AC 01.09.23 ITEM NO: 1.2

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for
Program: Masters of Science
Course: First Year
Subject: Computer Science

Choice Based Credit System (CBCS)
with effect from
Academic Year 2023-2024

PROGRAM OUTCOMES

PO	Description
A student completing Master's Degree in **Science** Program will be able to	
PO1	Demonstrate an in-depth understanding of the relevant science discipline. Recall, explain, extrapolate, and organize conceptual scientific knowledge for execution and application and also to evaluate its relevance
PO2	Critically evaluate, analyze, and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
PO3	Access, evaluate, understand, and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation.
PO4	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language
PO5	Demonstrate initiative, competence, and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups
PO6	Use an objective, unbiased and non-manipulative approach in the collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance
PO7	Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills, and lead a team in the planning and execution of a task
PO8	Understand the cross-disciplinary relevance of scientific developments and relearn and reskill to adapt to technological advancements.

Deccan Education Society's

Kirti M. Doongursee College

(Autonomous) Proposed

Curriculum as per NEP-2020

Year of implementation- 2023-2024

Name of the Department-Computer Science

Semester	Course Code	Course Title	Vertical	Credit
I	K23PSCSMJ111	Algorithm for Optimization	Major	4
	K23PSCSMJP11	Practical- Algorithm for Optimization	Major	2
	K23PSCSMJ112	Advanced Database Techniques	Major	4
	K23PSCSMJP12	Practical-Advanced Database Techniques	Major	2
	K23PSCSE121	Software Defined Technology	Elective	4
	K23PSCSRM131	Research Methodology	Research Methodology	4
II	K23PSCSMJ211	Applied Machine and Deep Learning	Major	4
	K23PSCSMJP21	Practical- Applied Machine and Deep Learning	Major	2
	K23PSCSMJ212	Natural Language Processing	Major	4
	K23PSCSMJP21	Practical- Natural Language Processing	Major	2
	K23PSCSE221	Embedded and IOT technology	Elective	4
	K23PSCSFP24	Project Implementation	Field Project	4

SEMESTER-I

Course Code	MAJOR SEM – I - Algorithm for Optimization	Credits	Lectures /Week
K23PSCSMJ111	PAPER I	4	4

Course Outcomes:

After successful completion of this course, students would be able to

- Recall the fundamental knowledge of Linear Programming and Dynamic Programming problems
- Learn a wide variety of optimization topics, introducing the underlying mathematical problem formulations and the algorithms for solving them.
- Exposure to multivariable calculus, linear algebra, and probability concepts.
- Optimization with a focus on practical algorithms for the design of engineering systems

Unit	Topics	No of Lectures
I	**Ability Enhancement** Introduction to Optimization Process Basic Optimization Problem, Constraints, Critical Points, Conditions for Local Minima, Contour Plots. Unimodality, Fibonacci Search, Golden Section Search, Quadratic Fit Search.	15
II	**Order Methods** First-Order Methods, Gradient Descent, Conjugate Gradient, Adagrad, RMSProp, Adadelta, Adam, Hypergradient Descent. Second-Order Methods, Newton's Method, Secant Method, QuasiNewton Methods.	15
III	**Sampling and Surrogate Models** Sampling Plans, Full Factorial, Random Sampling, Uniform Projection Plans, Stratified Sampling, Space-Filling Metrics. Surrogate Models, Fitting Surrogate Models, Linear Models, Basis Functions, Fitting Noisy Objective Functions, Model Selection, 15L 9 Probabilistic Surrogate Models, Gaussian Distribution, Gaussian Processes, Prediction	15
IV	**Skill Enhancement** Optimization and Uncertainty Optimization under Uncertainty, Uncertainty, Set-Based Uncertainty, Probabilistic Uncertainty. Uncertainty Propagation, Sampling Methods, Taylor Approximation, Polynomial Chaos, Bayesian Monte Carlo. Dynamic Programming, Ant Colony Optimization. Expression Optimization, Grammars, Genetic	15

	Programming, Grammatical Evolution, Probabilistic Grammars, Probabilistic Prototype Trees	

REFERENCE BOOKS:

- Algorithms for Optimization Mykel J. Kochenderfer, Tim A. Wheeler, The MIT Press 2019.
- Think Julia: How to Think Like a Computer Scientist by Allen B. Downey and Ben Lauwens 1st Edition 2019 O'reilly.
- Decision Making Under Uncertainty: Theory and Application by Mykel J. Kochenderfer MIT Lincoln Laboratory Series 2015.
- Introduction to Algorithms, By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein 3Ed. (International Edition) (MIT Press) 2009.

