ISBM College of Engineering, Pune
Department of Computer Engineering

Course Outcomes of Computer Engineering Subjects	
210241: Discrete Mathematics	
CO 1	**Formulate** problems precisely, solve the problems, apply formal proof techniques, and explain the reasoning clearly.
CO 2	**Apply** appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts.
CO 3	**Design and analyze** real world engineering problems by applying set theory, propositional logic and to construct proofs using mathematical induction.
CO 4	**Specify, manipulate and apply** equivalence relations; construct and use functions and apply these concepts to solve new problems.
CO 5	**Calculate** numbers of possible outcomes using permutations and combinations; to model and analyze computational processes using combinatorics.
CO 6	**Model and solve** computing problem using tree and graph and solve problems using appropriate algorithms.
210242: Fundamentals of Data Structures	
CO 1	**Design** the algorithms to solve the programming problems, **identify** appropriate algorithmic strategy for specific application, and **analyze** the time and space complexity.
CO 2	**Discriminate** the usage of various structures, **Design**/**Program/Implement** the appropriate data structures; use them in implementations of abstract data types and Identity the appropriate data structure in approaching the problem solution.
CO 3	**Demonstrate** use of sequential data structures- Array and Linked lists to store and process data.
CO 4	**Understand** the computational efficiency of the principal algorithms for searching and sorting and choose the most efficient one for the application.
CO 5	**Compare** and **contrast** different implementations of data structures (dynamic and static).
CO 6	**Understand, Implement and apply** principles of data structures-stack and queue to solve computational problems.
210243: Object Oriented Programming(OOP)	
CO 1	**Apply** constructs- sequence, selection and iteration; classes and objects, inheritance, use of predefined classes from libraries while developing software.
CO 2	**Design** object-oriented solutions for small systems involving multiple objects.
CO 3	**Use** virtual and pure virtual function and complex programming situations.
CO 4	**Apply** object-oriented software principles in problem solving.
CO 5	**Analyze** the strengths of object-oriented programming.
CO 6	**Develop** the application using object oriented programming language(C++).
210244: Computer Graphics	
CO 1	**Identify** the basic terminologies of Computer Graphics and interpret the mathematical foundation of the concepts of computer graphics.
CO 2	**Apply** mathematics to develop Computer programs for elementary graphic operations.
CO 3	**Illustrate** the concepts of windowing and clipping and **apply** various algorithms to fill and clip polygons.
CO 4	**Understand** and **apply** the core concepts of computer graphics, including transformation in two and three dimensions, viewing and projection.
CO 5	**Understand** the concepts of color models, lighting, shading models and hidden surface elimination.
CO 6	**Create** effective programs using concepts of curves, fractals, animation and gaming.
210245: Digital Electronics and Logic Design	
CO 1	**Simplify** Boolean Expressions using K Map.
CO 2	**Design and implement** combinational circuits.
CO 3	**Design and implement** sequential circuits.
CO 4	**Develop** simple real-world application using ASM and PLD.
CO 5	**Differentiate and Choose** appropriate logic families IC packages as per the given design specifications.
CO 6	**Explain** organization and architecture of computer system
210246: Data Structures Laboratory	
CO 1	**Use** algorithms on various linear data structure using sequential organization to solve real life problems.
CO 2	**Analyze** problems to **apply** suitable searching and sorting algorithm to various applications.
CO 3	**Analyze** problems to **use variants of** linked list and solve various real life problems.
CO 4	Designing and implement data structures and algorithms for solving different kinds of problems.
210247: OOP and Computer Graphics Laboratory	
CO 1	U**nderstand** and **apply** the concepts like inheritance, polymorphism, exception handling and generic structures for implementing reusable programming codes.
CO 2	**Analyze** the concept of file and **apply** it while storing and retrieving the data from secondary storages.
CO 3	**Analyze** and **apply** computer graphics algorithms for line-circle drawing, scan conversion and filling with the help of object oriented programming concepts.
CO 4	**Understand** the concept of windowing and clipping and **apply** various algorithms to fill and clip polygons.
CO 5	**Apply** logic to implement, curves, fractals, animation and gaming programs.
210245: Digital Electronics and Logic Design	
CO 1	**Understand** the working of digital electronic circuits.
CO 2	**Apply the knowledge** to appropriate IC as per the design specifications.
CO 3	**Design and implement** Sequential and Combinational digital circuits as per the specifications.
210249: Business Communication Skills	
CO 1	**Express** effectively through verbal/oral communication and improve listening skills
CO 2	**Write** precise briefs or reports and technical documents.
CO 3	**Prepare** for group discussion / meetings / interviews and presentations.

CO 4	**Explore** goal/target setting, self-motivation and practicing creative thinking.
CO 5	**Operate** effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership qualities.
210250: Humanity and Social Science	
CO 1	**Aware** of the various issues concerning humans and society.
CO 2	**Aware** about their responsibilities towards society.
