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Course Code	Course Name	CO Code	CO
18MAT31	TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES	CO1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
		CO2	Demonstrate Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.
		CO3	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
		CO4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
		CO5	Determine the externals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.
18CS32	ANALOG AND DIGITAL ELECTRONICS	CO1	Demonstrate application of analog circuits using photo devices, timer IC, power supply and regulator IC and op-amp
		CO2	Find the simplified digital circuits using Karnaugh Map, and Quine-McClusky Methods
		CO3	Illustrate combinational and sequential digital circuits
		CO4	Explain Gates and flip flops and make us in designing different data processing circuits, registers and counters and compare the types and develop simple HDL programs
		CO5	Demonstrate registers and counters and its design
18CS33	DATA STRUCTURES AND APPLICATIONS	CO1	To understand the fundamentals of data structures and their applications essential for programming/problem solving.
		CO2	To apply Linear Data Structures: Stack, Queues and Recursion.
		CO3	To apply Linear Data Structures: Linked Lists.
		CO4	To apply Non-Linear Data Structures: Trees and Graphs.

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		CO5	To understand the concepts of Hashing, Files and their Organization and Sorting Algorithms.
18CS34	COMPUTER ORGANIZATIONS	CO1	Explain the basic organization of a computer system.
		CO2	Demonstrate functioning of different sub systems, such as processor, Input/output,and memory.
		CO3	Illustrate hardwired control and micro programmed control, pipelining, embedded and other computing systems.
		CO4	Design and analyze simple arithmetic and logical units.
		CO5	Understand the concepts of Basic Processing Units.
18CS35	SOFTWARE ENGINEERING	CO1	Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to software engineers
		CO2	Explain the fundamentals of object oriented concepts.
		CO3	Describe the process of requirements gathering, requirements classification, requirements specification and requirements validation. Differentiate system models, use UML diagrams and apply design patterns.
		CO4	Discuss the distinctions between validation testing and defect testing.
		CO5	Recognize the importance of software maintenance and describe the intricacies involved in software evolution.
18CS36	DISCRETE MATHEMATICAL STRUCTURES	CO1	Use Propositional and Predicate logic in Knowledge representation and truth verification.
		CO2	Demonstrate the application of discrete structures in different fields of computer science.
		CO3	Solve problems using recurrence relations and generating functions.
		CO4	Application of Different mathematical proofs techniques in proving theorems in the courses.
		CO5	Compare graphs, trees and their applications.
18CSL37	ANALOG AND DIGITAL ELECTRONICS LABORATORY	CO1	Get practical experience in design, assembly and evaluation/testing of Analog components and circuits including Operational Amplifier, Timer, etc.

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		CO2	Use appropriate design equations / methods to design the given circuit.
		CO3	Examine and verify the design of both analog and digital circuits using simulators.
		CO4	Make us of electronic components, ICs, instruments, and tools for design and testing of circuits for the given the appropriate inputs.
		CO5	Compile a laboratory journal which includes; aim, tool/instruments/software/components used, design equations used and designs, schematics, program listing, procedure followed, relevant theory, results as graphs and tables, interpreting and concluding the findings.
18CSL38	DATA STRUCTURES LABORATORY	CO1	Asymptotic performance of algorithms using arrays and strings.
		CO2	DEVELOP Linear data structures and their applications of stacks
		CO3	EXTEND Linear data structures and their applications of queues.
		CO4	DEMONSTRATE Linear data structures and their applications of Lists and its types
		CO5	Experiment with Non-Linear data structures and their applications such as trees and graphs
18KAK39	AADALITHA KANNADA	CO1	students are able to learn and understand kannada language and kannada grammar.
		CO2	students are able to learn and understand kannada language rules and special symbols.
		CO3	students are able to learn and write all types of letter writing.
		CO4	students are able to learn and write easy writing.
		CO5	students are able to learn and understand kannada language with the different words used for communication.
18KVK39	VYAVAHARIKA KANNADA	CO1	Limits the barriers between people: barriers cause distrust and fear.
		CO2	Opens the door to art, music, dance, fashion, cuisine, film, philosophy, science…etc.
		CO3	Leads to an appreciation of cultural diversity.
		CO4	Encourages the respect for other people.
		CO5	It fosters an understanding of the interrelation of language and human nature.
18MAT41	COMPLEX ANALYSIS, PROBABILITY AND	CO1	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.