Course Code	**Algorithm for Optimization – Practical**	**Credits**	**Practicals/Week**
K23PSCSMJP11	**Paper I**	**2**	**4**

Course Outcome -

- Explain Integer programming techniques and apply different optimization techniques to solve various models arising from engineering areas.
- Use classical optimization techniques and numerical methods of optimization.
- Describe the basics of different evolutionary algorithms.
- Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.

Note: All the Practical's should be implemented using Julia
Link: Julia:https://julialang.org/

1	Implement Contour Plots.
2	Implement Fibonacci and Golden section search.
3	Implement Quadratic Fit Search.
4	Implement Gradient descent.
5	Implement quasi-Newton methods to find the local maxima.
6	Implement the Adagrad method with application, RMSprop and Adadelta.
7	Implement radial basis functions using surrogate modelling.
8	Apply Random Forest in surrogate Model.
9	Implement Gaussian Process and its application.
10	Path finding using Ant Colony Optimization with an application.

Course Code	MAJOR SEM – I - Advanced Database Techniques	Credits	Lectures /Week
K23PSCSMJ112	Paper II	4	4

Course Outcomes:

After successful completion of this course, students would be able to

- Recall the fundamentals of relational database systems including: data models, database architectures and ER features.
- To cover advanced topics of databases to become more proficient.
- To provide students with theoretical knowledge and practical skills in advanced topics in database systems, big data and modern data-intensive systems.
- To Expand Students, view and introduce advanced topics and Business Intelligence.

Unit	Topics	No of Lectures
I	**Enhanced Database Models** Object–Oriented Databases: Need of Object-oriented databases, Complex Data Types, Structured Types and Inheritance, ObjectIdentity and Reference, ODL and OQL, Implementing O-R Features, Persistent Programming Languages, Object-Oriented versus ObjectRelational, Example of Object oriented and object relational database implementation, comparison of RDBMS, OODBMS, ORDBMS XML Databases: Structured Semi structure and unstructured data, XML hierarchical tree data model, Documents DTD and XML schema, XML Documents & Database, XML query and transformation, Storage of XML data, Xpath. XQuery, Join and Nesting Queries, XML database applications. Spatial Databases: Types of spatial data, Geographical Information Systems (GIS), Conceptual Data Models for spatial databases, Logical data models for spatial databases: Raster and vector model. Physical data models for spatial databases: Clustering methods (space filling curves), Storage methods (R-tree). Query processing. Temporal Databases: Time ontology, structure, and granularity, Temporal data models, Temporal relational algebra.	15