CO 3	**Sensitized about broader issues regarding the social, cultural, economic and human aspects, involved in social changes.**
CO 4	**Able** to understand the nature of the individual and the relationship between self and the community.
CO 5	**Able** to understand major ideas, values, beliefs, and experiences that have shaped human history and cultures.
207003: Engineering Mathematics III	
CO 1	**Solve** Linear differential equations, essential in modelling and design of computer-based systems.
CO 2	**Apply** concept of Fourier transform and Z-transform and its applications to continuous and discrete systems and image processing.
CO 3	**Apply** Statistical methods like correlation and regression analysis and probability theory for data analysis and predictions in machine learning.
CO 4	**Solve** Algebraic and Transcendental equations and System of linear equations using numerical techniques.
CO 5	**Obtain** Interpolating polynomials, numerical differentiation and integration, numerical solutions of ordinary differential equations used in modern scientific computing.
210252: Data Structures and Algorithms	
CO 1	**Identify and articulate** the complexity goals and benefits of a good hashing scheme for real- world applications.
CO 2	**Apply** non-linear data structures for solving problems of various domain.
CO 3	**Design and specify** the operations of a nonlinear-based abstract data type and implement them in a high-level programming language.
CO 4	**Analyze** the algorithmic solutions for resource requirements and optimization
CO 5	**Use** efficient indexing methods and multiway search techniques to store and maintain data.
CO 6	**Use** appropriate modern tools to understand and analyze the functionalities confined to the secondary storage.
210253: Software Engineering	
CO 1	**Analyze** software requirements and formulate design solution for a software.
CO 2	**Design** applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.
CO 3	**Apply** new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.
CO 4	**Model** and design User interface and component-level.
CO 5	**Identify** and handle risk management and software configuration management.
CO 6	**Utilize** knowledge of software testing approaches, approaches to verification and validation.
CO 7	**Construct** software of high quality – software that is reliable, and that is reasonably easy to understand, modify and maintain efficient, reliable, robust and cost-effective software solutions.
210254: Microprocessor	
CO 1	**Exhibit** skill of assembly language programming for the application.
CO 2	**Classify** Processor architectures.
CO 3	**Illustrate** advanced features of 80386 Microprocessor.
CO 4	**Compare** and **contrast** different processor modes.
CO 5	**Use** interrupts mechanism in applications
CO 6	**Differentiate** between Microprocessors and Microcontrollers.
CO 7	**Identify** and **analyze** the tools and techniques used to design, implement, and debug microprocessor-based systems.
210255: Principles of Programming Languages	
CO 1	**Make** use of basic principles of programming languages.
CO 2	**Develop** a program with Data representation and Computations.
CO 3	**Develop** programs using Object Oriented Programming language : Java.
CO 4	**Develop** application using inheritance, encapsulation, and polymorphism.
CO 5	**Demonstrate** Multithreading for robust application development.
CO 6	**Develop** a simple program using basic concepts of Functional and Logical programming paradigm.
210256: Data Structures and Algorithms	
CO 1	**Understand** the ADT/libraries, hash tables and dictionary to design algorithms for a specific problem.
CO 2	Choose most appropriate data structures and **apply** algorithms for graphical solutions of the problems.
CO 3	**Apply** and **analyze** non linear data structures to solve real world complex problems.
CO 4	**Apply** and **analyze** algorithm design techniques for indexing, sorting, multi-way searching, file organization and compression.
CO 5	**Analyze** the efficiency of most appropriate data structure for creating efficient solutions for engineering design situations.
210257: Microprocessor Laboratory	
CO 1	**Understand** and **apply** various addressing modes and instruction set to implement assembly language programs
CO 2	**Apply** logic to **implement** code conversion
CO 3	**Analyze** and **apply** logic to **demonstrate** processor mode of operation
210258: Project Based Learning II	
CO 1	Identify the real life problem from societal need point of view
CO 2	Choose and compare alternative approaches to select most feasible one

CO 3	Analyze and synthesize the identified problem from technological perspective
CO 4	Design the reliable and scalable solution to meet challenges
CO 5	Evaluate the solution based on the criteria specified
CO 6	Inculcate long life learning attitude towards the societal problems
Intellectual Property Rights and Patents	
CO 1	**Understand** the fundamental legal principles related to confidential information, copyright, patents, designs, trademarks and unfair competition
CO 2	**Identify, apply** and **assess** principles of law relating to each of these areas of intellectual property
CO 3	**Apply** the appropriate ownership rules to intellectual property you have been involved
310241: Database Management Systems	
CO 1	Analyze and design Database Management System using ER model
CO 2	Implement database queries using database languages
CO 3	Normalize the database design using normal forms
CO 4	Apply Transaction Management concepts in real-time situations
CO 5	Use NoSQL databases for processing unstructured data
CO 6	Differentiate between Complex Data Types and analyze the use of appropriate data types
310424: Theory of Computation	
CO 1	Understand formal language, translation logic, essentials of translation, alphabets, language representation and apply it to design Finite Automata and its variants
CO 2	Construct regular expression to present regular language and understand pumping lemma for RE
CO 3	Design Context Free Grammars and learn to simplify the grammar
CO 4	Construct Pushdown Automaton model for the Context Free Language
CO 5	Design Turing Machine for the different requirements outlined by theoretical computer science
CO 6	Understand different classes of problems, classify and analyze them and study concepts of NP completeness
310243: Systems Programming and Operating System	
CO 1	Analyze and synthesize basic System Software and its functionality.
