Teerthanker Mahaveer University
College of Computing Sciences & IT

B.Tech. (Computer Sciences and Engineering)
Data Science (In collaboration with TCS-iON)

Programme Outcome

PO-1	**:**	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO-2	**:**	Problem analysis& Solving: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO-3	**:**	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO-4	**:**	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO-5	**:**	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO-6	**:**	Social Interaction & effective citizenship: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO-7	**:**	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO-8	**:**	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO-9	**:**	Attitude (Individual and team work): Function effectively as an individual, and as member or leader in diverse teams, and in multidisciplinary settings.
PO-10	**:**	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clean instructions.
PO-11	**:**	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO-12	**:**	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcome

PSO-1	**:**	Understanding the knowledge of basic sciences, humanities and technical management courses of the program. Able to solve engineering problems of real time projects in the field of computer science and information technology.
PSO-2	**:**	Understanding the phases of software project development life cycle and various roles.
PSO-3	**:**	Applying hardware and software skills pertinent to practices in the field of computer science and information technology while acquiring mathematical foundations, algorithmic principles along with proper judgment through projects and industrial interactions.
PSO-4	**:**	Analyzing the various storage structures of data on different platforms along with security issues.
PSO-5	**:**	Developing skills of practical competency with emerging technologies, programming languages and open source platforms.

Course Outcomes

EAS116	**CO-1**	Understanding the concepts of eigenvalues and eigenvectors, Optimization & derivatives of functions of several variables, partial and total differentiation, implicit functions
	CO-2	Understanding the concepts of curl and divergence of vector field.
	CO-3	Understanding of Green‟s theorem, Gauss Theorem, and Stokes theorem.
	CO-4	Applying the concept of Leibnitz‟s theorem for successive derivatives.
	CO-5	Analyzing the intangibility of a differential equation to find the optimal solution of first order first degree equations.
	CO-6	Evaluating the double integration and triple integration using Cartesian, polar co-ordinates and the concept of Jacobian of transformation.
EAS112	**CO-1**	Understanding the basic concepts of interference, diffraction and polarisation.
	CO-2	Understanding the concept of bonding in solids and semiconductors.
	CO-3	Understanding the special theory of relativity.
	CO-4	Applying special theory of relativity to explain the phenomenon of length contraction, time dilation, mass-energy equivalence etc.
	CO-5	Applying the concepts of polarized light by the Brewster‟s and Malus Law
EAS113	**CO-1**	Understanding the concept of softening & purification of water.
	CO-2	Understanding calorific value& combustion, analysis of coal, Physical & Chemical properties of hydrocarbons & quality improvements.
	CO-3	Understanding the concept of lubrication, Properties of Refractory & Manufacturing of cements.
	CO-4	Applying the concepts of the mechanism of polymerization reactions, Natural and synthetic rubber& vulcanization.
	CO-5	Applying the concepts of spectroscopic & chromatographic techniques
EEE117	**CO-1**	Understanding the basics of Network, AC Waveform and its characteristics.
	CO-2	Understanding the basic concept of Measuring Instruments, Transformers

		& three phase Power systems.
	CO-3	Understanding the basic concepts of Transformer.
	CO-4	Understanding the basic concept of power measurement using two wattmeter methods.
	CO-5	Applying the concept of Kirchhoff‟s laws and Network Theorems to analyze complex electrical circuits.
EEC111	**CO-1**	Understanding the concepts of electronic components like diode, BJT & FET.
	CO-2	Understanding the applications of pn junction diode as clipper, clamper, rectifier & regulator whereas BJT & FET as amplifiers
	CO-3	Understanding the functions and applications of operational amplifier-based circuits such as differentiator, integrator, and inverting, non-inverting, summing & differential amplifier.
	CO-4	Understanding the concepts of number system, Boolean algebra and logic gates
	CO-5	Applying the knowledge of series, parallel and electromagnetic circuits.
TMU101	**CO-1**	Understanding environmental problems arising due to constructional and developmental activities.
	CO-2	Understanding the natural resources and suitable methods for conservation of resources for sustainable development.
	CO-3	Understanding the importance of ecosystem and biodiversity and its conservation for maintaining ecological balance.
	CO-4	Understanding the types and adverse effects of various environmental pollutants and their abatement devices.
	CO-5	Understanding Greenhouse effect, various Environmental laws, impact of human population explosion, environment protection movements, different disasters and their management.
TMUGE101	**CO-1**	Remembering and understanding of the basic of English grammar and vocabulary.
	CO-2	Understanding of the basic Communication process.
	CO-3	Applying correct vocabulary and tenses in sentences construction.
	CO-4	Analyzing communication needs and developing communication strategies using both verbal & non-verbal method.
	CO-5	Drafting applications in correct format for common issues.
	CO-6	Developing self-confidence.
EAS162	**CO-1**	Understanding of the operation of various model of optical devices.
	CO-2	Understanding types of Semiconductors using Hall experiments.
	CO-3	Applying the concept of interference, polarization & dispersion in optical devices through Newton’s ring, Laser, polarimeter& spectrometer.
	CO-4	Applying the concept of resonance to determine the AC frequency using sonometer & Melde’s apparatus.
	CO-5	Applying the concept of resolving & dispersive power by a prism.
EAS163	**CO-1**	Understanding the concepts of Hardness of water.
	CO-2	Analyzing & estimating of various parameters of water
	CO-3	Analyzing of Calorific value of Solid fuel by Bomb calorimeter & Liquid Fuels by Junkers Gas Calorimeter.
	CO-4	Analyzing of open & closed Flash point of oil by Cleveland & Pensky’s