II	**Cooperative Transaction Model** Parallel and Distributed Databases: Architecture of parallel databases, Parallel query evaluation, Parallelizing individual operations, Sorting Joins Distributed Databases: Concepts, Data fragmentation, Replication and allocation techniques for distributed database design, Query processing, Concurrency control and recovery in distributed databases Architecture and Design: Centralised versus non centralized Databases, Homogeneous and Heterogeneous DDBMS, Functions and Architecture, Distributed database design, query processing in DDBMS, Distributed concurrency management, deadlock management Distributed Commit Protocols: 2 PC and 3 PC, Concepts of replication servers. Mobile Database: Overview, Features, Advantages and Disadvantages, Mobile databases in Android System	**15**
III	**Learning the NoSQL Basics** Introduction to NoSQL: Characteristics of NoSQL, NoSQL Storage types, Advantages and Drawbacks, NoSQL Products Interfacing and interacting with NoSQL: Storing Data In and Accessing Data from MongoDB, Redis, HBase and Apache Cassandra, Language Bindings for NoSQL Data Stores Understanding the storage architecture: Working with ColumnOriented Databases, HBase Distributed Storage Architecture, Document Store Internals, Understanding Key/Value Stores in Memcached and Redis, Eventually Consistent Non-relational Databases Performing CRUD operations: Creating Records, Accessing Data, Updating and Deleting Data	**15**
IV	**Gaining Proficiency With NoSQL** Querying NoSQL Stores: Similarities Between SQL and MongoDB Query Features, Accessing Data from Column-Oriented Databases Like HBase, Querying Redis Data Stores Indexing And Ordering Data Sets: Essential Concepts Behind a Database Index, Indexing and Ordering in MongoDB, ouchDB and Apache Cassandra Managing Transactions And Data Integrity: RDBMS and ACID, Distributed ACID Systems, Upholding CAP, Consistency Implementations Using NoSQL in The Cloud: Google App Engine Data Store, Amazon SimpleDB	**15**

REFERENCE BOOKS:

1. Database Management Systems by Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill, 3rd Edition, 2014
2. Professional NoSQL By Shashank Tiwari, Wrox-John Wiley & Sons, Inc, 2011
3. Getting Started with NoSQL, Gaurav Vaish, Packt Publishing Ltd, 2013

Course Code	Advanced Database Techniques – Practical	Credits	Lectures/Week
K23PSCSMJP12	Paper II	2	4

Course Outcome: -

- Recall the basics of query processing, object-oriented, distributed databases.
- Understand the roles that databases play in organizations and familiarize with basic database storage, file organization, database accessing techniques.
- To provide students with theoretical knowledge and practical skills in advanced topics in database systems, big data and modern data-intensive systems.
- Analyze non-relational database systems and structures and XML.

Note: All the Practical's should be implemented using NoSQL Link: https://www.oracle.com/database/technologies/nosql-databaseserver-downloads.html

1	Create different types that include attributes and methods. Define tables for these types by adding a sufficient number of tuples. Demonstrate insert, update and delete operations on these tables. Execute queries on them.
2	Create an XML database and demonstrate insert, update and delete operations on these tables. Issue queries on it.
3	Demonstrate distributed databases environment by dividing given global conceCreate a table that stores spatial data and issue queries on it. ptual schema, into vertical and Horizontal fragments and place them on different nodes. Execute queries on these fragments.
4	Create a table that stores spatial data and issues queries on it
5	Create a temporal database and issue queries on it.
6	Demonstrate the Accessing and Storing and performing CRUD operations in 21 1. MongoDB 2. Redis
7	Demonstrate the Accessing and Storing and performing CRUD operations in 1. HBase 2. Apache Cassandra
8	Demonstrating MapReduce in MongoDB to count the number of female (F) and male (M) respondents in the database.
9	Demonstrate the indexing and ordering operations in 1. MongoDB 2. CouchDB 3. Apache Cassandra
10	Demonstrate the use of data management and operations using NoSQL in the Cloud.

Course Code	ELECTIVES SEM – I – Software Defined Networking	Credits	Lectures /Week
K23PSCSE121	Paper I	4	4

Course Outcomes:

After successful completion of this course, students would be able to

- To make the students capable of understanding computer network basics.
- To Obtain the knowledge of Software defined networks with understanding of data plane, control plane and application plane.
- To apply network virtualization for industry standard solutions.
- To improve skills in implementing network virtualization and Software Defined Network (SDN).

