term End Examinations (TEE)**
360 - 400	12	50	250

Learning Objectives:

- Identifying research problem on basis of thorough literature review
- Identifying suitable datasets and incrementally create research methodology
- Implementing or performing experiments and develop correct practices of observing the results
- Applying various analytical techniques to evaluate results and deferring appropriate conclusions

Course Outcomes:

After completion of the course the learners will:

CO1: Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.

CO2: Plan, analyze, design a research project and demonstrate the ability to communicate effectively in speech and writing.

CO3: Incorporate information from various sources and devise a solution to the problem.

CO4: Exercise the skills, persistence, and commitment to excellence needed to engage in lifelong learning.

Guidelines for Project Implementation in Semester – IV

- To ensure proper conduction of each project, progress of each project should be monitored on continuous basis first by the supervisor.
- Students are expected to gather raw datasets for the completion of the project.
- Student must report progress of project to project supervisor (teacher in-charge) once a week.
- Project supervisor should conduct mid-semester presentations of the student project as part of continuous evaluation.
- **Evaluation scheme for continuous evaluation:**

Maximum : 50 Marks

	Excellent (100 – 80%)	Good (80 – 70%)	Average (70 – 50%)	Poor (<50%)
Topic selection & Problem Definition (20%)	Complete Innovative and useful, Exceeds expectations and problem and its implication are thoroughly understood.	Somewhat innovative and useful, within expectations and its implications are well understood.	Useful but not innovative, meets expectations, problems and its implications are not well described and presented.	Useful for limited group, not innovative, problem are not well defined and specified.

Literature Survey Purpose and need of the project (25%)	Outstanding investigation in all aspects. Detailed and extensive explanation of the purpose and need of the project	Well-researched project, good depth and thoroughness, sensible planning of research and well referenced throughout. Collects a great deal of information and good study of the existing systems	Research is clear and structured. Appropriate coverage is present and referenced. Moderate study of the existing work; collects some basic information	Minimal research or cursory coverage , minimal referencing, Moderate explanation of the purpose and need of the project
Justification of Project Objectives and Proposed Methodology (25%)	All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified	Good justification to the objectives; Methodology to be followed is specified but detailing is not done	Incomplete justification to the objectives proposed; Steps are mentioned but unclear; without justification to objectives	Limited information Only Some objectives of the proposed work are defined
Demonstration and Presentation (30%)	Objectives achieved as per time frame. Contents of presentations are appropriate and well arranged	Objectives achieved as per time frame. Contents of presentations are appropriate but not well arranged	Objectives achieved as per time frame. Contents of presentations are appropriate but not well arranged	Objectives not achieved as per time frame. Contents of presentations are not appropriate

- **Evaluation Scheme for End Semester:**

Maximum : 250 Marks

	Excellent (100 – 80%)	Good (80 – 70%)	Average (70 – 50%)	Poor (<50%)
Project Report (20%)	Project report is according to the specified format References and citations are appropriate and well mentioned	Project report is according to the specified format References and citations are appropriate but not mentioned well	Project report is according to the specified format but some mistakes In-sufficient references and citations	Project report not prepared according to the specified format References and citations are not appropriate
Description of Concepts and	Complete explanation of	Complete explanation of the	Incomplete explanation of the	Inappropriate explanation of the

Technical Details (15%)	the key concepts and strong description of the technical requirements of the project	key concepts but in-sufficient description of the technical requirements of the project	key concepts and in-sufficient description of the technical requirements of the project	key concepts and poor description of the technical requirements of the project
Project Demonstration (30%)	All defined objectives are achieved. Each module working well and properly demonstrated. All modules of project are well integrated and system working is accurate	All defined objectives are achieved. Each module working well and properly demonstrated. Integration of all modules not done and system working is not Very satisfactory	All defined objectives are achieved. Modules are working well in isolation and properly demonstrate. Modules of project are not properly integrated	Only some of the defined objectives are achieved. Modules are not in proper working form that further leads to failure of integrated system
Presentation (20%)	Contents of presentations are appropriate and well delivered Proper eye contact with audience and clear voice with good spoken language	Contents of presentations are appropriate and well delivered Clear voice with good spoken language but less eye contact with audience	Contents of presentations are appropriate but not well delivered Eye contact with only few people and unclear voice	Contents of presentations are not appropriate and not well delivered Poor eye contact with audience and unclear voice
Conclusion and Discussion (15%)	Results are presented in very appropriate manner Project work is well summarized and concluded Future extensions in the project are well specified	Results are presented in good manner Project work summary and conclusion not very appropriate Future extensions in the project are specified	Results presented are not much satisfactory Project work summary and conclusion not very appropriate Future extensions in the project are not specified	Results are not presented properly Project work is not summarized and concluded Future extensions in the project are not specified

Guidelines for Documentation of Project Implementation in Semester – IV	
1.	Title: Title of the project
2.	Introduction: An introduction to the topic of around 3-5 pages, giving proper back ground of the topic discussed
3.	Literature survey: A detailed survey of the relevant works done by others in the domain.

	Student is expected to refer at least 8-10 research papers. It may be around 10 to 12 pages.
4.	Objective: A detailed objective of the proposal is needed. It may be of 1 to 2 pages.
5.	Methodology: A proper and detailed procedure of how to solve the problem discussed. It shall contain the techniques, tools, software and data to be used. It shall be of around 3 to 5 pages.
6.	Implementation details: A description of how the project has been implemented. It shall be of 2 to 4 pages.
7.	Experimental set up and results: A detailed explanation on how experiments were conducted, what software used and the results obtained. Details like screen shots, tables and graphs can come here. It shall be of 6 to 10 pages.
8.	Analysis of the results: A description on what the results means and how they have been arrived at. Different performing measures or statistical tools used etc may be part of this. It shall be of 4 to 6 pages.
9.	Conclusion: A conclusion of the project performed in terms of its outcome (May be half a page).
10.	Future enhancement: A small description on what enhancement can be done when more time and resources are available (May be half a page).
11.	Program code: The program code is optional to be given as appendix.
12.	The report may be of around 40 - 80 pages (excluding program code), which needs to be signed by the teacher in charge and head of the Department. Student should submit the signed project implementation report.