CO 2	Identify suitable data structures and Design & Implement various System Software
CO 3	Compare different loading schemes and analyze the performance of linker and loader
CO 4	Implement and Analyze the performance of process scheduling algorithms
CO 5	Identify the mechanism to deal with deadlock and concurrency issues
CO 6	Demonstrate memory organization and memory management policies
310244: Computer Networks and Security	
CO 1	Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies
CO 2	Illustrate the working and functions of data link layer
CO 3	Analyze the working of different routing protocols and mechanisms
CO 4	Implement client-server applications using sockets
CO 5	Illustrate role of application layer with its protocols, client-server architectures
CO 6	Comprehend the basics of Network Security
310245(A): Internet of Things and Embedded Systems	
CO 1	Understand the fundamentals and need of Embedded Systems for the Internet of Things
CO 2	Apply IoT enabling technologies for developing IoT systems
CO 3	Apply design methodology for designing and implementing IoT applications
CO 4	Analyze IoT protocols for making IoT devices communication
CO 5	Design cloud based IoT systems
CO 6	Design and Develop secured IoT applications
310245(B): Human Computer Interface	
CO 1	To design effective Human-Computer-Interfaces for all kinds of users
CO 2	To apply and analyze the user-interface with respect to golden rules of interface
CO 3	To analyze and evaluate the effectiveness of a user-interface design
CO 4	To implement the interactive designs for feasible data search and retrieval
CO 5	To analyze the scope of HCI in various paradigms like ubiquitous computing, virtual reality ,multi-media, World wide web related environments
CO 6	To analyze and identify user models, user support, and stakeholder requirements of HCI systems
310245(C): Distributed Systems	
CO 1	Analyze Distributed Systems types and architectural styles
CO 2	Implement communication mechanism in Distributed Systems
CO 3	Implement the synchronization algorithms in Distributed System applications
CO 4	Develop the components of Distributed File System
CO 5	Apply replication techniques and consistency model in Distributed Systems
CO 6	Build fault tolerant Distributed Systems
310245(D): Software Project Management	
CO 1	Comprehend Project Management Concepts
CO 2	Use various tools of Software Project Management
CO 3	Schedule various activities in software projects
CO 4	Track a project and manage changes
CO 5	Apply Agile Project Management
CO 6	Analyse staffing process for team building and decision making in Software Projects and Management
310246: Database Management Systems Laboratory	
CO 1	Design E-R Model for given requirements and convert the same into database tables
CO 2	Design schema in appropriate normal form considering actual requirements

CO 3	Implement SQL queries for given requirements , using different SQL concepts
CO 4	Implement PL/SQL Code block for given requirements
CO 5	Implement NoSQL queries using MongoDB
CO 6	Design and develop application considering actual requirements and using database concepts
310247:Computer Networks and Security Laboratory	
CO 1	Analyze the requirements of network types, topology and transmission media
CO 2	Demonstrate error control, flow control techniques and protocols and analyze them
CO 3	Demonstrate the subnet formation with IP allocation mechanism and apply various routing algorithms
CO 4	Develop Client-Server architectures and prototypes
CO 5	Implement web applications and services using application layer protocols
CO 6	Use network security services and mechanisms
310248: Laboratory Practice I • Systems Programming and Operating System	
CO 1	Implement language translators
CO 2	Use tools like LEX and YACC
CO 3	Implement internals and functionalities of Operating System
310248: Laboratory Practice I • Internet of Things and Embedded Systems	
CO 4	Design IoT and Embedded Systems based application
CO 5	Develop smart applications using IoT
CO 6	Develop IoT applications based on cloud environment
310248: Laboratory Practice I • Human Computer Interface	
CO 4	Implement the interactive designs for feasible data search and retrieval
CO 5	Analyze the scope of HCI in various paradigms like ubiquitous computing, virtual reality, multi-media, World wide web related environments
CO 6	Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems
310248: Laboratory Practice I • Distributed Systems	
CO 4	Demonstrate knowledge of the core concepts and techniques in Distributed Systems
CO 5	Apply the principles of state-of-the-Art Distributed Systems in real time applications
CO 6	Design, build and test application programs on Distributed Systems
310248: Laboratory Practice I • Software Project Management	
CO 4	Apply Software Project Management tools
CO 5	Implement software project planning and scheduling
CO 6	Analyse staffing in software project
310249: Seminar and Technical Communication	
CO 1	Analyze a latest topic of professional interest
CO 2	Enhance technical writing skills
CO 3	Identify an engineering problem, analyze it and propose a work plan to solve it
CO 4	Communicate with professional technical presentation skills
310250: Audit Course 5 AC5-I: Cyber Security	
CO 1	Understand and classify various cybercrimes
CO 2	Understand how criminals plan for the cybercrimes
CO 3	Apply tools and methods used in cybercrime
CO 4	Analyze the examples of few case studies of cybercrimes
310250: Audit Course 5 AC5-II: Professional Ethics and Etiquettes	
CO 1	Summarize the principles of proper courtesy as they are practiced in the workplace
CO 2	Apply proper courtesy in different professional situations
CO 3	Practice and apply appropriate etiquettes in the working environment and day to day life
CO 4	Build proper practices personal and business communications of Ethics and Etiquettes
310250: Audit Course 5 AC5-III: MOOC- Learn New Skills (Full stack Developer)	
CO 1	Design and develop web application using frontend and backend technologies.