Unit	Topics	No of Lectures
I	**Introduction to Computer Networking** Basic Concepts and Definitions: LAN, MAN, WAN, AD-Hoc, Wireless Network, Understanding the layered architecture of OSI/RM and TCP-IP Model, Concepts and implementation of IPV4 and IPV6, Study of various network Routing protocols, Introduction to Transport layer and Application layer protocols.	15
II	**Software Defined Networking** Elements of Modern Networking, Requirements and Technology, SDN: Background and Motivation, SDN Data Plane and OpenFlow, SDN Control Plane, SDN Application Plane	15
III	**Network Functions Virtualization** Concepts and Architecture, NFV Functionality, Network Virtualization Quality of Service, MODERN NETWORK ARCHITECTURE: CLOUDS AND FOG, Cloud Computing, The Internet of Things: Components	15
IV	**Design and implementation of Network** Understand and implement Layer 2/3 switching techniques (VLAN /TRUNKING/ Managing Spanning Tree), Implementation of OSPF V2 and V3, Implementation BGP, Implementation Multicast Routing, Implementation of MPLS, Implementation of Traffic Filtering by using Standard and Extended Access Control List, Implementation of Routing redistribution, Implementation of Policy Based Routing/ Load Balancing /QOS/Natting /VRF	15

REFERENCE BOOKS:

1. Behrouz A Forouzan ―TCPIP Protocol Suite‖ Fourth Edition 2010
2. William Stallings, ―Foundations of Modern Networking‖, Pearson Ltd.,2016.
3. Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2014
4. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013

Course Code	RESEARCH METHODOLOGY SEM – I – RESEARCH METHODOLOGY	Credits	Lectures /Week
K23PSCSRM131	**Paper I**	**4**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

- To learn the application of Research in different Business Sectors
- To be able to conduct business research with an understanding of all the latest theories.
- To develop the ability to explore research techniques used for solving any real world or innovate problem.
- Analyze the data to help the decision makers in innovative business process

Unit	Topics	No of Lectures
I	**Introduction:** Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues Beginning Stages of Research Process: Problem definition, Qualitative research tools, Secondary data research	**15**
II	Research Methods and Data Collection: Survey research, communicating with respondents, Observation methods, Experimental research	**15**
III	Measurement Concepts, Sampling and Field work: Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size.	**15**
IV	Data Analysis and Presentation: Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis and differences between two variables. Multivariate Statistical Analysis.	**15**

REFERENCE BOOKS-

1. Business Research Methods William, G.Zikmund, B.J, Babin, J.C. Carr, Atanu Adhikari, M.Griffin Cengage 8e 2016
2. Business Analytics, Albright Winston, Cengage 5e 2015
3. Research Methods for Business Students Fifth Edition, Mark Saunders 2011

SEMESTER-II

Course Code	MAJOR SEM – II - Applied Machine and Deep Learning	Credits	Lectures /Week
K23PSCSMJ211	Paper I	4	4

Course Outcomes:

After successful completion of this course, students would be able to

- To recall the fundamentals of deep learning
- Understand core concepts of ML through implementations in python.
- Working with diverse toolkits and packages useful for developing projects in ML
- Implement and understand deep learning and ANNs useful for industry today.

Unit	Topics	No of Lectures
I	**The Fundamentals of Machine Learning** What is Machine Learning? Why use Machine Learning? Types of Machine Learning, Supervised Learning, Unsupervised Learning & Reinforcement Learning. Challenges of Machine Learning, Testing and Validation A First Application: Classification, MNIST Dataset, Performance Measures, Confusion Matrix, Precision and Recall, Precision/Recall Tradeoff, The ROC Curve, Multiclass Classification, Error Analysis.	15
II	**Training Models** Linear Regression, Gradient Descent, Batch Gradient Descent, Stochastic Gradient Descent, Mini-batch Gradient Descent, Polynomial Regression, Learning Curves, The Bias/Variance Tradeoff, Ridge Regression, Lasso Regression, Early Stopping, Logistic Regression, Decision Boundaries, Softmax Regression, Cross Entropy.	15
III	**Support Vector Machines** Linear SVM Classification, Soft Margin Classification, Nonlinear SVM Classification, Polynomial Kernel, Gaussian RBF Kernel, SVM Regression, Decision Trees, Training and Visualizing a Decision Tree, Making Predictions, The CART Training Algorithm, Gini Impurity vs Entropy, Regularization Hyperparameters.	15
IV	**Fundamentals of Deep Learning** What is Deep Learning? Need Deep Learning? Introduction to Artificial Neural Network (ANN), Core components of neural networks, Multi-Layer Perceptron (MLP), Activation functions, Sigmoid, Rectified Linear Unit (ReLU), Introduction to Tensors and Operations, Tensorflow framework.	15