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	STATISTICAL METHODS	CO2	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
		CO3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
		CO4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
		CO5	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.
18CS42	DESIGN AND ANALYSIS OF ALGORITHMS	CO1	Describe various methods of algorithm analysis
		CO2	Apply Divide and Conquer approach to solve a given problem.
		CO3	Apply Greedy approach to solve a given problem.
		CO4	Apply Dynamic programming approach to solve a given problem.
		CO5	Apply Backtracking approach to solve a given problem.
18CS43	OPERATING SYSTEMS	CO1	Identify the significance of operating system in computing devices.
		CO2	Exemplify the communication between application programs and hardware devices through system calls.
		CO3	Compare and illustrate various process scheduling algorithms.
		CO4	Apply appropriate memory and file management schemes
		CO5	Illustrate various disk scheduling algorithms.
18CS44	MICROCONTROLLER AND EMBEDDED SYSTEMS	CO1	Describe the architectural features and instructions of arm microcontroller
		CO2	Apply the knowledge gained for programming arm for different applications
		CO3	interface external devices and i/o with arm microcontroller.
		CO4	interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system
		CO5	develop the hardware /software co-design and firmware design approaches and demonstrate the need of real time operating system for embedded system applications

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18CS45	OBJECT ORIENTED CONCEPTS	CO1	Understand fundamentals of Object Oriented Concepts.
		CO2	Explore the features of Object-oriented Programming in Java including defining classes, invoking methods, using class libraries, etc.
		CO3	Develop the ability to program in Java to solve specified problems usinginheritance and exception handling.
		CO4	Develop computer programs to solve real world problems using packages ,interfaces and Multithreaded programming.
		CO5	Develop simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles using swings.
18CS46	DATA COMMUNICATION	CO1	Explain the various components of data communication.
		CO2	Explain the Fundamentals of digital communication and switching.
		CO3	Explain switching And Error detection and correction.
		CO4	Compare and contrast data link layer protocols.
		CO5	Summarize IEEE 802.X Standards.
18CSL47	DESIGN AND ANALYSIS OF ALGORITHM LABORATORY	CO1	Design and implement various algorithms in JAVA
		CO2	Implement a variety of sorting algorithms such as quick sort and Merge sort.
		CO3	Design algorithms using appropriate design techniques (brute-force, greedy, dynamic programming, etc.
		CO4	Employ various design strategies and Algorithms for problem solving.
		CO5	Implement a variety of algorithms such as graph related, combinatorial, etc., in a high level language.
18CSL48	MICROPROCESSORS LABORATORY	CO1	Illustrate the architectural features and instructions of arm microcontroller.
		CO2	Apply the knowledge gained for programming arm for different applications.
		CO3	Make use of interfacing devices such external memory and i/o with arm microcontroller.
		CO4	Interpret the basic hardware components and their selection method based on the

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			characteristics and attributes of an embedded system.
		CO5	Develop the hardware /software co-design and firmware design approaches and demonstrate the need of real time operating system for embedded system applications.
18CPH39/49	Constitution of India, Professional Ethics and Human Rights	CO1	Learn in details with examples To assimilate and get familiarized with basic information about Indian constitution.
		CO2	Specify in details with examples provide overall legal literacy to the young technograts to manage complex societal issues in the present scenario.
		CO3	Learn the characteristics of To identify their individual roles and ethical responsibilities towards society.
		CO4	Specify in depth To understand engineering ethics & responsibilities.
		CO5	Deliberate in details with application, if applicable, To understand engineering ethics & responsibilities, through the learning of these topics students will be able to understand human rights/ values and its implications in their life.
18CS51	MANAGEMENT AND ENTREPRENEURSHIP FOR IT INDUSTRY	CO1	Explain the principles of management, organization and entrepreneur.
		CO2	Discuss on planning, staffing, ERP and their importance.
		CO3	Discuss on Preparation of project report and its importance.
		CO4	Explain the meaning of Entrepreneur and its process.
		CO5	Infer the importance of intellectual property rights and relate the institutional support.
18CS52	COMPUTER NETWORKS AND SECURITY	CO1	Explain principles of application layer protocols.
		CO2	Recognize transport layer services and infer UDP and TCP protocols.
		CO3	Classify routers, IP and Routing Algorithms in network layer.
		CO4	Understand the Wireless and Mobile Networks covering IEEE 802.11 Standard.
		CO5	Describe Multimedia Networking and Network Management.
18CS53		CO1	Understand the concept of database objects and ER model.

