Scheme of Instruction & Examination
B. E. - Computer Science and Engineering
CSE Semester – VI

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Contact Hours/ week	CIE	SEE	
Theory Courses									
1	3PC609CS	Design and Analysis of Algorithms	3	0	0	3	40	60	3
2	3PC610CS	Machine Learning	3	0	0	3	40	60	3
3	3PC611CS	Automata Languages and Compiler Design	3	0	0	3	40	60	3
4	3PE6(06 TO 10) CS	Professional Elective – II	3	0	0	3	40	60	3
5	OE	Open Elective – II	3	0	0	3	40	60	3
6	3HS602HS	Effective Technical Communication(ETCE)	2	0	0	2	40	60	2
Practical / Laboratory Courses									
7	3PC661CS	Machine Learning Lab	0	0	2	2	40	60	1
8	3PC662CS	Web Technology Lab	0	0	2*2	4	40	60	2
9	3PW663CS	Mini Project	0	0	2	2	40	60	1
Total Credits						**25**	**360**	**540**	**21**

Professional Elective – II

1	3PE606CS	Digital Forensics
2	3PE607CS	Big Data Analytics
3	3PE608CS	Software Project Management
4	3PE609CS	Scripting Languages
5	3PE610CS	Natural Language Processing

Open Elective – II

3OP60XXX	Open Elective - II	Offered by
1	Green Building Technologies	CIVIL
2	Software Engineering	CSE
3	Deep Learning	AI&DS
4	Electric Vehicle Technology	EEE
5	Fundamentals of IOT	ECE
6	3D Printing	MECH

Course Code	Course Title						Core/Elective
3PC609CS	DESIGN AND ANALYSIS OF ALGORITHMS						Core
Prerequisite					CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

The objective of this course is to make the student to

1. Analyze the asymptotic performance of algorithms and correctness proofs for algorithms.
2. Demonstrate a familiarity with major algorithms and data structures.
3. Apply important algorithmic design paradigms and methods of analysis.
4. Familiarizing students with specific algorithms for a number of important computational problems like sorting, searching, and graphs, etc.
5. Introducing the concept of NP-complete problems and different techniques to deal with them.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Understand the basic notation for analyzing the performance of the algorithms.
2. Use divide-and-conquer techniques for solving suitable problems.
3. Use greedy approach to solve an appropriate problem for optimal solution.
4. Apply dynamic programming approach to solve suitable problems.
5. Understand the limitations of algorithm power and study how to cope with the limitations of algorithm power for various problems.

UNIT - I

Introduction & Elementary Data Structures: Introduction, Fundamentals of algorithm (Line Count, Operation Count), Analysis of algorithms (Best, Average, Worst case), Asymptotic Notations (O, O, O) Recursive Algorithms, Analysis using Recurrence Relations, Master's Theorem.

Review of elementary data structures–Graphs: BFS, DFS, Articulation points, Bi-Connected Components. Sets: representation, UNION, FIND operations.

UNIT - II

Divide-and-Conquer Method: The general method, Binary search, Finding maximum and minimum, Merge sort, Quick sort.

Brute Force: Knapsack, Travelling salesman problem, Convex-Hull.

UNIT - III

Greedy Method: Knapsack problem, Minimum spanning trees, Single source shortest path, Job sequencing with deadlines, Optimal storage on tapes, Optimal merge pattern Dynamic programming method: All pairs shortest paths, Optimal binary search tress, 0/1 Knapsack problem, Reliability design, Travelling salesman problem.

UNIT–IV

Back tracking: N-queen's problem, Graph colouring, Hamiltonian cycles.

Branch-and-bound: FIFO & LC branch and Bound methods, 0/1 Knapsack problem, Travelling sales person.

UNIT - V

NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP - Hard and NP-Complete classes, Cook's theorem, Proofs for NP Complete Problems: Clique, Vertex Cover.

TEXT BOOKS

1. Fundamentals of Computer Algorithms, Horowitz E, Sahni S, II Edition Universities Press, 2007.
2. "Introduction to Algorithms", Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, III Edition ,PHI Learning Private Limited, 2012.

REFERENCE BOOKS

1. Algorithm Design: Foundations, Analysis and Internet Examples, Michael T. Goodrich, Roberto Tamassia, II Edition John Wiley & Sons, 2002.
2. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.
3. Design and Analysis of Algorithms, S Sridhar, First Edition, Oxford.

Course Code	Course Title						Core/Elective
3PC610CS	MACHINE LEARNING						Core
Prerequisite					CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student to

1. To learn the concepts of machine learning and types of learning along with evaluation metrics.
2. To study various supervised learning algorithms.
3. To learn ensemble techniques and various unsupervised learning algorithms.
4. To explore Neural Networks and Deep learning basics.
5. To learn reinforcement learning and study applications of machine learning

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Extract features that can be used for a particular machine learning approach in various applications.
2. Compare and contrast pros and cons of various machine learning techniques and to get an insight when to applyparticular machine learning approach.
3. Understand different machine learning types along with algorithms.
4. Understand how to apply machine learning in various applications.
5. Apply ensemble techniques for improvement of classifiers.

UNIT - I

Introduction: Representation and Learning : Feature Vectors, Feature Spaces, Learning Problem Formulation.