		Martens apparatus.
	CO-5	Analyzing of viscosity of lubricating oil using Redwood Viscometer.
EEE161	**CO-1**	Understanding the concepts of Kirchoff & Voltage law.
	CO-2	Understanding the concepts of Thevenin & Norton theorem.
	CO-3	Analyzing the energy by a single-phase energy meter.
	CO-4	Analyzing the losses and efficiency of Transformer on different load conditions.
	CO-5	Analyzing the electrical circuits using electrical and electronics components on bread board.
EEC161	**CO-1**	Understanding the implementation of diode-based circuits.
	CO-2	Understanding the implementation of Operational amplifier-based circuits.
	CO-3	Analyzing the characteristics of pn junction diode & BJT.
	CO-4	Analyzing the different parameters for characterizing different circuits like rectifiers, regulators using diodes and BJTs.
	CO-5	Analyzing the truth tables through the different type's adders.
EME161	**CO-1**	Understanding the concepts of Engineering Drawing.
	CO-2	Understanding how to draw and represent the shape, size & specifications of physical objects.
	CO-3	Applying the principles of projection and sectioning.
	CO-4	Applying the concepts of development of the lateral surface of a given object.
	CO-5	Creating isometric projection of the given orthographic projection.
EME162	**CO-1**	Understanding the concepts to prepare simple wooden joints using wood working tools.
	CO-2	Applying the techniques to produce fitting jobs of specified dimensions.
	CO-3	Applying the concepts to prepare simple lap, butt, T and corner joints using arc welding equipment.
	CO-4	Applying the concepts of black smithy and lathe machine to produce different jobs.
	CO-5	Creating core and moulds for casting.
EAS211	**CO-1**	Understanding the concepts of the wave, diffusion and Laplace equations & Fourier series.
	CO-2	Understanding the methods of separation of variables
	CO-3	Understanding the concepts of Fourier series' representation of single variable function.
	CO-4	Applying Laplace transform to determine the complete solutions of linear ODE
	CO-5	Applying the method of variations of parameters to find solution of equations with variable coefficients.
EAS212	**CO-1**	Understanding the basic concepts of interference, diffraction and polarisation.
	CO-2	Understanding the concept of bonding in solids and semiconductors.
	CO-3	Understanding the special theory of relativity.
	CO-4	Applying special theory of relativity to explain the phenomenon of length contraction, time dilation, mass-energy equivalence etc.
	CO-5	Applying the concepts of polarized light by the Brewster's and Malus Law

EAS213	**CO-1**	Understanding the concept of softening & purification of water.
	CO-2	Understanding calorific value& combustion, analysis of coal, Physical & Chemical properties of hydrocarbons & quality improvements.
	CO-3	Understanding the concept of lubrication, Properties of Refractory & Manufacturing of cements.
	CO-4	Applying the concepts of the mechanism of polymerization reactions, Natural and synthetic rubber& vulcanization.
	CO-5	Applying the concepts of spectroscopic & chromatographic techniques.
EEE217	**CO-1**	Understanding the basics of Network, AC Waveform and its characteristics.
	CO-2	Understanding the basic concept of Measuring Instruments, Transformers & three phase Power systems.
	CO-3	Understanding the basic concepts of Transformer.
	CO-4	Understanding the basic concept of power measurement using two wattmeter methods.
	CO-5	Applying the concept of Kirchhoff's laws and Network Theorems to analyze complex electrical circuits
EEC211	**CO-1**	Understanding the concepts of electronic components like diode, BJT & FET.
	CO-2	Understanding the applications of pn junction diode as clipper, clamper, rectifier & regulator whereas BJT & FET as amplifiers
	CO-3	Understanding the functions and applications of operational amplifier-based circuits such as differentiator, integrator, and inverting, non-inverting, summing & differential amplifier.
	CO-4	Understanding the concepts of number system, Boolean algebra and logic gates.
	CO-5	Applying the knowledge of series, parallel and electromagnetic circuits.
ECS201	**CO-1**	Understanding the concept of various components of computer system
	CO-2	Understanding the basic programming Language constructs.
	CO-3	Analyzing basic mathematical problem and their solutions through programming
	CO-4	Applying knowledge to prepare programming solutions for distinct problems.
	CO-5	Applying knowledge to prepare scalable solutions through functions.
TMUGE201	**CO-1**	Remembering & understanding the basics of English Grammar and Vocabulary
	CO-2	Understanding the basics of Listening, Speaking & Writing Skills, Understanding principles of letter drafting and various types of formats.
	CO-3	Applying correct vocabulary and grammar in sentence construction while writing and delivering presentations
	CO-4	Analyzing different types of listening, role of Audience & Locale in presentation
	CO-6	Creating Official Letters, E-Mail & Paragraphs in correct format.
EAS262	**CO-1**	Understanding of the operation of various models of optical devices.
	CO-2	Understanding types of Semiconductors using Hall experiments.
	CO-3	Applying the concept of interference, polarization & dispersion in optical devices through Newton's ring, Laser, polarimeter & spectrometer.