REFERENCE BOOKS-

1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems by AurélienGéron, Second Edition, O'reilly 2019
2. Deep Learning with Python by François Chollet Published by Manning 2018
3. Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto, Second Edition 2014

Course Code	**Applied Machine and Deep Learning– Practical**	**Credits**	**Practicals/Week**
K23PSCSMJP21	**Paper I**	**2**	**4**

Course Outcomes-

- To know the main techniques in deep learning and the main research in this field.
- To understand different Algorithms to work on Dataset
- Be able to design and implement deep neural network systems.
- Be able to structure and prepare scientific and technical documentation describing project activities

Note: All the Practical's should be implemented using Python and TensorFlow.
Link:Python :https://www.python.org/downloads/
TensorFlow :https://www.tensorflow.org/install

1	Implement Linear Regression (Diabetes Dataset)
2	Implement Logistic Regression (Iris Dataset)
3	Implements Multinomial Logistic Regression (Iris Dataset)
4	Implement SVM classifier (Iris Dataset)
5	Train and fine-tune a Decision Tree for the Moons Dataset
6	Train an SVM regressor on the California Housing Dataset
7	Implement Batch Gradient Descent with early stopping for Softmax Regression
8	Implement MLP for classification of handwritten digits (MNIST Dataset)
9	Classification of images of clothing using Tensorflow (Fashion MNIST dataset)
10	Implement Regression to predict fuel efficiency using Tensorflow (Auto MPG dataset)

Course Code	MAJOR SEM – II - Natural Language Processing	Credits	Lectures /Week
K23PSCSMJ212	Paper II	4	4

Course Outcomes:

After successful completion of this course, students would be able to

- Knowledge on various morphological, syntactic, and semantic NLP tasks.
- Understanding the importance and concepts of Natural Language Processing (NLP)
- Applying algorithms available for the processing of linguistic information and computational properties of natural languages.
- Designing and developing practical NLP based applications

Unit	Topics	No of Lectures
I	**Introduction to Natural Language Processing (NLP) and Language Modelling** Introduction to NLP: Introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model; Concepts of Parts-of speech and Formal Grammar of English. Language Modelling: N-gram and Neural Language Models Language Modelling with N-gram, Simple N-gram models, smoothing (basic techniques), Evaluating language models; Neural Network basics, Training; Neural Language Model, Case study: application of neural language model in NLP system development Python Libraries for NLP: Using Python libraries/packages such as NaturalLanguage Toolkit (NLTK), spaCy, genism	15
II	**Morphology & Parsing in NLP** Computational morphology & Parts-of-speech Tagging: basic concepts; Tagset; Lemmatization, Early approaches: Rule-based and TBL; POS tagging using HMM, Introduction to POS Tagging using Neural Model. Parsing Basic concepts: top-down and bottom-up parsing, treebank; Syntactic parsing: CKY parsing; Statistical Parsing basics: Probabilistic Context-Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGS.	15
III	**Semantics and Word Embedding** Semantics Vector Semantics: Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis Embeddings from prediction: Skip-gram and Continuous Bag of words; Concept of Word Sense; Introduction to WordNet.	15

IV	**NLP Applications and Case Studies** Intelligent Work Processors: Machine Translation; User Interfaces; man-machine Interfaces: Natural language Querying Tutoring and Authoring Systems. Speech Recognition Commercial use of NLP: NLP in customer Service, Sentiment Analysis, Emotion Mining, Handling Frauds and SMS, Bots, LSTM & BERT models, Conversations	**15**

REFERENCE BOOKS:

1. —Speech and Language Processing‖, Jurafsky Dan and Martin James H., 3rd Edition, Pearson, 2018.
2. —Natural Language Processing with Python‖, Steven Bird, Ewan Klein, and Edward Loper, 2nd Edition, O'Reilly, 2016.
3. —Practical NaturalLanguage Processing with Python‖, Mathangi Sri, Apress, 2021
4. "Handbook of Computational Linguistics and Natural Language Processing‖, Martin Whitehead, Clanrye International, 2020