Types of Machine Learning Algorithms: Parametric and Non-parametric Machine Learning Algorithms, Supervised, Unsupervised, Semi-Supervised and Reinforced Learning.

UNIT - II

Supervised Algorithms :

Regression : Linear Regression, Logistic Regression, Evaluation Measures: SSE, RMSE, R2.

Classification: Decision Tree, Naïve Bayes, K-Nearest Neighbors, Support Vector Machines, Overfitting, Training, Testing, and Validation Sets

Accuracy Metrics: The Confusion Matrix, precision, recall, F-Score, Receiver Operator Characteristic (ROC) Curve.

UNIT - III

Feature Selection and Dimensionality Reduction.

Ensemble Algorithms: Bagging, Random Forest, Boosting.

Unsupervised Learning: Cluster Analysis: Similarity Measures, categories of clustering algorithms, k- means, Hierarchical, Expectation-Maximization Algorithm, Fuzzy c-means algorithm.

UNIT - IV

Neural Networks: Multilayer Perceptron, Activation Functions.

Training strategies: Back-propagation algorithm, Gradient Descent.

Radial basis functions, Hopfield network, Recurrent Neural Networks.

UNIT - V

Reinforcement Learning: overview, example: getting lost, State and Action Spaces, The Reward Function, Discounting, Action Selection, Policy, Markov decision processes Q-learning, uses of Reinforcement learning Applications of Machine Learning in various fields: Text classification, Image Classification, Speech Recognition.

TEXTBOOKS

1. Machine Learning & Pattern Recognition (2014) Tom Mitchell, I Edition, McGrawˆHillScience/ Engineering/ Math;(1997).
2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, II Edition Chapman & Hall/CRC Press

REFERENCE BOOKS

1. Machine Learning: A Probabilistic Perspective, Kevin Murphy, I Edition, MIT Press, 2012.
2. Pattern Recognition and Machine Learning, Christopher Bishop, I Edition, Springer 2007.
3. Machine Learning for Beginners, Chris Sebastian.

Course Code	Course Title						Core/Elective
3PC611CS	AUTOMATA LANGUAGES AND COMPILER DESIGN						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Introduce the concept of formal specification of languages and different classes of formal languages.
2. Discuss automata models corresponding to different levels of Chomsky hierarchy.
3. Analyze and explain the behavior of push-down automata and TM.
4. To teach concepts of language translation and phases of compiler design.
5. To inculcate knowledge of parser by parsing LL parser and LR parser.
6. To demonstrate intermediate code using technique of syntax directed translation.
7. To Illustrate the various optimization techniques for designing various optimizing compilers.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Explain finite state machines for modeling and their power to recognize the languages.
2. Summarize the concept of Regular languages and context free languages.
3. Construct PDA and Turing machines for the given set of languages.
4. Build the lexical and Syntax analyser phases of compiler.
5. Model SDD's using Intermediate Representations.

UNIT - I

Formal Language and Regular Expressions: Languages, Definition Languages regular expressions, Finite Automata – DFA, NFA. Conversion of regular expression to NFA, NFA to DFA. Finite automata with output – Moore and Mealy machines, conversion of Moore to Mealy and Mealy to Moore.

UNIT - II

Context Free grammars and parsing: Context free grammars, derivation, parse trees, ambiguity, Leftmost and rightmost derivation of strings and Sentential forms, Ambiguity, left recursion and left factoring in context free grammars, Minimization

of context free grammars, Normal forms for context free grammars, Chomsky normal form

Pushdown Automata: Introduction to Pushdown automata, Acceptance of context free languages, Acceptance by final state and acceptance by empty state and its equivalence, Equivalence of context free grammars and pushdown automata.

UNIT - III

Turing Machine: Introduction to Turing Machine, Design of Turing machines, Types of Turing machines.

Introduction to Compiling: Overview of Compilers, Phases of a Compiler.

Lexical Analysis : The Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, LEX tool.

UNIT - IV

Syntax Analysis: The role of the Parser, First and Follow, Predictive Parsing.

Bottom up parsing: Shift reduce parsing, LR Parsers-SLR, Canonical LR, LALR, Parser Generator(YACC).

Semantic Analysis: Syntax directed translation, S-attributed and L-attributed grammars.

Intermediate code generation - abstract syntax tree, Three address code, Implementations.

UNIT - V

Run time storage: Storage organization, storage allocation strategies.

Code optimization: Optimization of basic blocks, peephole optimization, flow graphs, Data flow analysis of flow graphs.

Code generation: Machine dependent code generation, Register allocation and assignment. Using DAG representation of Block.

TEXT BOOKS

1. Introduction to Automata TheoryLanguages and Computation, John E Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, ,III Edition, Pearson Education, 2011.
2. Compilers- Principles Techniques and Tool, Alfred Aho,Monica S Lam, RaviSethi, Jeffrey D.Ullman, II Edition, Pearson Education India, 2013.

REFERENCE BOOKS

1. An introduction to Formal Languages and Automata, Peter Linz, VI Edition, Jones & Bartlett, 2016
2. Principles of Compiler Design, V.Raghavan, I Edition, McGraw Hill Education, 2017.
3. Theory of Computer Science – Automata Languages and Computation, Mishra and Chandrashekaran, III Edition, PHI, 2009.