	CO-4	Applying the concept of resonance to determine the AC frequency using sonometer & Melde's apparatus.
	CO-5	Applying the concept of resolving & dispersive power by a prism.
EAS263	**CO-1**	Understanding the concepts of Hardness of water.
	CO-2	Analyzing & estimating of various parameters of water.
	CO-3	Analyzing of Calorific value of Solid fuel by Bomb calorimeter & Liquid Fuels by Junkers Gas Calorimeter.
	CO-4	Analyzing of open & closed Flash point of oil by Cleveland & Pensky's Martens apparatus.
	CO-5	Analyzing of viscosity of lubricating oil using Redwood Viscometer.
EEE261	**CO-1**	Understanding the concepts of Kirchoff & Voltage law.
	CO-2	Understanding the concepts of Thevenin & Norton theorem.
	CO-3	Analyzing the energy by a single-phase energy meter.
	CO-4	Analyzing the losses and efficiency of Transformer on different load conditions.
	CO-5	Analyzing the electrical circuits using electrical and electronics components on bread board.
EEC261	**CO-1**	Understanding the implementation of diode-based circuits.
	CO-2	Understanding the implementation of Operational amplifier-based circuits.
	CO-3	Analyzing the characteristics of pn junction diode & BJT.
	CO-4	Analyzing the different parameters for characterizing different circuits like rectifiers, regulators using diodes and BJTs.
	CO-5	Analyzing the truth tables through the different type's adders.
ECS251	**CO-1**	Analyzing basic mathematical problem and their solutions through programming
	CO-2	Applying knowledge to prepare programming solutions for specific problems.
	CO-3	Applying knowledge to prepare scalable solutions through function
	CO-4	Applying the concepts of programming solutions for distinct problems
	CO-5	Applying the concepts of scalable solutions through function
EME261	**CO-1**	Understanding the concepts of Engineering Drawing.
	CO-2	Understanding how to draw and represent the shape, size & specifications of physical objects.
	CO-3	Applying the principles of projection and sectioning.
	CO-4	Applying the concepts of development of the lateral surface of a given object.
	CO-5	Creating isometric projection of the given orthographic projection.
EME262	**CO-1**	Understanding the concepts to prepare simple wooden joints using wood working tools.
	CO-2	Applying the techniques to produce fitting jobs of specified dimensions.
	CO-3	Applying the concepts to prepare simple lap, butt, T and corner joints using arc welding equipment.
	CO-4	Applying the concepts of black smithy and lathe machine to produce different jobs.
	CO-5	Creating core and moulds for casting.
ECS305	**CO-1**	Understanding of different data structures and their usage.

	CO-2	Applying the understanding to solve basic operations on data structures.
	CO-3	Analyzing various approaches to solve different problems using data structures.
	CO-4	Analyzing various methods and the best solution as per running time of basic problems of programming.
	CO-5	Developing programming skills to solve problems with various storage structures.
ECS306	**CO-1**	Understanding the basics of data base systems, structure and architecture, data models and types.
	CO-2	Understanding different transaction processing concepts and different types of serialization techniques.
	CO-3	Understanding different database recovery like shadow paging, deferred/immediate updates and Concurrency control techniques
	CO-4	Applying integrity and constraints using SQL and PL/SQL.
	CO-5	Analyzing the anomalies of database and removal of these anomalies using different normalization techniques.
EECS302	**CO-1**	Understanding the basics of Number system, Boolean algebra and its applications in digital electronics.
	CO-2	Understanding different combinational and sequential circuits in digital electronics.
	CO-3	Understanding the organization of computer system and its components, memory hierarchy, I/O mechanism.
	CO-4	Applying the concepts to design various combinational and sequential circuits.
	CO-5	Analyzing the efficiency of various gates and flip-flops based upon their functionality.
EAS301	**CO-1**	Understanding the concepts of singularities, zeroes and poles, functions , relations, propositions, truth tables, logical equivalence and implications, converse, inverse, biconditional statements, negation of compound arguments, fallacies, quantifiers.
	CO-2	Applying the concept of power series, Taylor's and Laurent‟s series, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions, Residue theorem.
	CO-3	Applying the core mathematics concept to solve the problems.
	CO-4	Analyzing the method of least squares and curve fitting of straight line and parabola, solution of cubic and bi-quadratic equations, correlation and regression, Binomial distribution, Poisson distribution and Normal distribution.
	CO-5	Evaluating the real integral of the type , Line integral in the complex Plane.
EAS303	**CO-1**	Understanding the importance of value education in life and method of self-exploration.
	CO-2	Understanding „Natural Acceptance‟ and Experiential Validation- as the mechanism for self-exploration.
	CO-3	Applying right understanding about relationship and physical facilities.
	CO-4	Analyzing harmony in myself, harmony in the family and society, harmony in the nature and existence.