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	DATABASE MANAGEMENT SYSTEM	CO2	Analyse and develop relational model, Relational algebra and SQL commands .
		CO3	Design and build simple real-world database systems and applications using GUI.
		CO4	Implement normalization algorithms using database design theory for different Applications.
		CO5	Analyse and implement transaction processing, concurrency control and database recovery protocols in databases.
18CS54	AUTOMATA THEORY AND COMPUTABILITY	CO1	Understand the fundamentals of the core concepts in automata theory and Theory of Computation
		CO2	Illustrate how to translate between different models of Computation (e.g., Deterministic and Non-deterministic and Software models).
		CO3	Remembering pumping lemma for regular languages and context free languages.
		CO4	Develop skills in formal reasoning and reduction of a problem to a formal model, with an emphasis on semantic precision and conciseness.
		CO5	Classify a problem with respect to different models of Computation.
18CS55	APPLICATION DEVELOPMENT USING PYTHON	CO1	Demonstrate the proficiency in handling loops and creation of functions.
		CO2	Identify the method to create and manipulate list ,tuple and dictionaries.
		CO3	Discover the commonly used operations involving regular expressions and files
		CO4	Interpret the concept of Object Oriented Programming as used in python.
		CO5	Determine the need for scrapping website and working with CSV ,JSON and other file format.
18CS56	UNIX PROGRAMMING	CO1	Understand the UNIX Architecture, file system and basic Unix commands.
		CO2	Apply the shell programming concepts in real time problems.
		CO3	Apply the UNIX File and Process system calls on problems.
		CO4	Understand the application/service concepts over a Unix system.
		CO5	Understand the working of Signals and Daemon Processes.
18CSL57		CO1	Able to Analyze the working of networking protocols using modern tool NS2.

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	COMPUTER NETWORK LABORATORY	CO2	CO2: Able to Develop wired and wireless topology using XGraph, NAM in NS2.
		CO3	CO3: Able to Simulate and demonstrate the performance of GSM and CDMA.
		CO4	CO4: Able to Apply and develop the algorithms in data link layer, Network layer and application layer.
		CO5	CO5: Able to Design client-server applications using TCP and UDP socket IPC.
18CSL58	DBMS LABORATORY WITH MINI PROJECT	CO1	Create, update and query on the database using SQL commands.
		CO2	CO2: Design and implement a database schema for a given problem-domain.
		CO3	CO3: Strong practice in SQL programming through a variety of database problems.
		CO4	CO4: Analyse and apply concepts of normalization to design an optimal database.
		CO5	CO5: Develop database applications using front-end tools and back-end DBMS.
18CS61	SYSTEM SOFTWARE & COMPILERS	CO1	Explain the System Software.
		CO2	Design and Develop lexical
		CO3	Design and Develop parser
		CO4	Utilize Lex and Yaac tools for implementing different concepts of system software
		CO5	Design and Develop Syntax Directed Translation, Intermediate Code Generator and code generator
18CS62	COMPUTER GRAPHICS AND VISUALIZATION	CO1	Design and implement algorithms for 2D graphics primitives and attributes.
		CO2	Illustrate Geometric transformations on both 2D and 3D objects.
		CO3	Apply concepts of clipping in 2D viewing and Illumination Models.
		CO4	Apply concepts of visible surface detection in 3D viewing.
		CO5	Infer the representation of curves and surfaces.
18CS63	WEB TECHNOLOGY AND ITS APPLICATIONS	CO1	Illustrate the Semantic Structure of HTML
		CO2	Compose forms and tables using HTML and CSS
		CO3	Design Client-Side programs using JavaScript and Server-Side programs using PHP.
		CO4	Infer Object Oriented Programming capabilities of PHP.
		CO5	Examine JavaScript frameworks such as jQuery and Backbone.