CO 2	Design and develop dynamic and scalable web applications
CO 3	Develop server side scripts
CO 4	Design and develop projects applying various database techniques
310250: Audit Course 5 AC5-IV: Engineering Economics	
CO 1	Understand economics, the cost money and management in engineering
CO 2	Analyze business economics and engineering assets evaluation
CO 3	Evaluate project cost and its elements for business
CO 4	Develop financial statements and make business decisions
310250: Audit Course 5 AC5-V: Foreign Language (Japanese) Module 3	
CO 1	Apply language to communicate confidently and clearly in the Japanese language
CO 2	Understand and use Japanese script to read and write
CO 3	Apply knowledge for next advance level reading, writing and listening skills
CO 4	Develop interest to pursue further study, work and leisure
310251: Data Science and Big Data Analytics	
CO 1	Analyze needs and challenges for Data Science Big Data Analytics
CO 2	Apply statistics for Big Data Analytics
CO 3	Apply the lifecycle of Big Data analytics to real world problems
CO 4	Implement Big Data Analytics using Python programming
CO 5	Implement data visualization using visualization tools in Python programming
CO 6	Design and implement Big Databases using the Hadoop ecosystem

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310252: Web Technology	
CO 1	Implement and analyze behavior of web pages using HTML and CSS
CO 2	Apply the client side technologies for web development
CO 3	Analyze the concepts of Servlet and JSP
CO 4	Analyze the Web services and frameworks
CO 5	Apply the server side technologies for web development
CO 6	Create the effective web applications for business functionalities using latest web development platforms
310253: Artificial Intelligence	
CO 1	Identify and apply suitable Intelligent agents for various AI applications
CO 2	Build smart system using different informed search / uninformed search or heuristic approaches
CO 3	Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem
CO 4	Apply the suitable algorithms to solve AI problems
CO 5	Implement ideas underlying modern logical inference systems
CO 6	Represent complex problems with expressive yet carefully constrained language of representation
Elective II 310254(A): Information Security	
CO 1	Model the cyber security threats and apply formal procedures to defend the attacks
CO 2	Apply appropriate cryptographic techniques by learning symmetric and asymmetric key cryptography
CO 3	Design and analyze web security solutions by deploying various cryptographic techniques along with data integrity algorithms
CO 4	Identify and Evaluate Information Security threats and vulnerabilities in Information systems and apply security measures to real time scenarios
CO 5	Demonstrate the use of standards and cyber laws to enhance Information Security in the development process and infrastructure protection
Elective II 310254(B): Augmented and Virtual Reality	
CO 1	Understand the basics of Augmented and Virtual reality systems and list their applications
CO 2	Describe interface to the Virtual World with the help of input and output devices
CO 3	Explain representation and rendering system in the context of Virtual Reality
CO 4	Analyze manipulation, navigation and interaction of elements in the virtual world
CO 5	Summarize the basic concepts and hardware of Augmented Reality system
CO 6	Create Mobile Augmented Reality using Augmented Reality techniques and software
Elective II 310254(C): Cloud Computing	
CO 1	Understand the different Cloud Computing environment
CO 2	Use appropriate data storage technique on Cloud, based on Cloud application
CO 3	Analyze virtualization technology and install virtualization software
CO 4	Develop and deploy applications on Cloud
CO 5	Apply security in cloud applications
CO 6	Use advance techniques in Cloud Computing
Elective II 310254(D): Software Modelling and Architecture	
CO 1	Analyze the problem statement (SRS) and choose proper design technique for designing web-based/ desktop application
CO 2	Design and analyze an application using UML modeling as fundamental tool
CO 3	Evaluate software architectures
CO 4	Use appropriate architectural styles and software design patterns
CO 5	Apply appropriate modern tool for designing and modeling
310255: Internship	
CO 1	To demonstrate professional competence through industry internship.
CO 2	To apply knowledge gained through internships to complete academic activities in a professional manner.
CO 3	To choose appropriate technology and tools to solve given problem.
CO 4	To demonstrate abilities of a responsible professional and use ethical practices in day to day life.
CO 5	Creating network and social circle, and developing relationships with industry people.
CO 6	To analyze various career opportunities and decide carrier goals.