	CO-5	Evaluating human conduct on ethical basis.
ECS355	**CO-1**	Applying the concept of different data types and their usage using C++ Programs.
	CO-2	Applying the concept of recursion for problem solving.
	CO-3	Applying the programming constructs and their usage for problem solving.
	CO-4	Applying the understanding to solve basic operations searching, sorting, insertion, deletion on data structures.
	CO-5	Developing programming skills to solve problems with various storage structures like stack, queue, linked list and tree.
ECS356	**CO-1**	Understanding the concepts of DML operation to database table to complete different queries on database.
	CO-2	Applying the concepts of different DDL operations.
	CO-3	Applying the concepts of DCL operations like grant and revoke for administration purpose on a table.
	CO-4	Applying the concepts of PL/SQL for creating different triggers to develop event driven action in database.
	CO-5	Analyzing the concepts of PL/SQL for creating functions and procedure to apply DML on tables
EAI305	**CO-1**	Understanding of different control statements of python.
	CO-2	Understanding various data storage structure used in python like dictionary, List and Series.
	CO-3	Understanding the concept of network programming usage with python.
	CO-4	Applying various packages used in data science like numpy, pandas and scikit.
	CO-5	Analyzing the concept of exception handling concept.
TMUGE301	**CO-1**	Developing problem solving skills using python constructs
	CO-2	Understanding the art of public speaking and strategies of reading comprehension.
	CO-3	Applying correct vocabulary and sentence construction during public speaking or professional writing.
	CO-4	Aanalyzing different types of sentences like simple, compound and complex.
	CO-5	Creating skills for Drafting notice, agenda and minutes of the meeting.
TMUGA-301	**CO-1**	Solving complex problems using Criss cross method, base method and square techniques.
	CO-2	Applying the arithmetical concepts of Average, Mixture and Allegation.
	CO-3	Evaluating the different possibilities of various reasoning based problems in series, Blood relation and Direction.
	CO-4	Operationalizing the inter-related concept of Percentage in Profit Loss and Discount, Si/CI and Mixture/Allegation.
ECS401	**CO-1**	Understanding the fundamentals of Computational theory and basic terminology used.
	CO-2	Understanding basics of various machines used for computations like FSM, PDA, TM.
	CO-3	Understanding the grammar, language, formation of regular expression in FA, minimization of FA and CFG.

	CO-4	Applying the concepts to design various machines like FSM, PDA etc.
	CO-5	Analyzing the efficiency of various machines based upon their functionality and limitations.
EDS301	**CO-1**	Understanding the concepts of different collections - list, tuple, dictionaries and dataframes.
	CO-2	Applying the concepts to built functions in Python.
	CO-3	Applying the concept of database connectivity with python to perform some operations in database.
	CO-4	Applying the programming construct to perform various matrix operations.
EAI353	**CO-1**	Understanding the concepts of different collections - list, tuple, dictionaries and dataframes.
	CO-2	Applying the concepts to built functions in Python.
	CO-3	Applying the concept of database connectivity with python to perform some operations in database.
	CO-4	Applying the programming construct to perform various matrix operations.
	CO-5	Analyzing the concepts of packages in python and create own packages.
EAI452	**CO-1**	Understanding the role of PROLOG for implementation of solutions of AI problems
	CO-2	Understanding the architecture and evaluation scheme of PROLOG
	CO-3	Applying the PROLOG for solving trivial problems
	CO-4	Analyzing the solutions for Water Jug problem, Eight Puzzle problem, Monkey Banana problem using PROLOG
	CO-5	Analyzing the various knowledge representation structures.
ECS406	**CO-1**	Understanding the concepts and states of process, also evaluating the use of various scheduling algorithms and finding the suitability for their usage.
	CO-2	Understanding and Analyzing various issues in Inter Process Communication (IPC) and the role of OS in IPC, also understanding the various characteristics of deadlock and applying the learnt concepts and algorithm to avoid and recover from the deadlock.
	CO-3	Understanding the concepts and implementation of various Memory management policies and usage of the virtual memory.
	CO-4	Applying the basics of operating system along with the types and main functionalities of the operating system
	CO-5	Applying the file management policies and disk structure along with scheduling algorithm for applying it to solve the disk scheduling problems.
EAI503	**CO-1**	Understanding basic components of a Web Technology (Design And Architecture Using .NET).
	CO-2	Understanding various categories of programs, Web, Window and Console Application. Organize and work with many projects.
	CO-3	Applying skills and concepts to built small real life applications using Web Technology (Design And Architecture Using .NET) standards.
	CO-4	Analyzing the usage of the Web Technology (Design And Architecture Using .NET) programs to create professional, academic, business and many software projects.
	CO-5	Developing personal, academic and business documents by following the