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18CS64	DATA MINING AND DATA WAREHOUSING	CO1	Define multi-dimensional data models. •, and clustering analysis. • Compare and contrast between different classification and clustering algorithms
		CO2	Illustrate data preprocessing techniques and OLAP server.
		CO3	Explain rules related to association analysis.
		CO4	Demonstrate rules related to classification techniques.
		CO5	Discuss rules related to clustering algorithms.
18CSL66	SYSTEM SOFTWARE LABORATORY	CO1	To make students familiar with Lexical Analysis and Syntax Analysis phases of Compiler Design.
		CO2	To make students to implement programs on these phases using LEX & YACC tools and/or C/C++/Java.
		CO3	To enable students to learn different types of CPU scheduling algorithms used in the operating systems.
		CO4	To make students able to implement memory management - page replacement and deadlock handling algorithms.
		CO5	To make students can utilize lex and yacc tools for implementing different concepts of system software.
18CSL67	COMPUTER GRAPHICS LABORATORY WITH MINI PROJECT	CO1	Demonstrate simple algorithms using OpenGL Graphics Primitives and attributes.
		CO2	Implementation of line drawing algorithm using OpenGL.
		CO3	Implementation of line drawing clipping algorithms using OpenGL functions
		CO4	Design and implementation of algorithms Geometric transformations on 2D objects.
		CO5	Implementation of algorithms Geometric transformations on 3D objects.
18CSMP68	MOBILE APPLICATION DEVELOPMENT	CO1	Build an application using Android development environment .
		CO2	2.Experiment with the method of storing, sharing and retrieving the data in Android Applications
		CO3	3.Examine responsive user interface across wide range of devices .
		CO4	4.Create a mobile Application by using various components like activity, views, services, content providers and receivers.

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		CO5	5. Create a mobile Application by using various components like Permissions, Performance and Security.
18CS71	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	CO1	Understand the theory of Artificial intelligence and Machine Learning.
		CO2	Understand the Knowledge representation issues and concept learning.
		CO3	Apply decision tree learning and artificial neural networks.
		CO4	Apply Bayesian learning using bayes theorem, naive bayes classifier and EM Algorithm.
		CO5	Apply Instance based learning and reinforcement learning.
18CS72	BIG DATA AND ANALYTICS	CO1	Understand fundamentals of Big Data analytics.
		CO2	Investigate Hadoop framework and Hadoop Distributed File system. Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.
		CO3	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
		CO4	Use Machine Learning algorithms for real world big data
		CO5	Analyze web contents and Social Networks to provide analytics with relevant visualization tools.
18CS733	ADVANCED COMPUTER ARCHITECTURES	CO1	Describe the parallelism and principles of scalable computer.
		CO2	Discuss the various Processors and Memory Architecture.
		CO3	Describe the performance of pipelining processors.
		CO4	Demonstrate the various techniques in multi computers and multiprocessors.
		CO5	Summarize parallel architecture and the software used for them.
18CS742	NETWORK MANAGEMENT	CO1	Describe the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets.
		CO2	Understand network management standards to manage practical networks
		CO3	Describe the functions SNMP for managing the network and RMON for monitoring the behavior of the network.

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		CO4	Understand possible approaches for managing OSI network model.
		CO5	Identify the various components of network and understand the scheme for the managing them.
18CSL76	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LABORATORY	CO1	Implement and Demonstrate Heuristic Searching Algorithms using Python
		CO2	Implement and Demonstrate Concept - Learning Algorithms
		CO3	Implement and Demonstrate Backpropagation Algorithm by building an Artificial Neural Network.
		CO4	Implement and Demonstrate Bayesian Classifier Algorithms
		CO5	Implement and Demonstrate Instance - Based Learning Algorithms

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COURSE CODE	COURSE NAME	CO CODE	CO's
18MAT31	TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES	CO1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
		CO2	Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
		CO3	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
		CO4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
		CO5	Determine the externals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.
18EE32	ELECTRIC CIRCUIT ANALYSIS	CO1	Understand the basic concepts, basic laws and methods of analysis of DC and AC networks and reduce the complexity of network using source shifting, source transformation and network reduction using transformations.
		CO2	Solve complex electric circuits using network theorems.
		CO3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their
		CO4	evaluation.
		CO5	Synthesize typical waveforms using Laplace transformation.
18EE33	TRANSFORMERS AND GENERATORS	CO1	Understand the construction and operation of 1-phase, 3-Phase transformers and Autotransformer.
		CO2	Analyze the performance of transformers by polarity test, Sumpner's Test, phase conversion, 3-phase connection, and parallel operation.
		CO3	Understand the construction and working of AC and DC Generators.
		CO4	Analyze the performance of the AC Generators on infinite bus and parallel operation.
		CO5	Determine the regulation of AC Generator by Slip test, EMF, MMF, and ZPF Methods.