310256: Data Science and Big Data Analytics Laboratory	
CO 1	Apply principles of Data Science for the analysis of real time problems
CO 2	Implement data representation using statistical methods
CO 3	Implement and evaluate data analytics algorithms
CO 4	Perform text preprocessing
CO 5	Implement data visualization techniques
CO 6	Use cutting edge tools and technologies to analyze Big Data
310257: Web Technology Laboratory	
CO 1	Understand the importance of website planning and website design issues
CO 2	Apply the client side and server side technologies for web application development
CO 3	Analyze the web technology languages, frameworks and services
CO 4	Create three tier web based applications
310258: Laboratory Practice II • Artificial Intelligence	
CO 1	Design system using different informed search / uninformed search or heuristic approaches
CO 2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning
CO 3	Design and develop an expert system
310258: Laboratory Practice II • Information Security	
CO 4	Use tools and techniques in the area of Information Security

CO 5	Use the knowledge of security for problem solving
CO 6	Apply the concepts of Information Security to design and develop applications
310258: Laboratory Practice II • Augmented and Virtual Reality	
CO 4	Use tools and techniques in the area of Augmented and Virtual Reality
CO 5	Use the knowledge of Augmented and Virtual Reality for problem solving
CO 6	Apply the concepts of Augmented and Virtual Reality to design and develop applications
310258: Laboratory Practice II • Cloud Computing	
CO 4	Use tools and techniques in the area of Cloud Computing
CO 5	Use the knowledge of Cloud Computing for problem solving
CO 6	Apply the concepts Cloud Computing to design and develop applications
310258: Laboratory Practice II • Software Modeling and Architectures	
CO 4	Use tools and techniques in the area Software Modeling and Architectures
CO 5	Use the knowledge of Software Modeling and Architectures for problem solving
CO 6	Apply the concepts Software Modeling and Architectures to design and develop applications
310259: Audit Course 6 AC6-I Digital and Social Media Marketing	
CO 1	Understand the fundamentals and importance of digital marketing
CO 2	Use the power of social media for business marketing
CO 3	Analyze the effectiveness of digital marketing and social media over traditional process
310259: Audit Course 6 AC6-II Sustainable Energy Systems	
CO 1	Comprehend the importance of Sustainable Energy Systems
CO 2	Correlate the human population growth and its trend to the natural resource degradation and develop the awareness about his/her role towards Sustainable Energy Systems protection
CO 3	Identify different types of natural resource pollution and control measures
CO 4	Correlate the exploitation and utilization of conventional and non-conventional resources
310259: Audit Course 6 AC6-III Leadership and Personality Development	
CO 1	Express effectively through communication and improve listening skills
CO 2	Develop **e**ffective team leadership abilities.
CO 3	Explore self-motivation and practicing creative/new age thinking.
CO 4	Operate effectively in heterogeneous teams through the knowledge of team work, people skills and leadership qualities.
310259: Audit Course 6 AC6-IV: Foreign Language (Japanese) Module 4	
CO 1	Have the ability to communicate confidently and clearly in the Japanese language
CO 2	Understand the nature of Japanese script
CO 3	Get introduced to reading, writing and listening skills
CO 4	Develop interest to pursue further study, work and leisure
310259: Audit Course 6 AC6-V: MOOC- Learn New Skills	
CO 1	Illustrate the agility and principles
CO 2	Understand the software development using agile methodology
CO 3	Apply DevOps for the software product development
CO 4	Develop software products for early delivery through continual feedback and learning
410241: Design and Analysis of Algorithms	
CO 1	**Formulate** the problem
CO 2	**Analyze** the asymptotic performance of algorithms
CO 3	Decide and **apply** algorithmic strategies to solve given problem
CO 4	**Find** optimal solution by applying various methods
CO 5	**Analyze** and **Apply** Scheduling and Sorting Algorithms.
CO 6	**Solve** problems for multi-core or distributed or concurrent environments
410242: Machine Learning	
CO 1	Identify the needs and challenges of machine learning for real time applications.
CO 2	Apply various data pre-processing techniques to simplify and speed up machine learning algorithms.
CO 3	Select and apply appropriately supervised machine learning algorithms for real timeapplications.
CO 4	Implement variants of multi-class classifier and measure its performance.
CO 5	Compare and contrast different clustering algorithms.
CO 6	Design a neural network for solving engineering problems
410243: Blockchain Technology	
CO 1	Interpret the fundamentals and basic concepts in Blockchain
CO 2	Compare the working of different blockchain platforms
CO 3	Use Crypto wallet for cryptocurrency based transactions
CO 4	Analyze the importance of blockchain in finding the solution to the real-world problems.
CO 5	Illustrate the Ethereum public block chain platform
CO 6	Identify relative application where block chain technology can be effectively used andimplemented.
Elective III 410244(A): Pervasive Computing	
CO 1	Demonstrate fundamental concepts in pervasive computing.
CO 2	Explain pervasive devices and decide appropriate one as per the need of real timeapplications.