Course Code	Course Title						Core/Elective
3PE606CS	DIGITAL FORENSICS						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
2. To understand how to examine digital evidences such as the data acquisition, identification analysis.
3. Understand the processing crimes and incident scenes
4. Understand the latest computer forensic tools.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Apply forensic analysis tools to recover important evidence for identifying computer crime.
2. Understand computing investigation
3. Understand the perspective of data acquisition tools
4. Understand the process of digital crimes
5. Understand the latest computer forensic tools.

UNIT - I

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

UNIT - II

Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

UNIT - III

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions,

performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

UNIT - IV

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

UNIT - V

Current computer forensics tools-software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigationsˆinvestigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

TEXT BOOKS

1. Computer Forensics: Incident Response Essentials, Warren G. Kruse II and Jay G. Heiser,, Addison Wesley, 2002.
2. Guide to Computer Forensics and Investigations, Nelson, B, Phillips, A, Enfinger, F, Stuart, C., II Edition, Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

REFERENCE BOOKS

1. Computer Forensics, Computer Crime Scene Investigation, Vacca, J,II Edition, Charles River Media, 2005, ISBN: 1-58450-389
2. Digital Forensics Explained, Greg Gogolin, II Edition, CRC Press.
3. Cybersecurity and Digital Forensics, Challenges and Future Trends, Mangesh M Ghonge, Sabyasachi Pramanik, I Edition, Scrivener Publishing.

Course Code	Course Title						Core/Elective
3PE607CS	BIG DATA ANALYTICS						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Understand the Big Data Platform and overview of Apache Hadoop.
2. Provide HDFS Concepts and Interfacing with HDFS.
3. Understand Map Reduce Jobs.
4. Provide hands on Hodoop Eco System Pig, Hive.
5. Understand various Hadoop Eco Systems like Hbase, Zookeeper.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Explain the foundations, definitions, and challenges of Big Data.
2. Use Hadoop file system interfaces.
3. Program using HADOOP and Map reduce.
4. Understand various Hadoop Eco Systems like Pig, Hive.
5. Outline Hadoop Eco System using HBase, Zookeeper.

UNIT - I

Introduction to Big Data and Hadoop

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with UNIX tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System.

UNIT - II

HDFS (Hadoop Distributed File System)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT - III

Map Reduce, Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

UNIT - IV

Hadoop Eco System-I.

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig.

Latin, User Defined Functions, Data Processing operators.

Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

UNIT - V

Hadoop Eco System-II.

HBase: HBasics, Concepts, Clients, Example, Hbase versus RDBMS.

Zookeeper: The Zookeeper Services, Zookeeper in Production.

TEXT BOOKS

1. Hadoop: The Definitive Guide, Tom White III Edition, O'Reily Media, 2012.
2. Intelligent Data Analysis, Michael Berthold, David J. Hand,I Edition, Springer, 2007.

REFERENCE BOOKS

1. Big Data and Business Analytics,Jay Liebowitz, Auerbach Publications, CRC press (2013).
2. Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop, Tom Plunkett, Mark Hornick, McGraw-Hill/Osborne Media (2013), Oracle press.
3. Mining of Massive Datasets, Anand Rajaraman and Jefrey David Ulman, Cambridge University Press, 2012.

Course Code	Course Title						Core/Elective
3PE608CS	SOFTWARE PROJECT MANAGEMENT						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To understand software project planning and evaluation techniques.
2. To plan and manage projects at each stage of the software development life cycle (SDLC).
3. To learn about the activity planning and risk management principles.
4. To acquire skills to manage various phases involved in project management and people management.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the basic project management concepts,framework and the process models.
2. Apply appropriate software process model and software effort estimation techniques.
3. Estimate risks involved in various project activities, staff and issues related to people management.
4. Analyze checkpoints, project reporting structure, project progress and trackingmechanisms using project management principles.

UNIT - I

PROJECT EVALUATION AND PROJECT PLANNING

Importance of Software Project Management - Activities - Methodologies - Categorization of Software Projects - Setting objectives - Management Principles - Management Control - Project portfolio Management - Cost-benefit evaluation technology - Risk evaluation - Strategic program Management - Stepwise Project Planning.

UNIT - II

PROJECT LIFE CYCLE AND EFFORT ESTIMATION

Software process and Process Models - Choice of Process models - Rapid Application development - Agile methods - Dynamic System Development Method - Extreme

Programming - Managing interactive processes - Basics of Software estimation - Effortand Cost estimation techniques - COSMIC Full function points - COCOMO II - a Parametric Productivity Model.

UNIT - III

ACTIVITY PLANNING AND RISK MANAGEMENT

Objectives of Activity planning -Project schedules - Activities -Sequencing and scheduling - Network Planning models - Formulating Network Model - Forward Pass &Backward Pass techniques - Critical path (CRM) method - Risk identification - Assessment - Risk Planning - Risk Management - PERT technique - Monte Carlosimulation - Resource Allocation – Creation of critical paths – Cost schedules.