		current professional and/or industry standards.
EAI504	**CO-1**	Understanding basic concept of machine learning, advantages and disadvantages, applications, learning algorithms: supervised learning, unsupervised learning, semi- supervised learning, reinforcement learning, decision trees, Hunt's algorithm for learning a decision tree.
	CO-2	Understanding concept of KNNs,SVMsand Naïve Bayes algorithms in text classification, decision boundary of KNN, feature selection using KNN, linear classifiers.
	CO-3	Understanding concept of ANN and regression, perceptron algorithm, decision boundary of single neuron, linear regression, logistic regression, and logistic regression for multi-class classification.
	CO-4	Applying concept of feature selection and feature extraction, filter based methods for feature selection, wrapper methods for features selection.
	CO-5	Applying concept of sequence labeling and clustering in classification, probabilistic sequence model, hidden markov model in classification, K-mean clustering, hierarchical clustering methods.
EHM505	**CO-1**	Understanding the importance of value education in life and method of self-exploration.
	CO-2	Understanding 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration.
	CO-3	Applying right understanding about relationship and physical facilities.
	CO-4	Analyzing harmony in myself, harmony in the family and society, harmony in the nature and existence.
	CO-5	Evaluating human conduct on ethical basis.
ECS455	**CO-1**	Understanding various methods to perform the basic operations on a UNIX based operating system.
	CO-2	Applying the concept to implement and simulate the various CPU scheduling and Page replacement algorithms.
	CO-3	Applying the file read, write and access methods and perform the operations on a file in UNIX.
	CO-4	Analyzing the methods for creating SRS and various diagrams using software engineering paradigms
	CO-5	Analyzing the methods for creating flowchart to show process flow.
TMUGE401	**CO-1**	Remembering and understanding the English grammar and vocabulary.
	CO-2	Understanding the essentials of effective listening and speaking.
	CO-3	Understanding the corporate expectations and professional ethics.
	CO-4	Applying correct vocabulary and sentence construction during professional writing or job interviews.
	CO-5	Aanalyzing different types of interviews.
	CO-6	Developing the skills to create resume, C.V. or cover letter.
TMUGA-401	**CO-1**	Applying the arithmetical concepts in Ratio Proportion Variation.
	CO-2	Employing the techniques of Percentage; Ratios and Average in inter related concepts of Time and Work, Time Speed and Distance.
	CO-3	Identifying different possibilities of reasoning based problems of Syllogisms and Venn diagram.
	CO-4	Examining the optimized approach to solve logs and Surds.
EAI404	**CO-1**	Understanding the Artificial Intelligence, application areas and

	CO-2	importance of Turing test in identifying AI applications
	CO-3	Understanding the role of state space search and production system in enumerating complex problems in AI
	CO-4	Understanding the syntax & programming constructs of both PROLOG and LISP. Applying the PROLOG to implement solutions of complex problems in AI.
	CO-5	Understanding the symbolic logic in AI and able to use predicates & High order logic, effectively for representation of scenario and Understanding the different knowledge representation mechanisms and effectively use them for representing knowledge
ECS503	**CO-1**	Evaluating the performance of various search algorithms and heuristic algorithms in solving complex problems
	CO-2	Understanding concept of greedy method in problem solving, exact optimization solution for minimum cost spanning tree, approximate solution for knapsack problem, single shortest path computation.
	CO-3	Applying concept of dynamic programming in problem solving, dynamic programming vs divide and conquer, shortest path computation application, matrix multiplication application, traveling salesman problem application, longest common subsequence application.
	CO-4	Applying concept of graph problem to get solutions of depth first search method, breadth first search method, back tracking, 8-queen problem, knapsack problem.
	CO-5	Analyzing the concept of branch and bound method, LC searching bounding, FIFO branch and bound, 0/1 knapsack problem, travelling salesman problem, complexity measures, polynomial v/s non-polynomial time complexity, NP-hard and NP-complete problem.
EAI402	**CO-1**	Understanding the concepts of network fundamentals and terminology.
	CO-2	Understanding the principles of LAN design such as topology and configuration
	CO-3	Understanding various network industry standards such as: the OSI model, Routing Protocols, Address Resolution and Reverse Address Resolution Protocols.
	CO-4	Analyzing different type of network interfaces and their usage.
	CO-5	Evaluating the configurations of IP Addresses and Subnetting, MAC Addressing.
ECS552	**CO-1**	Applying divide and conquer concept of algorithm in binary search, quick sorting and merge sorting.
	CO-2	Applying concept of greedy method in exact optimization solution for minimum cost spanning tree, approximate solution for knapsack problem, single shortest path computation.
	CO-3	Applying concept of dynamic programming in shortest path computation application, matrix multiplication application, traveling salesman problem application, longest common subsequence application.
	CO-4	Applying concept of graph in to find solution of depth first search method, breadth first search method, back tracking, 8-queen problem, and knapsack problem.
	CO-5	Analyzing backtracking concept in connected components computation in