CO 3	Classify and analyze context aware systems for their efficiency in different ICT systems.
CO 4	Illustrate intelligent systems and generic intelligent interactive applications.
CO 5	Design HCI systems in pervasive computing environment.
CO 6	Explore the security challenges and know the role of ethics in the context of pervasivecomputing.
Elective III 410244(B): Multimedia Techniques	
CO 1	Describe the media and supporting devices commonly associated with multimedia information andsystems.
CO 2	Demonstrate the use of content-based information analysis in a multimedia information system.

CO 3	Critique multimedia presentations in terms of their appropriate use of audio, video, graphics, color,and other information presentation concepts.
CO 4	Implement a multimedia application using an authoring system.
CO 5	Understanding of technologies for tracking, navigation and gestural control.
CO 6	Implement Multimedia Internet of Things Architectures.
Elective III 410244(C): Cyber Security and Digital Forensics	
CO 1	Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
CO 2	Build appropriate security solutions against cyber-attacks.
CO 3	Underline the need of digital forensic and role of digital evidences.
CO 4	Explain rules and types of evidence collection
CO 5	Analyze, validate and process crime scenes
CO 6	Identify the methods to generate legal evidence and supporting investigation reports.
Elective III 410244(D): Object oriented Modeling and Design	
CO 1	Describe the concepts of object-oriented and basic class modelling.
CO 2	Draw class diagrams, sequence diagrams and interaction diagrams to solve problems.
CO 3	Choose and apply a befitting design pattern for the given problem
CO 4	To Analyze applications, architectural Styles & software control strategies
CO 5	To develop Class design Models & choose Legacy Systems.
CO 6	To Understand Design Patterns
Elective III 410244(E): Digital Signal Processing	
CO 1	Understand the mathematical models and representations of DT Signals and Systems
CO 2	Apply different transforms like Fourier and Z-Transform from applications point of view.
CO 3	Understand the design and implementation of DT systems as DT filters with filter structuresand different transforms.
CO 4	Demonstrate the knowledge of signals and systems for design and analysis of systems
CO 5	Apply knowledge and use the signal transforms for digital processing applications
CO 6	To understand Filtering and Different Filter Structures
Elective IV 410245(A): Information Retrieval	
CO 1	Implement the concept of Information Retrieval
CO 2	Generate quality information out of retrieved information
CO 3	Apply techniques such as classification, clustering, and filtering over multimedia to analyzethe information
CO 4	Evaluate and analyze retrieved information
CO 5	Understand the data in various Application and Extensions of information retrieval
CO 6	Understand Parallel information retrieving and web structure.
Elective IV 410245(B): GPU Programming and Architecture	
CO 1	Describe GPU architecture
CO 2	Write programs using CUDA, identify issues and debug them.
CO 3	Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication
CO 4	Write simple programs using OpenCL
CO 5	Identify efficient parallel programming patterns to solve problems
CO 6	Explore the modern GPUs architecture and it‘s Applications.
Elective IV 410245(C): Mobile Computing	
CO 1	Develop a strong grounding in the fundamentals of mobile Networks
CO 2	Apply knowledge in MAC, Network, and Transport Layer protocols ofWireless Network
CO 3	Illustrate Global System for Mobile Communications
CO 4	Use the 3G/4G technology based network with bandwidth capacity planning,VLR and HLR identification algorithms
CO 5	Classify network and transport layer of mobile communication
CO 6	Design & development of various wireless network protocols using simulationtools
Elective IV 410245 (D): Software Testing and Quality Assurance	
CO 1	**Describe** fundamental concepts in software testing such as manual testing, automation testingand software quality assurance.
CO 2	**Design and Develop** project test plan, design test cases, test data, and conduct test operations.
CO 3	**Apply** recent automation tool for various software testing for testing software.
CO 4	**Apply** different approaches of quality management, assurance, and quality standard to softwaresystem.
CO 5	**Apply** and analyze effectiveness Software Quality Tools.
CO 6	**Apply** tools necessary for efficient testing framework.
Elective IV 410245(E): Compilers	
CO 1	**Design** and **implement** a lexical analyzer using LEX tools
CO 2	Design and implement a syntax analyzer using YACC tools
CO 3	**Understand** syntax-directed translation and run-time environment
CO 4	Generate intermediate codes for high-level statements.
CO 5	**Construct** algorithms to produce computer code.
CO 6	**Analyze and transform** programs to improve their time and memory efficiency
410246: Laboratory Practice III	
CO 1	Apply preprocessing techniques on datasets.
CO 2	Implement and evaluate linear regression and random forest regression models.
CO 3	Apply and evaluate classification and clustering techniques.
CO 4	Analyze performance of an algorithm.
CO 5	Implement an algorithm that follows one of the following algorithm design strategies: divide and conquer, greedy, dynamic programming, backtracking, branch and bound.
CO 6	Interpret the basic concepts in Blockchain technology and its applications

410247:Laboratory Practice IV	
CO 1	Apply android application development for solving real life problems
CO 2	Design and develop system using various multimedia components.