UNIT - IV

PROJECT MANAGEMENT AND CONTROL

Framework for Management and control - Collection of data - Visualizing progress - Cost monitoring - Earned Value Analysis - Prioritizing Monitoring – Project tracking -Change control - Software Configuration Management - Managing contracts - Contract Management.

UNIT - V

STAFFING IN SOFTWARE PROJECTS

Managing people – Organizational behavior – Best methods of staff selection – Motivation– The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures –Dispersed and Virtual teams – Communications genres – Communication plans – Leadership

TEXT BOOKS

1. Software Project Management, Bob Hughes, Mike Cotterell and Rajib Mall, V Edition Tata McGraw Hill, New Delhi, 2012
2. Effective Software Project Management, Robert K. Wysocki, Wiley Publication,2011

REFERENCE BOOKS

1. Software Project Management, Walker Royce, Addison-Wesley, 1998
2. Managing Global Software Projects, Gopalaswamy Ramesh, McGraw Hill Education (India), Fourteenth Reprint 2013.

Course Code	Course Title						Core/Elective
3PE609CS	SCRIPTING LANGUAGES						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Able to differentiate scripting and non- scripting languages.
2. To learn Scripting languages such as PERL, TCL/TK, python and BASH.
3. Expertise to program in the Linux environment.
4. Usage of scripting languages in IC design flow.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Describe about basics of Linux and Linux Networking
2. Utilize Linux environment and write programs for automation
3. Understand the concepts of Scripting languages
4. Create and run scripts using PERL/TCl.
5. Develop scripts using Python.

UNIT - I

Linux Basics: Introduction to Linux, File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts.

UNIT - II

Linux Networking: Introduction to Networking in Linux, Network basics & Tools, File Transfer Protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

UNIT - III

Perl Scripting: Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References & Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

UNIT - IV

Tcl / Tk Scripting: Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List box Widgets Focus, Grabs and Dialogs

UNIT - V

Python Scripting : Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library

TEXT BOOKS

1. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk 4.0.
2. Red Hat Enterprise Linux 4 : System Administration Guide Copyright, Red Hat Inc, 2005

REFERENCE BOOKS

1. Learning Python – Mark Lutz and David Ascher, 2nd Ed. , O'Reilly, 2003.
2. Learning Perl – 4 th Ed. Randal Schwartz, Tom Phoenix and Brain d foy. 2005.
3. Python Essentials – Samuele Pedroni and Noel Pappin. O'Reilly, 2002.
4. Programming Perl – Larry Wall, Tom Christiansen and John Orwant, 3rd Edition, O'Reilly, 2000. (ISBN 0596000278).

Course Code	Course Title						Core/Elective
3PE610CS	NATURAL LANGUAGE PROCESSING						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Explain text normalization techniques and n-gram language model
2. Discuss Part of speech methods and naïve bayes classification techniques
3. Understand word sense disambiguation techniques and process of building question answering system.
4. Understand about grammars and their hierarchy.
5. Introduce the concepts of chatbots, dialogue systems, speech recognition systems and text to speech recognition methods.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Apply normalization techniques on a document and evaluate a language model.
2. Implement parts of speech tagging and classification techniques on the words.
3. Establish relationships among words of a sentence using word net and also build the question answering system.
4. Understand the WSD and understand to use WORDNET.
5. Analyze chatbots, dialogue systems, and automatic speech recognition systems.

UNIT - I

Introduction: Regular Expressions, Text Normalization, Edit Distance: Words, Corpora, Text Normalization, Word Normalization, Lemmatization and Stemming, Sentence Segmentation, the Minimum Edit Distance Algorithm.

UNIT - II

N-gram Language Models : N-Grams, Evaluating Language Model, Sampling sentences from a language model,

Sequence Labeling for Parts of Speech and Named Entities: Part-of-Speech Tagging, Named Entities and Named Entity Tagging.

UNIT - III

Naive Bayes and Sentiment Classification: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Optimizing for Sentiment Analysis, Naive Bayes as a Language Model,

Evaluation : Precision, Recall, F-measure, Test sets and Cross-validation.

UNIT - IV

Word Senses and WordNet : Word Senses, Relations Between Senses, WordNet: A Database of Lexical Relations, Word Sense Disambiguation, WSD Algorithm: Contextual Embeddings.

Question Answering: Information Retrieval, IR-based Factoid Question Answering, IRbased QA: Datasets, Entity Linking, Knowledge-based Question Answering, Using Language Models to do QA, Classic QA Models.

UNIT - V

Chatbots & Dialogue Systems: Properties of Human Conversation, Chatbots, GUS: Simple Frame-based Dialogue Systems, The Dialogue-State Architecture, Evaluating Dialogue Systems, Dialogue System Design.

Automatic Speech Recognition and Text-to-Speech: The Automatic Speech Recognition Task, Feature Extraction for ASR: Log Mel Spectrum, Speech Recognition Architecture.

TEXT BOOKS

1. Speech and Language Processing, Dan Jurafsky and James H. Martin (Stanford.edu), 3rd Edition, Pearson Publications.
2. Natural Language Processing with Python, Analyzing Text with the Natural Language Toolkit, Steven Bird, Ewan Klein, and Edward Loper.
3. Ela Kumar, " Natural Language Processing", IK international Publication, second edition, 2014.