		graph
EAI552	**CO-1**	Understanding the basic constructs of HTML.
	CO-2	Understanding various categories of programs, Web, Window and Console Application. Organize and work with many projects.
	CO-3	Analyzing the usage of the Web Technology (Design And Architecture Using .NET) programs to create professional, academic, business and many software projects.
	CO-4	Analyzing personal, academic and business documents by following the current professional and/or industry standards.
	CO-5	Applying skills and concepts to built small real life applications using Web Technology (Design And Architecture Using .NET) standards.
ECS591	**CO-1**	Understanding knowledge through research and development on latest technology.
	CO-2	Developing greater clarity about academic and career goals
	CO-3	Understanding of administrative functions and company culture
	CO-4	Applying critical reasoning and independent learning
	CO-5	Developing ability to effectively communicate solution to problems (oral, visual, written).
ECS611	**CO-1**	Understanding the various components of data warehousing.
	CO-2	Understanding the constructs and usage of R-Programming language for developers.
	CO-3	Understanding how to design the physical model of data warehouse.
	CO-4	Understanding various algorithms of Data Mining and its process.
	CO-5	Applying the programming concept to solve problems using R-Programming.
	CO-6	Analyzing the concept of data mining using R-Programming.
	C07	Developing skills for analyzing and cleaning of the data.
EAI602	**CO-1**	Understanding the essential features of genetic algorithm (GA) and to evaluate the population, fitness and search space in it.
	CO-2	Understanding the concepts of encoding, decoding in genetics and implement the various operators and features of GA.
	CO-3	Applying the optimization and searching techniques in search space.
	CO-4	Applying GA for building solutions to various problems and to study and evaluate the stopping criteria for the algorithm.
	CO-5	Analyzing and applying different crossover and mutation operators for effectively solving the desired real-world problems.
EAI604	**CO-1**	Understanding the concept of knowledge representation and its various techniques
	CO-2	Understanding the concept of predicate logic, forward chaining, unification, Rate Algorithm
	CO-3	Understanding the concept of Default Reasoning Circumscription, Minimal Models, The Event Calculus Revisited, Default Logic, Auto epistemc Logic. Ontology and Description Logics and applying the reasoning in Multi-agent Systems Epistemic Logic and understand and apply Kripke Semantics in a Multi Agent Scenario.
	CO-4	Understanding the concept of Frame and applying to demonstrate semantic net and understating the concept of Scripts, Script Applier

		Mechanism (SAM), Plan Applier Mechanism (PAM)and their mechanism and Top Down and Bottom Up Reasoning
	CO-5	Applying the concept of FOL to demonstrate Skolemization and understanding properties and categories of Knowledge representation, Reification and Abstract Entities, Resource Description Framework (RDF), The Event Calculus
EAI605	**CO-1**	Understanding the concepts of Pattern Recognition, its principles and various approaches.
	CO-2	Understanding the concepts of Statistical Pattern Recognition
	CO-3	Understanding various methods of parameter estimation like Maximum Likelihood, Bayesian parameter and also methods of dimension reduction.
	CO-4	Understanding the nonparametric techniques of pattern recognition like KNN etc.
	CO-5	Understanding the various techniques of Unsupervised Learning & Clustering.
EHM601	**CO-1**	Understanding the meaning and concepts of Entrepreneurship
	CO-2	Understanding the concepts and theories of motivation
	CO-3	Understanding different financing options
	CO-4	Understanding the government support policies and its applications
	CO-5	Understanding and applying remedies to sick businesses
EAI603	**CO-1**	Understanding the requirement of Big data with respect to 5 V's .
	CO-2	Understanding the basic storage structure used in Big data with respect to clusters.
	CO-3	Understanding the Hadoop Ecosystem and its components.
	CO-4	Applying the data processing in Big data with HIVE , PIG and HBASE.
	CO-5	Analyzing the functionality and working of Zookeeper for monitoring Servers in Cluster.
EAI606	**CO-1**	Understanding the basic concept of mobile computing, wireless networks, structure of mobile computing based application.
	CO-2	Understanding various schemes like Fixed Assignment Schemes, Random Assignment Schemes, Reservation Based Schemes .
	CO-3	Understanding the mobile IP, Key functionality of IP, Choose the required functionality at each layer for given application.
	CO-4	Analyzing solution for each functionality at each layer x Use simulator tools and design Ad hoc networks
	CO-5	Evaluating a mobile application and network concepts.
EAI607	**CO-1**	Understanding the overview, limitations of existing operating system and study the classical problems related to IPC in operating system.
	CO-2	Understanding the event handling and mutual exclusion in distributed system and further apply it to solve certain problems in distributed environment.
	CO-3	Understanding the recovery techniques along with fault tolerance issues and protocols.
	CO-4	Understanding distributed file system and shared memory architecture and design issues.
	CO-5	Analyzing distributed deadlock and transaction.