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18EE34	**ANALOG ELECTRONIC CIRCUITS**	**CO1**	**Obtain the output characteristics of clipper and clamper circuits.**
		CO2	**Design and compare biasing circuits for transistor amplifiers & explain the transistor switching.**
		CO3	**Explain the concept of feedback, its types and design of feedback circuits**
		CO4	**Design and analyze the power amplifier circuits and oscillators for different frequencies.**
		CO5	**Design and analysis of FET and MOSFET amplifiers.**
18EE35	**DIGITAL SYSTEM DESIGN**	**CO1**	**Develop simplified switching equation using Karnaugh Maps and QuineMcClusky techniques.**
		CO2	**Design Multiplexer, Encoder, Decoder, Adder, Subtractors and Comparator as digital combinational control circuits.**
		CO3	**Design flip flops, counters, shift registers as sequential control circuits.**
		CO4	**Develop Mealy/Moore Models and state diagrams for the given clocked sequential circuits.**
		CO5	**Explain the functioning of Read only and Read/Write Memories, Programmable ROM, EPROM and Flash memory.**
18EE36	**ELECTRICAL AND ELECTRONICMEASUREMENTS**	**CO1**	**Measure resistance, inductance and capacitance using bridges and determine earth resistance.**
		CO2	**Explain the working of various meters used for measurement of Power, Energy & understand the adjustments, calibration & errors in energy meters.**
		CO3	**Understand methods of extending the range of instruments & instrument transformers.**
		CO4	**Explain the working of different electronic instruments.**
		CO5	**Explain the working of different display and recording devices.**
18EEL37	**ELECTRICALMACHINES LABORATORY - 1**	**CO1**	**Evaluate the performance of transformers from the test data obtained.**
		CO2	**Connect and operate two single phase transformers of different KVA rating in parallel.**
		CO3	**Connect single phase transformers for three phase operation and phase conversion.**
		CO4	**Compute the voltage regulation of synchronous generator using the test data obtained in the laboratory.**

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		CO5	**Evaluate the performance of synchronous generators from the test data and assess the performance of synchronous generator connected to infinite bus.**
18EEL38	**ELECTRONICS LABORATORY**	**CO1**	**Design and test rectifier circuits with and without capacitor filters.**
		CO2	**Determine h-parameter models of transistor for all modes.**
		CO3	**Design and test BJT and FET amplifier and oscillator circuits.**
		CO4	**Realize Boolean expressions, adders and subtractors using gates.**
		CO5	**Design and test Ring counter/Johnson counter, Sequence generator and 3 bit counters.**
18CPC39/49	**CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)**	**CO1**	**Have constitutional knowledge and legal literacy.**
		CO2	**Understand Engineering and Professional ethics and responsibilities of Engineers.**
		CO3	**Understand the the cybercrimes and cyber laws for cyber safety measures.**
18MATDIP31	**ADDITIONAL MATHEMATICS – I**	**CO1**	**Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.**
		CO2	**Use derivatives and partial derivatives to calculate rate of change of multivariate functions.**
		CO3	**Analyze position, velocity and acceleration in two and three dimensions of vector valued functions.**
		CO4	**Learn techniques of integration including the evaluation of double and triple integrals.**
		CO5	**Identify and solve first order ordinary differential equations.**
18MAT41	**COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS**	**CO1**	**Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.**
		CO2	**Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.**
		CO3	**Apply discrete and continuous probability distributions in analyzing the probability models arising in**

			engineering field.
		CO4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
		CO5	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.
18EE42	POWER GENERATION AND ECONOMICS	CO1	Describe the working of hydroelectric, steam, nuclear power plants and state functions of major equipment of the power plants.
		CO2	Classify various substations and explain the functions of major equipments in substations.
		CO3	Explain the types of grounding and its importance.
		CO4	Infer the economic aspects of power system operation and its effects.
		CO5	Explain the importance of power factor improvement.
18EE43	TRANSMISSION AND DISTRIBUTION	CO1	Explain transmission and distribution scheme, identify the importance of different transmission systems and types of insulators.
		CO2	Analyze and compute the parameters of the transmission line for different configurations.
		CO3	Assess the performance of overhead lines.
		CO4	Interpret corona, explain the use of underground cables.
		CO5	Classify different types of distribution systems; examine its quality & reliability.
18EE44	ELECTRIC MOTORS	CO1	Explain the construction, operation and classification of DC Motor, AC motor and Special purpose motors.
		CO2	Describe the performance characteristics & applications of Electric motors.
		CO3	Demonstrate and explain the methods of testing of DC machines and determine losses and efficiency.
		CO4	Control the speed of DC motor and induction motor.
		CO5	Explain the starting methods, equivalent circuit and phasor diagrams, torque angle, effect of change in excitation and change in load, hunting and