REFERENCE BOOKS

1. Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana
2. Foundations of Statistical Natural Language Processing, Christopher Manning and Hinrich Schütze.
3. Natural Language Processing in Action, Understanding, Analysing, and Generating Text with Python, Hobson Lane, Cole Howard, Hannes Max Hapke
4. The Handbook of Computational Linguistics and Natural Language Processing, (Blackwell Handbooks in Linguistics) I Edition.

Course Code	Course Title						Core/Elective
3OE602CS	SOFTWARE ENGINEERING						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Describe and compare various software development methods and understand the context in which each approach might be applicable.
2. To impart knowledge on various phases, methodologies and practices of software development.
3. To apply the project management and analysis principles to software project development.
4. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metric.
5. To apply the design & testing principles to software project development.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Acquired working knowledge of alternative approaches and techniques for each phase of SDLC.
2. Judge an appropriate process model(s) for software project attributes and analyze requirements for project development.
3. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting
4. Concede product quality through testing techniques employing appropriate metrics byunderstanding the practical challenges associated with the development of a significant software system.
5. Apply the software engineering principles in real time project development

UNIT - I

Introduction to Software: What is software? Types of software, Characteristics of Software Attributes of good software.

Software Engineering: What is software engineering, Software engineering costs? What are the key challenges facing software engineering, Systems engineering & software Engineering, SDLC.

Software Development Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

UNIT - II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modelling Principles, Construction Principles, Deployment.

Software Requirement Analysis and Specification: System and software requirements, Types of software requirements, Elicitation and analysis of requirements, Requirement validation, Requirement specification, Feasibility.

UNIT - III

Building the Analysis Model: Data Modeling Concepts, Object-Oriented Analysis, Scenarioˆbased Modeling, Flow-oriented Modeling, Class-based Modeling.

Design Engineering: Design Process and Quality, Design Concepts, the Design Model, Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT - IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Coding: Programming languages and development tools, Selecting languages and tools Good programming practices, Coding Standards.

UNIT - V

Software Testing and Quality Assurance: Verification and validation Techniques of testing Black-box and White-box testing Inspections Levels of testing Unit testing, Integration Testing, Interface testing, System testing, Alpha and beta testing, Regression testing Design of test cases.

Quality management activities: Product and process quality Standards, ISO900, Capability Maturity Model (CMM), Risk management.

Debugging: Debugging Techniques, The Art of Debugging.

Current trends in Software Engineering Software Engineering for projects and products.

TEXT BOOKS

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, VII Edition, McGraw Hill, 2009.
2. Software Engineering by Ian Sommerville, VII edition, Addison-Wesley.
3. Fundamentals of Software Engineering by Rajib Mall.

REFERENCE BOOKS

1. Ali Behforooz and Frederick J. Hudson, Software Engineering Fundamentals, Oxford University Press, 1996.
2. PankajJalote, An Integrated Approach to Software Engineering, III Edition, Narosa Publishing House, 2000.

Course Code	Course Title						Core/Elective
3PC661CS	MACHINE LEARNING LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	-	-	-	2	40	60	1

COURSE OBJECTIVES:

1. Demonstration of different classifiers on different data.
2. Demonstrate ensembling of classifiers for solving real world problems.
3. Make use of real world data to implement machine learning models

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Applymachine learning algorithms: dataset preparation, model selection, model building etc.
2. Evaluate various Machine Learning approaches.
3. Use scikit-learn, Keras and Tensorflow to apply ML techniques.
4. Design and develop solutions to real world problems using ML techniques.
5. Apply unsupervised learning and interpret the results.

List of Programs

1. Installation of python environment/Anaconda IDE for machine learning: installingpython modules/Packages like scikit-learn, Keras and Tensorflow etc.
2. Programs involving pandas, Numpy and Scipy libraries.
3. Build models using linear regression and logistic regression.
4. Build Models using Decision tree.
5. Build Models using K nearest neighbour.
6. Build Models using Naïve bayes.
7. Build Models using Support vector machine.
8. Demonstrate Clustering using k-means and Interpret the clusters obtained.
9. Demonstrate Clustering using Hierarchical algorithms (agglomerative and divisive) and Interpret the clusters obtained.
10. Demonstrate ensemble techniqueslike boosting, bagging and random forest
11. Build a classifier, compare its performance with an ensemble technique like random forest.
12. Evaluate various classification algorithms performance on a dataset using various measures like TruePositive rate, False positive rate, precision, recall etc
13. Case study on supervised/unsupervised learning algorithms using Weka tool.

Course Code	Course Title						Core/Elective
3PC662CS	WEB TECHNOLOGY LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	-	-	-	2*2	40	60	2

COURSE OBJECTIVES:

1. To develop an ability to design and implement static and dynamic website.
2. Choose best technologies for solving web client/server problems.
3. Use JavaScript & PHP to validate form input entry.
4. Use appropriate client-side or Server-side applications.
5. Handling Cookies and Sessions using PHP, SERVLETS and JSP.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Create web pages using HTML and Cascading Styles sheets.
2. Develop web applications using PHP.
3. write a well formed / valid XML document.
4. Write a server side java application.
5. Compare Servlet and JSP concepts and apply JSP concepts to create dynamic web pages by reducing the code complexity.