EAI608	**CO-1**	Understanding parallel computing, it's architecture, along with pipeline processing.
	CO-2	Understanding different processor architectures and system-level design processes.
	CO-3	Understand different interconnection network and learn the multiprocessor architecture.
	CO-4	Understanding of assembly level programming.
	CO-5	Analyzing multiprocessor scheduling strategies and models.
EAI609	**CO-1**	Understanding of the information system architecture and the involved components.
	CO-2	Understanding of the basic principles of Information Security, Online payment systems and related security issues along with the rules of E Governance.
	CO-3	Applying and regulating Cyber Laws dealing with Cyber Ethics by implementation of Intellectual Property Right in the areas of Copyright, Patent, Piracy and Plagiarism.
	CO-4	Analyzing the security of Cryptographic System and design and implementation issues related with Firewalls, Virtual Private Networks and Intrusion Detection Systems.
	CO-5	Analyzing the need of physical security in Information System, need of Biometric Security System and related challenges.
ECS654	**CO-1**	Understanding Modeling and design of data warehouse.
	CO-2	Understanding how to Install and Configure R Tool and R Studio.
	CO-3	Applying the concept to design a star and snowflake schema.
	CO-4	Analyzing R Explorer, Mining techniques and Attribute Relation File
	CO-5	Developing basic data warehouse applications along with the data visualization using R.
EAI653	**CO-1**	Understanding Arduino Experiments to ON, ON/OFF, BLINK LED light.
	CO-2	Understanding various structures of the data received through sensors in IOT
	CO-3	Applying Arduino Experiments using GPS to identify location.
	CO-4	Applying IOT to identify the different technologies.
	CO-5	Applying and Evaluate the use of different type of shields such as Bluetooth relay, Key –pad screw etc.
TMUGS-601	**CO-1**	Communicating effectively in a variety of public and interpersonal settings.
	CO-2	Applying concepts of change management for growth and development by understanding inertia of change and mastering the Laws of Change.
	CO-3	Analyzing scenarios, synthesizing alternatives and thinking critically to negotiate, resolve conflicts and develop cordial interpersonal relationships.
	CO-4	Functioning in a team and enabling other people to act while encouraging growth and creating mutual respect and trust.
	CO-5	Handling difficult situations with grace, style, and professionalism.
TMUGA-601	**CO-1**	Recognizing the rules of Crypt-arithmetic and relate them to find out the solutions.
	CO-2	Illustrating the different concepts of Height and Distance and Functions.

	CO-3	Employing the concept of higher level reasoning in Clocks, Calendars and Puzzle Problems.
	CO-4	Correlating the various arithmetic and reasoning concepts in checking sufficiency of data.
ECS709	**CO-1**	Understanding the Cloud Computing and its role in current scenario.
	CO-2	Understanding the different models of Cloud Computing and their limitations
	CO-3	Understanding the importance of Cloud services and economic factors related to them
	CO-4	Analyzing various risk factors involved in Cloud Computing and to tackle them using risk management techniques
	CO-5	Evaluating the virtual data centre architecture, governance strategy, security mechanism and contingency plans.
EAI704	**CO-1**	Understanding basic concept of AI, knowledge acquisition, knowledge representation, expert system architecture, inference engine.
	CO-2	Understanding concept of neural ANN, neuron model, activation functions, NN architecture, supervised and unsupervised learning, applications of NN.
	CO-3	Understanding concept of fuzzy rule, uncertainity, statistics and random processes, fuzzy sets, classical sets, operations on fuzzy and classical sets, crisp relations, properties of crisp relations, fuzzy relations.
	CO-4	Understanding basic concept of genetic algorithms, reproduction, cross-over and mutation scaling, fitness, applications, neuro-fuzzy system, fuzzy-expert system, fuzzy-ga system.
	CO-5	Applying concept of fuzzy arithmetic, fuzzy to crisp conversion, lambda cut for fuzzy relations, de-fuzzification, fuzzy transform, fuzzy set extension principle.
EAI705	**CO-1**	Understanding of the history and background of web search, internet, WWW, web-search characteristics, spam, The Web Search Users, search engines, architecture of search engines.Crawling, indexing, and ranking and apply ranking concept to analysis page ranking algorithm.
	CO-2	Understanding the basic data mining concepts, Association Rules and Sequential Patterns, Generation of Frequent & Interesting item-sets, Mining with multiple minimum supports, Extended Model and Various Mining Algorithm.
	CO-3	Understanding the concept Web crawling algorithms, Breadth First Search, Best First Search, A* Search, Adaptive A* Search, Page Rank algorithms for Ranking Google Sites
	CO-4	Understanding the basic concept of Web Spiders & Crawlers and various method of information retrievals
	CO-5	Applying the concept of web crawling and analysis the various web crawling algorithms
EAI707	**CO-1**	Understanding about non lineardimention reduction
	CO-2	Understanding dimensional reduction methods
	CO-3	Understanding various dimensionality reduction method
	CO-4	Analyzing PCA and its variants
	CO-5	Analyzing about real world actionability from analytics