CO 3	Identify various vulnerabilities and demonstrate using various tools.
CO 4	Apply information retrieval tools for natural language processing
CO 5	Develop an application using open source GPU programming languages
CO 6	Apply software testing tools to perform automated testing
410248: Project Work Stage I	
CO 1	Solve real life problems by applying knowledge.
CO 2	Analyze alternative approaches, apply and use most appropriate one for feasible solution.
CO 3	Write precise reports and technical documents in a nutshell.
CO 4	Participate effectively in multi-disciplinary and heterogeneous teams exhibiting team work
CO 5	Inter-personal relationships, conflict management and leadership quality.
410249: Audit Course 7 AC7 – I: MOOC-learn New Skill	
CO 1	To acquire additional knowledge and skill.
410249: Audit Course 7 AC7 – II: Entrepreneurship Development	
CO 1	Understand the legalities in product development
CO 2	Undertake the process of IPR, Trademarks, Copyright and patenting
CO 3	Understand and apply functional plans
CO 4	Manage Entrepreneurial Finance
CO 5	Inculcate managerial skill as an entrepreneur
410249: Audit Course 7 AC7 – III: Botnet of Things	
CO 1	Implement security as a culture and show mistakes that make applications vulnerable to attacks.
CO 2	Understand various attacks like DoS, buffer overflow, web specific, database specific, web spoofing attacks.
CO 3	Demonstrate skills needed to deal with common programming errors that lead to most securityproblems and to learn how to develop secure applications
410249: Audit Course 7 AC7 – IV: 3D Printing	
CO 1	Understand the basic knowledge of Shop Floor Safety rules and regulations basics of Machinetools and 3D printing machines
CO 2	Understand the concept of concept of technical sketching, multi-view drawings, Lettering,tolerance, and metric construction
CO 3	Identify and Distinguish drafting terminologies and construction of geometrical figures using drawing instruments, procedure to prepare a drawing sheet as per SP-46:2003
CO 4	Describe and Explain practical aspects to generate detailed and assembly views with dimensions,annotations, in 3D Modeling software.
CO 5	**Apply** concepts and **Fabricate** the simple mechanical parts, prototype/ end use product for 3D Printing
410249: Audit Course 7 AC7 – V: Industrial Safety and Environment Consciousness	
CO 1	Develop the plan for Safety performance
CO 2	Demonstrate the action plan for accidents and hazards
CO 3	Apply the safety and security norms in the industry
CO 4	Evaluate the environmental issues of Industrialization
410250: High Performance Computing	
CO 1	Understand various Parallel Paradigm
CO 2	Design and Develop an efficient parallel algorithm to solve given problem
CO 3	Illustrate data communication operations on various parallel architecture
CO 4	Analyze and measure performance of modern parallel computing systems
CO 5	Apply CUDA architecture for parallel programming
CO 6	Analyze the performance of HPC applications
410251: Deep Learning	
CO 1	Understand the basics of Deep Learning and apply the tools to implement deep learningapplications
CO 2	Evaluate the performance of deep learning models (e.g., with respect to the bias-variance trade- off, overfitting and underfitting, estimation of test error).
CO 3	To apply the technique of Convolution (CNN) and Recurrent Neural Network (RNN) forimplementing Deep Learning models
CO 4	To implement and apply deep generative models.
CO 5	Construct and apply on-policy reinforcement learning algorithms
CO 6	To Understand Reinforcement Learning Process
Elective V 410252(A): Natural Language Processing	
CO 1	Describe the fundamental concepts of NLP, challenges and issues in NLP
CO 2	Analyze Natural languages morphologically, syntactical and semantically OR Describe the concepts of morphology, syntax, semantics of natural language
CO 3	Illustrate various language modelling techniques
CO 4	Integrate the NLP techniques for the information retrieval task
CO 5	Demonstrate the use of NLP tools and techniques for text-based processing of natural languages
CO 6	Develop real world NLP applications
Elective V 410252 (B): Image Processing	
CO 1	Apply Relevant Mathematics Required for Digital Image Processing.
CO 2	Apply Special and Frequency Domain Method for Image Enhancement.
CO 3	Apply algorithmic approaches for Image segmentation.
CO 4	Summarize the Concept of Image Compression and Object Recognition.

CO 5	Explore the Image Restoration Techniques.
CO 6	Explore the Medical and Satellite Image Processing Applications.
Elective V 410252(C): Software Defined Networks	
CO 1	Interpret the need of Software Defined networking solutions.
CO 2	Analyze different methodologies for sustainable Software Defined Networkingsolutions.
CO 3	Select best practices for design, deploy and troubleshoot of next generation networks.
CO 4	Develop programmability of network elements.