List of Programs

1. Develop static pages (using Only HTML) of an online book store. The pages should resemble: www.amazon.com. The website should consist the following pages.
   a) Home page
   b) Registration and user Login
   c) User Profile Page
   d) Books catalog
   e) Shopping Cart
   f) Payment By credit card
   g) Order Conformation

2. Validate the Registration, user login, user profile and payment by credit card pages using JavaScript.
3. Create and save an XML document on the server, which contains 10 users information. Write a program, which takes User Id as an input and returns the user details by taking the user information from the XML document.
4. Write a PHP script to print prime numbers between 1-50.
5. PHP script to
   a. Find the length of a string.
   b. Count no of words in a string.
   c. Reverse a string.
   d. Search for a specific string.
6. Write a PHP script to merge two arrays and sort them as numbers, in descending order.
7. Write a PHP script that reads data from one file and write into another file.
8. Develop a Servlet to validate user name and password with the data stored in Servlet configuration file. Display authorized user if she/he is authorized else display Unauthorized user.
9. Write JSP Program to store student information sent from registration page into database table.
10 Develop a program to validate username and password that are stored in Database table using JSP.

TEXT BOOKS

1. WEB TECHNOLOGIES: A Computer Science Perspective, Jeffrey C. Jackson, Pearson Education

REFERENCE BOOKS

1. Deitel H.M. and Deitel P.J., "Internet and World Wide Web How to program", Pearson International, 2012, IV Edition.
2. J2EE: The complete Reference By James Keogh, McGraw-Hill
3. Bai and Ekedhi, The Web Warrior Guide to Web Programming, Thomson
4. Paul Dietel and Harvey Deitel," Java How to Program", Prentice Hall of India, VIII Edition
5. Web technologies, Black Book, Dreamtech press.Gopalan N.P. and Akilandeswari J., "Web Technology", Prentice Hall of Ind.

Course Code	Course Title						Core/Elective
3PC663CS	MINI PROJECT						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. To enhance practical and professional skills.
2. To familiarize tools and techniques of systematic literature survey and documentation.
3. To expose students to industry practices and teamwork.
4. To encourage students to work with innovative and entrepreneurial data.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Demonstrate the ability to synthesize and apply knowledge and skills acquired in the academic program to real world problems.
2. Evaluate different solutions based on economic and technical feasibility.
3. Effectively plan a project and confidently perform all aspects of project management.
4. 4. Develop and test the solution.

Guidelines for Mini Project

1. The mini-project is a team activity having maximum of 3 students in a team. This is software based design work.
2. The mini project may be a combination of hardware and software
3. Mini Project should cater to a small system required in laboratory or real life.
4. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.
5. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
6. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

Course Code	Course Title						Core/Elective
1OE602AD	DEEP LEARNING						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Develop and Train Deep Neural Networks.
2. Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition.
3. Build and train RNNs, work with NLP and Word Embeddings.
4. The internal structure of LSTM and GRU and the differences between them.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Feature Extraction from Image and Video Data.
2. Implement Image Segmentation and Instance Segmentation in Images.
3. Implement image recognition and image classification using a pretrained network (Transfer Learning).
4. Traffic Information analysis using Twitter Data.
5. Auto encoder for Classification & Feature Extraction

UNIT - I

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT - II

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Under fitting. Hyper parameters.

UNIT - III

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers.

Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. RCNN, Fast R-CNN, Faster RˆCNN, Mask-RCNN, YOLO

UNIT - IV

About NLP & its Toolkits. Language Modeling. Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Coˆoccurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation Glove. Backpropagation Through Time. Bidirectional RNNs (BRNN). Long Short-term Memory (LSTM). Bi-directional LSTM. Sequence-to- Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT - V

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Auto encoding. Convolutional Auto Encoding. Variation

TEXT BOOKS

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, JojoMoolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020

REFERENCE BOOKS

1. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017.
2. Pro Deep Learning with Tensor Flow, Santanu Pattanayak, Apress, 2017.

Course Code	Course Title						Core/Elective
OE602CE	Green BuildingTechnologies						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To impart knowledge of the principles behind the green building technologies.
2. To know the importance of sustainable use of natural resources and energy.
3. To understand the principles of effective energy and resources management in buildings.
4. To bring awareness of the basic criteria in the green building rating systems.
5. To understand the methodologies to reduce, recycle and reuse towards sustainability.

COURSE OUTCOMES:

After the completion of course the students will be able to:

After completion of the course, the student will be able to

CO 1. Define a green building, along with its features,benefits and rating systems.

CO 2. Describe the criteria used for site selection andwater efficiency methods.

CO 3. Explain the energy efficiency terms andmethods used in green building practices.

CO 4. Select materials for sustainable built environment & adopt waste management methods.

CO 5. Describe the methods used to maintain indoor environmental quality.

UNIT - I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical featuresof green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT - II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT - III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operationalenergy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT - IV

Building materials: Methods to reduce embodied energy in building materials : (a)Use of local buildingmaterials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrifiedtiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials.

Waste Management: Handling of construction waste materials, separation of household waste, onˆsite and off-site organic waste management.

UNIT - V

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaustsystems, low VOC paints, materials & adhesives, building acoustics.