EAI708	**CO-1**	Understanding and remember LISP and other functional programming paradigm.
	CO-2	Understanding and analyzing the first order logic for solving real world problems.
	CO-3	Understanding various knowledge representation methods.
	CO-4	Applying the reasoning capabilities under uncertain situations in any event.
	CO-5	Analyzing the use of logic programming languages for AI and other domains.
ECS716	**CO-1**	Understanding the different types of image transforms and their properties
	CO-2	Understanding the different techniques employed for the enhancement of images
	CO-3	Understanding the concept of image restoration & degradation models and color models.
	CO-4	Understanding the concept of supervised, un-supervised, and semi-supervised learning algorithms.
	CO-5	Analyzing different image compression techniques and their functionality.
EAI753	**CO-1**	Understanding the phases of SDLC and performing initial investigation about project.
	CO-2	Understanding to design ER-Diagram and DFD of the project.
	CO-3	Applying the designing procedures to design database.
	CO-4	Developing SRS Document for the project.
	CO-5	Developing Forms and Front end of the Project.
EAI803	**CO-1**	Understanding the Forensic Science procedures and their role in cyber computing
	CO-2	Understanding the importance of evidences, their types, recovery and preservation procedures
	CO-3	Understanding the steganography, cloaking and backup techniques for cyber security
	CO-4	Understanding the security threats and common security standards & techniques available to secure the computer resources
	CO-5	Understanding the key elements of Machine Learning for solving complex problems and application areas of ML
EAI805	**CO-1**	Understanding the concept of sensors signals, sensor classification, sensor characteristics and unit of measurement of different sensors.
	CO-2	Understanding the concept of physical characteristics of sensors like sensing of electric charge, Fields, Potentials, Magnetism, Induction, Resistance, temperature and thermal properties of material, dynamic models of sensor elements.
	CO-3	Understanding the concept of Input Characteristics of Interface Circuits like Amplifiers, Analog to Digital Converters, Digitization processing, data transmission and batteries for law power sensors.
	CO-4	Understanding the concept of different types of sensor with different types of sensors application.
	CO-5	Understanding the concept of different sensor materials, uses of Nano-Technology to create sensors and smart sensors.

EAI806	**CO-1**	Understanding the concept of security concern with IoT Applications, secure IoT Architecture, types of attacks, maintaining privacy of data gathered by smart IoT devices.
	CO-2	Understanding the concept of cryptography like encryption, decryption, Hashes, digital signature, security key management, IoT node authentication etc.
	CO-3	Understanding the concept of identification by authorization, IAM architecture, Publish-Subscribe schemes.
	CO-4	Understanding the concept of privacy preservation using lightweight and robust schemes, Trust models and preventing unauthorized access in data dissemination.
	CO-5	Analyzing the concept of cloud security in which data is gathered from different IoT devices by different cloud security controls and Enterprise-IoT cloud security architecture.
EAI808	**CO-1**	Understanding the need of automation and basic structure, control system & different controllers used in Robotics
	CO-2	Understanding the importance of sensors and actuators in design of Robots
	CO-3	Understanding the process of image processing, image analysis and training to develop vision system for Robots
	CO-4	Understanding the methods of Robot programming with their limitations
	CO-5	Developing robotic applications by using Arduino UNO, Raspberry Pi and Python
ECS814	**CO-1**	Understanding of the history of Block-chain, different models and protocols
	CO-2	Understanding of the history of Block-chain, different models and protocols
	CO-3	Understanding of the history of Block-chain, different models and protocols
	CO-4	Understanding of the history of Block-chain, different models and protocols
	CO-5	Understanding of the history of Block-chain, different models and protocols
EAI852	**CO-1**	Understanding the process of Project development.
	CO-2	Applying the knowledge to develop applications based on deep learning.
	CO-3	Applying the learning to develop applications on different platforms like Window, Web based or Mobile based applications to specific set of problem and their solutions.
	CO-4	Developing face recognition models using NN
	CO-5	Developing methods for text summarization and classification