Course Code	**Natural Language Processing – Practical**	**Credits**	**Practicals/Week**
K23PSCSMJP22	**Paper II**	**2**	**4**

Course Outcome

- To learn how to apply basic algorithms & design and implement applications based on natural language processing
- Understand current methods for statistical approaches to machine translation.
- To design an innovative application system who uses NLP components
- Be able to apply NLP techniques design real-world NLP applications

Note: - The following set of practicals can be performed using any Python Libraries for NLP such as NLTK, spaCy, genism:
Link:-https://www.python.org/downloads/

1	Write a program to implement sentence segmentation and word tokenization
2	Write a program to Implement stemming and lemmatization
3	Write a program to Implement a tri-gram model
4	Write a program to Implement PoS tagging using HMM & Neural Model
5	Write a program to Implement syntactic parsing of a given text
6	Write a program to Implement dependency parsing of a given text
7	Write a program to Implement Named Entity Recognition (NER)
8	Write a program to Implement Text Summarization for the given sample text

Apply the concepts and techniques of Natural language processing learned for real-life applications. **A suitable application can be modelled which demonstrates the NLP skills.** **Some of the concepts/themes for lab exercises (not limited to the following) are described.**	
9	Consider a scenario of applying NLP in Customer Service. Design and develop an application that demonstrates NLP operations for working with tasks and data like voice calls, chats, Ticket Data, Email Data. Process the data to understand the voice of the Customer (intent mining, Top words, word cloud, classify topics). Identify issues, replace patterns and gain insight into sales chats
10	Consider a scenario of Online Review and demonstrate the concept of sentiment analysis and emotion mining by applying various approaches like lexicon-based approach and rule-based 28 approaches.
11	Apply NLP in Banking, Financial Services, and Insurance. Design Application to detect frauds and work with SMS data.
12	Demonstrate the use of NLP in designing Virtual Assistants. Apply LSTM, build conversational Bots.

Course Code	ELECTIVES SEM – II – Embedded and IoT Technology	Credits	Lectures /Week
K23PSCSE221	Paper I	4	4

Course Outcomes:

After successful completion of this course, students would be able to

- Understand basic components and functionalities of Embedded System including its hardware.
- Design and executive projects in IoT with Automatic Identification and Data Capture
- Effectively achieve collaboration of various technologies in IoT and enable the same using software programming like Python, Embedded C etc.
- Understand case studies in IoT and replicate the same for more detailed analysis of the IoT development.

Unit	Topics	No of Lectures
I	**Embedded System Basics** Introduction to Embedded Systems, Design of Embedded Systems, Memory Architecture, Input/Output. Basic electronics: Semiconductors, Transistors, BJT, Flip Flops, Resistors, Capacitors, CMOS, MOSFET, FPGA, Relays. Microcontrollers, UART Communications, SPI-peripherals interface, I2C communication, Wireless Sensor Network (WSN)	15
II	**Basics of IOT** Introduction IoT:Evolution of the IoT concept, vision and definition of IoT, basic characteristics of IoT, distinguish the IoT from other related technologies, IoT enablers, IoT architectures, pros and cons of IoT, IoT architecture concepts for specific IoT applications. IoT Building Blocks -Hardware and Software:The basic IoT building blocks, smart thing components and capabilities, basics of Packet Tracer with reference to IoT, basics of IoT gateway, Cloud, and analytics Sensing Principles and Wireless Sensor Network:Sensor fundamentals and classification of sensors, physical principles of some common sensors, basics of	15
III	**Advanced IOT Technologies** IoT Gateway:IoT architecture domains, IoT gateway architecture, IoT 15L 32 gateway functionalities, IoT gateway selection criteria, IoT gateway and edge computing, edge computing-based solution for specific IoT applications IoT Protocol Stack:Mapping of IoT protocols to layered IoT architecture, functionality of infrastructure, service discovery, and application layer protocols of IoT protocol stack IoT Cloud and Fog Computing:Components of IoT Cloud architecture, usage of application domains of IoT Cloud	15