Codes related to green buildings : NBC, ECBC, ASHRAE, UPC etc.

TEXT BOOKS

T1. Michael Bauer, Peter Mösle and Michael Schwarz "Green Building – Guidebook for SustainableArchitecture" Springer, 2010.

T2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.

REFERENCE BOOKS

R1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green BuildingCouncil Publishers.

R2. 'Alternative building materials and technologies' by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.

Course Code	Course Title						Core/Elective
3OE602CS	SOFTWARE ENGINEERING						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Describe and compare various software development methods and understand the context in which each approach might be applicable.
2. To impart knowledge on variousphases, methodologies and practices of software development.
3. To apply the project management and analysis principles to software project development.
4. To understand the importance oftesting in software development, study various testing strategies along with its relationship with software quality and metric.
5. To apply the design & testing principles to software project development.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Acquired working knowledge of alternative approaches and techniques for each phase of SDLC.
2. Judge an appropriate process model(s) for software project attributes and analyze requirements for project development.
3. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting
4. Concede product quality through testing techniques employing appropriate metrics by understanding the practical challenges associatedwith the development of a significant software system
5. Apply the software engineering principles in realtime project development.

UNIT - I

Introduction to Software : What is software? Types of software, Characteristics of SoftwareAttributes of good software.

Software Engineering : What is software engineering, Software engineering costs? What are the key challenges facing software engineering, Systems engineering & software Engineering, SDLC.

Software Development Process Models: prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process

Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

UNIT - II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modelling Principles, Construction Principles, Deployment.

Software Requirement Analysis and Specification: System and software requirements,Types of software requirements, Elicitation and analysis of requirements, Requirement validation, Requirements specification, Feasibility.

UNIT - III

Building the Analysis Model: Data Modelling Concepts, Object-Oriented Analysis, Scenario-based Modelling, Flow-oriented Modelling, Class-based Modelling.

Design Engineering: Design Process and Quality, Design Concepts, the Design Model, Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT - IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Coding: Programming languages and development tools, Selecting languages and tools Good programming practices, Coding Standards.

UNIT - V

Software Testing and Quality Assurance: Verification and validation Techniques of testing Black-box and White-box testing Inspections Levels of testing Unit testing, Integration Testing, Interface testing, System testing, Alpha and beta testing, Regression testing Design of test cases, Quality management activities: Product and process quality Standards, ISO900, Capability Maturity Model (CMM), Risk management.

Debugging: Debugging Techniques, The Art of Debugging.

Current trends in Software Engineering Software Engineering for projects and products.

TEXT BOOKS

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, VII Edition,McGraw Hill, 2009.
2. Software Engineering by IanSommerville, VIIedition, Addison-Wesley.
3. Fundamentals of Software Engineering by Rajib Mall.

REFERENCE BOOKS

1. Ali Behforooz and Frederick J. Hudson, Software Engineering Fundamentals, Oxford University Press, 1996.
2. Pankaj Jalote, An Integrated Approach to Software Engineering, III Edition, Narosa Publishing House, 2000.

Course Code	Course Title						Core/Elective
5OE602EC	FUNDAMENTALS OF IOT						Elective
Prerequisite Controllers, Communication protocols, web services	Contact Hoursper Week				CIE	SIE	Credits
	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To introduce the fundamentals, applications and requisite infrastructure of IoT.
2. To describe Internet principles and communication technologies relevant to IoT.
3. To discuss hardware and software aspects of designing an IoT system.
4. To explain the concepts of cloud computing and data analytics.
5. To illustrate the business models and manufacturing strategies of IoT products.

COURSE OUTCOMES :

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT.
3. Construct simple IoT systems with requisite hardware and p ython programming.
4. Understand the relevance of cloud computing and data analytics to IoT.
5. Apply the business model of IoT from developing a prototype to launching a product.

UNIT-I

Introduction to Internet of Things: Introduction to Internet of Things: Physical Design of IoT: Things in IoT, IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, IoT Applications: Smart Home, Smart Cities, SmartEnvironment, Smart Energy, Smart Retail and logistics, Smart Agriculture and Industry, Smart Industry and smart Health.

UNIT - II

Internet Principles and communication technology: Internet Communications: An Overview –IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS.

UNIT - III

Prototyping and Programming: Cost Vs Ease of Production, Prototypes and Production, Open-Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations., Classes, Python packages for IoT, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT-IV

Cloud computing and Data analytics: Introduction to Cloud storage models -SAAS, PAAS, IAAS. Communication APIs, Amazon web services for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT - Apache Hadoop- Map reduce job execution workflow.

UNIT - V

IoT Case Studies: Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation, Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.

TEXT BOOKS:

1. Internet of Things - Converging Technologies for smart environments andintegrated ecosystems, River Publishers.
2. Adrian McEwen (Author), Hakim Cassimally, “Designing the Internet ofThings”, Wiley India Publishers.

REFERENCE BOOKS:

1. Fundamentals of Python, Kenneth A Lambert and B.L. Juneja, Cenage Learning.
2. Internet of Things (A Hands-on-Approach), Vijay Madisetti, Arshdeep Bahga,VPT Publisher, 1st Ed., 2014.