CO 5	Demonstrate virtualization and SDN Controllers using Open Flow protocol
CO 6	Design and develop various applications of SDN
Elective V 410252(D): Advanced Digital Signal Processing	
CO 1	Understand and apply different transforms for the design of DT/Digital systems
CO 2	Explore the knowledge of adaptive filtering and Multi-rate DSP
CO 3	Design DT systems in the field/area of adaptive filtering, spectral estimation and multi-rateDSP
CO 4	Explore use of DCT and WT in speech and image processing
CO 5	Develop algorithms in the field of speech , image processing and other DSP applications
CO 6	Identify Image Processing Techniques
Elective VI 410253(A): Pattern Recognition	
CO 1	Analyze various type of pattern recognition techniques
CO 2	Identify and apply various pattern recognition and classification approaches to solvethe problems
CO 3	Evaluate statistical and structural pattern recognition
CO 4	Percept recent advances in pattern recognition confined to various applications
CO 5	Implement Bellman‘s optimality principle and dynamic programming
CO 6	Analyze Patterns using Genetic Algorithms & Pattern recognition applications.
Elective VI 410253(B): Soft Computing	
CO 1	Understand requirement of soft computing and be aware of various soft computing techniques.
CO 2	Understand Artificial Neural Network and its characteristics and implement ANN algorithms.
CO 3	Understand and Implement Evolutionary Computing Techniques.
CO 4	Understand the Fuzzy logic and Implement fuzzy algorithms for solving real life problems.
CO 5	Apply knowledge of Genetic algorithms for problem solving.
CO 6	Develop hybrid systems for problem solving.
Elective VI 410253(C): Business Intelligence	
CO 1	Differentiate the concepts of Decision Support System & Business Intelligence
CO 2	Use Data Warehouse & Business Architecture to design a BI system.
CO 3	Build graphical reports
CO 4	Apply different data preprocessing techniques on dataset
CO 5	Implement machine learning algorithms as per business needs
CO 6	Identify role of BI in marketing, logistics, and finance and telecommunication sector
Elective VI 410253(D): Quantum Computing	
CO 1	To understand the concepts of Quantum Computing
CO 2	To understand and get exposure to mathematical foundation and quantum mechanics
CO 3	To understand and implement buiding blocks of Quantum circuits
CO 4	To understand quantum information, its processing and Simulation tools
CO 5	To understand basic signal processing algorithms FT, DFT and FFT
CO 6	To study and solve examples of Quantum Fourier Transforms and their applications
410255: Laboratory Practice V	
CO 1	Analyze and measure performance of sequential and parallel algorithms.
CO 2	Design and Implement solutions for multicore/Distributed/parallel environment.
CO 3	Identify and apply the suitable algorithms to solve AI/ML problems.
CO 4	Apply the technique of Deep Neural network for implementing Linear regression andclassification.
CO 5	Apply the technique of Convolution (CNN) for implementing Deep Learning models.
CO 6	Design and develop Recurrent Neural Network (RNN) for prediction.
410256: Laboratory Practice VI	
CO 1	Apply basic principles of elective subjects to problem solving and modeling.
CO 2	Use tools and techniques in the area of software development to build mini projects
CO 3	Design and develop applications on subjects of their choice.
CO 4	Generate and manage deployment, administration & security.
410256: Project Work Stage II	
CO 1	Show evidence of independent investigation
CO 2	Critically analyze the results and their interpretation.
CO 3	Report and present the original results in an orderly way and placing the open questions in the rightperspective.
CO 4	Link techniques and results from literature as well as actual research and future research lines withthe research.
CO 5	Appreciate practical implications and constraints of the specialist subject
410257: Audit Course 8 AC8 – I: Usability Engineering	
CO 1	Describe the human centered design process and usability engineering process and theirroles in system design and development.
CO 2	Discuss usability design guidelines, their foundations, assumptions, advantages, andweaknesses.
CO 3	Design a user interface based on analysis of human needs and prepare a prototype system.
CO 4	Assess user interfaces using different usability engineering techniques.
CO 5	Present the design decisions
	410257: Audit Course 8 AC8 – II: Conversational Interfaces

CO 1	Develop an effective interface for conversation
CO 2	Explore advanced concepts in user interface
410257: Audit Course 8 AC8–III: Social Media And Analytics	
CO 1	Develop a far deeper understanding of the changing digital land scape.
CO 2	Identify some of the latest digital marketing trends and skill sets needed for today's marketer.
CO 3	Successful planning, prediction, and management of digital marketing campaigns
CO 4	Assessuserinterfacesusingdifferentusabilityengineeringtechniques.
CO 5	Implement smart management of different digital assets for marketing needs.
CO 6	Assess digital marketing as a long term career opportunity.
410257: Audit Course 8 AC8 – IV: MOOC-learn New Skill	
CO 1	To acquire additional knowledge and skill.
410257: Audit Course 8 AC8 – V: Emotional Intelligence	
CO 1	Expand your knowledge of emotional patterns in yourself and others
CO 2	Discover how you can manage your emotions, and positively influence yourself and others
CO 3	Build more effective relationships with people at work and at home
CO 4	Positively influence and motivate colleagues, team members, managers
CO 5	Increase the leadership effectiveness by creating an atmosphere that engages others