	platforms, layered architecture of Fog computing, distinguish Fog computing from other related terms IoT Applications:Main applications of IoT, Implementation details of various IoT application domains	
IV	**Security, Communication and Data analytics in IOT** IoT Security: Security constraints in IoT systems, security requirements of IoT systems, IoT attacks, security threats at each layer of IoT architecture, design secure IoT system for specific application Social IoT: Nature of social relationships among IoT Devices, functionality of different components of social IoT architecture, social aspects of smart devices in IoT applications Packet Tracer and IoT: Basics of Packet Tracer and Blockly programming language, design simple IoT projects in Packet Tracer.	**15**

REFERENCE BOOKS-

1. Introduction to Embedded Systems – Cyber physical systems Approach Edward Ashford Lee &SanjitArunkumarSeshia Second Edition — MIT Press — 2017
2. Enabling the Internet of Things Fundamentals, Design and Applications by Muhammad Azhar Iqbal, Sajjad Hussain, Huanlai Xing, Muhammad Ali Imran Wiley Pub.1stEdition 2021
3. Introduction Embedded Systems by K.V. Shibu Second Edition McGraw Hills–2017
4. Build your own IoT Platform Develop a Fully Flexible and Scalable Internet 33 of Things Platform in 24 Hours by Anand Tamboli 2019 Apress

Course Code	FP SEM – II – PROJECT IMPLEMENTATION	Credits	Lectures /Week
K23PSCSFP24	Paper I	4	4

Course Outcome:

- To learn the process of project implementation
- To understand the system, submit the proposal and implement the same in the semester–II.
- To propose project implementation as part of the semester–II.
- Experimental setup, analysis of results, comparison with results of related works, conclusion, and prospects will be part of the project implementation.
- To make a project implementation report and appear for a project viva

PROJECT IMPLEMENTATION

The syllabus proposes project implementation as part of the semester–II.
The student is expected to submit the proposal and implement the same in the semester–II. In addition, experimental setup, analysis of results, comparison with results of related works, conclusion, and prospects will be part of the project implementation.
A student is expected to make a project implementation report and appear for a project viva. He or she needs to spend around 133 hours for the project implementation, which fetches 4 credits.

Guidelines for Project Implementation in Semester - II

● A student is expected to devote at least 3 to 4 months of effort to the implementation.
● Students should submit a detailed project implementation report at the time of viva.

Guidelines for Documentation of Project Proposal in Semester –II

A student should submit a project implementation report with the following details:
● Title: Title of the project.
● Objective: A detailed objective of the proposal is needed.
● Related works: A detailed survey of the relevant works done by others in the domain. The student is expected to refer to at least 15 recent (last five years) research papers in addition to textbooks and web links in the relevant topic.
● 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.
● Implementation details: A description of how the project has been implemented.
● Experimental setup and results: A detailed explanation of how experiments were conducted, what software was used, and the results obtained. Details like screenshots, tables, and graphs can come here.
● Analysis of the results: A description of what the results mean and how they have been arrived at. Different performing measures or statistical tools used etc may be part of this.
● Conclusion: A conclusion of the project performed in terms of its outcome
● Future enhancement: A small description of what enhancement can be done when more time and resources are available
● Program code: The program code may be given as an appendix.
The project documentation needs to be signed by the teacher in charge and head of the Department. Student should also attach the certified copy of the internal evaluation report (Appendix III) at the time of Project evaluation and viva as part of the University examination.

Evaluation Scheme for First Year (PG) under NEP (4 credits)

I. Internal Evaluation for Theory Courses – 40 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 20 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 20 marks

II. External Examination for Theory Courses – 60 Marks

Duration: 2 Hours

Theory question paper pattern:

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15
Q.3	Unit III	15
Q.4	Unit IV	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be subdivided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination

- Each core subject carries 50 Marks
- Duration: 3 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.