OPENELECTIVE – II (VISEM)

Course Code	Course Title	Core/Elective					
		Elective					
4OE602EE	ELECTRIC VEHICLES TECHNOLOY (OPENELECTIVE - II)	L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Know the history of electric hybrid electric vehicles (EV & HEV) and emphasize the need and importance of EV-HEV forsustainable future.
2. Introduce the fundamental concepts and principles of electric and hybrid electric vehicles drive train topologies.
3. Develop a thorough understanding of the key elements of EV/HEV: Electric Machines for Propulsion Applications andEnergy Sources.

COURSE OUTCOMES :

At the end of the course students will be able to

1. To identify and describe the history and evolvement of electric & hybrid electric vehicles to emphasize on the need andimportance of EV/HEV for sustainable future.
2. To identify and describe the principles of various EV/HEVs drive train topologies along with their power flow control andfuel efficiency estimation.
3. To design and select electric propulsion system components for EV/HEV drives suitability for the desirable performanceand control.
4. To compare and evaluate various energy sources and energy storage components for EV and HEV applications.

UNIT - I

Introduction : History of electric vehicles (EV) and hybrid electric vehicles (HEV), need and importance of EV and HEV, Power/Energy supplies requirements for EV/ HEV applications, vehicle power source characterization, and transmission characteristics. Vehicle mechanics - Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion.

UNIT - II

Drive-Train Topologies: Series, Parallel, Series -Parallel and Complex configurations of HEV, basics of hybrid traction system, various hybrid drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis.

UNIT - III

Electrical Machines and Power Converters for Hybrid and Electric Vehicles: Electric system components for EV/HEV, suitability of DC and AC machines for EV/HEV applications, AC and DC Motor drives. Permanent magnet and switch reluctance machines, configuration and control of drives. Power Converters- Converters for EV and HEV applications.

UNIT - IV

Energy Sources for EV/HEV: Requirements of energy supplies and storage in EV/HEV, Review of batteries, fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, characteristics and comparison of energy sources for EV/HEV, hybridization of different energy sources.

UNIT - V

Electric Vehicles Charging Station: Type of Charging station, Selection and Sizing of charging station, Components of charging Station and Single line diagram of charging station. Contactless inductive charging Stationary Inductive charging, resonant and compensation circuit topologies.

TEXTBOOKS:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiely, USA, 2012.
2. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, 2nd Edition, CRC Press, 2011.

REFERENCES/SUGGESTEDREADING:

1. Chris Mi, M. Abdul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with PracticalPerspective, Wiely, 2011.
2. Simora Onori, Hybrid Electric Vehicles Energy Management Strategies, Springer.

Course Code	Course Title						Core/Elective
6OE602ME	3 D PRINTING TECHNOLOGIES						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSEOBJECTIVES :

1. To understand the fundamental concepts of 3D Printing, its advantages & limitations.
2. To know the various types of STL file errors and other data formats used in additive manufacturing Technology.
3. To know the working principle, advantages, disadvantages & applications of liquid, solid and powder based 3D Printing technologies.
4. To know the diversified applications of 3D Printing technologies and explore them in different industrial sectors.

COURSE OUTCOMES :

After the completion of course the students will be able to:

1. Describe the fundamentals of 3D printing, classify and explain advantages and disadvantages of 3D Printing technologies.
2. Select the suitable CAD data formats and software used in 3D Printing technology.
3. Describe the operating principles, capabilities and limitations of liquid, solid & powder based 3D Printing Technologies.
4. Compare different 3D printing technologies based on their process capabilities and applications.
5. Apply the capabilities and knowledge of 3D printing in different industrial sectors.

UNIT - I

Prototyping Fundamentals: Historical Development, Fundamentals of 3D Printing, Advantages and Limitations of 3D Printing, commonly used terms, 3D Printing Process Chain, 3D Modelling, Data conversion and transmission, Checking & Preparing, Building, Post processing, Classification of 3D Printing processes, Fundamental Automated Processes, Distinction between 3D Printing and Conventional Machining Processes.

Data Formats & Software: Data formats; conversion and transmission, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs, Newly Proposed Formats. Software's Features: Magics, Mimics, Solid View, Cura, ITK Snap.

UNIT - II

Liquid based Systems: Stereo Lithography Apparatus (SLA): Models and Specifications, Process, working principle, photopolymers, photo polymerization, Layering Technology,laser and laser scanning, Applications, Advantages and Disadvantages. **Poly jet:** Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages. **Solid ground curing (SGC):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT - III

Solid-based Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Fused Deposition

Modelling (FDM) : Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Multi Jet Modelling (MJM): Models and specifications, Process, Working principle, Applications, Advantages and Disadvantages.

UNIT - IV

Powder Based Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Three Dimensional Printing.

(3DP): Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT - V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Construction field, Arts and Architecture, Pattern for investment and vacuum casting, Medical Models

and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production Medical Devices, Forensic Science and Anthropology and Web Based Rapid PrototypingSystems.

TEXT BOOKS :

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific
2. 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" Springer, Second Edition.

REFERENCE BOOKS:

1. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies:
2. Frank W. Liou, "Rapid Prototyping & Engineering Applications"- CRC Press, Taylor & Francis Group.
3. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley & Sons.