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			damping of synchronous motors.
18EE45	**ELECTROMAGNETIC FIELD THEORY**	**CO1**	**Use different coordinate systems , Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.**
		CO2	**Calculate the energy and potential due to a system of charges & Explain the behavior of electric field across a boundary conditions.**
		CO3	**Explain the Poisson's, Laplace equations and behavior of steady magnetic fields.**
		CO4	**Explain the behavior of magnetic fields and magnetic materials.**
		CO5	**Asses time varying fields and propagation of waves in different media.**
18EE46	**OPERATIONAL AMPLIFIERS AND LINEAR Ics**	**CO1**	**Describe the characteristics of ideal and practical operational amplifier.**
		CO2	**Design filters and signal generators using linear ICs.**
		CO3	**Demonstrate the application of Linear ICs as comparators and rectifiers.**
		CO4	**Analyze voltage regulators for given specification using op-amp and IC voltage regulators.**
		CO5	**Summarize the basics of PLL and Timer.**
18EEL47	**ELECTRICAL MACHINES LABORATORY - 2**	**CO1**	**Test DC machines to determine their characteristics and also to control the speed of DC motor.**
		CO2	**Pre-determine the performance characteristics of DC machines by conducting suitable tests.**
		CO3	**Perform load test on single phase and three phase induction motor to assess its performance.**
		CO4	**Conduct test on induction motor to pre-determine the performance characteristics.**
		CO5	**Conduct test on synchronous motor to draw the performance curves.**
18EEL48	**OP- AMP AND LINEAR ICS LABORATORY**	**CO1**	**To conduct experiment to determine the characteristic parameters of OP-Amp**
		CO2	**To design test the OP-Amp as Amplifier, adder, subtractor, differentiator and integrator.**
		CO3	**To design test the OP-Amp as oscillators and filters.**
		CO4	**Design and study of Linear IC's as multivibrator power supplies.**
		CO5	**To design test the OP-Amp as ADC, DAC and Voltage**

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			Regulators
18MATDIP41	**ADDITIONAL MATHEMATICS – II**	**CO1**	**Solve systems of linear equations using matrix algebra**
		CO2	**Apply the knowledge of numerical methods in modelling and solving engineering problems.**
		CO3	**Make use of analytical methods to solve higher order differential equations.**
		CO4	**Classify partial differential equations and solve them by exact methods.**
		CO5	**Apply elementary probability theory and solve related problems.**
18EE51	**MANAGEMENT AND ENTREPRENEURSHIP**	**CO1**	**Explain the field of management, task of the manager, planning and steps in decision making.**
		CO2	**Discuss the structure of organization, importance of staffing, leadership styles, modes of communication, techniques of coordination and importance of managerial control in business.**
		CO3	**Explain the concepts of entrepreneurship and a businessman's social responsibilities towards different groups.**
		CO4	**Show an understanding of role of SSI's in the development of country and state/central level institutions/agencies supporting business enterprises.**
		CO5	**Discuss the concepts of project management, capital budgeting, project feasibility studies, need for project report and new control techniques.**
18EE52	**MICROCONTROLLER**	**CO1**	**Outline the 8051 architecture, registers, internal memory organization, addressing modes.**
		CO2	**Discuss 8051 addressing modes, instruction set of 8051, accessing data and I/O port programming.**
		CO3	**Develop 8051C programs for time delay, I/O operations, I/O bit manipulation, logic and arithmetic operations, data conversion and timer/counter programming.**
		CO4	**Summarize the basics of serial communication and interrupts, also develop 8051 programs for serial data communication and interrupt programming.**

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		CO5	**Program 8051 to work with external devices for ADC, DAC, Stepper motor control, DC motor control, Elevator control**
18EE53	**POWER ELECTRONICS**	**CO1**	**To give an overview of applications power electronics, different types of power semiconductor devices,their switching characteristics, power diode characteristics, types, their operation and the effects of powerdiodes on RL circuits.**
		CO2	**To explain the techniques for design and analysis of single phase diode rectifier circuits.**
		CO3	**To explain different power transistors, their steady state and switching characteristics and limitations.**
		CO4	**To explain different types of Thyristors, their gate characteristics and gate control requirements.**
		CO5	**To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.**
18EE54	**SIGNALS AND SYSTEMS**	**CO1**	**Explain the generation of signals, behavior of system and the basic operations that can be performed on signals and properties of systems.**
		CO2	**Apply convolution in both continuous and discrete domain for the analysis of systems given impulse response of a system.**
		CO3	**Solve the continuous time and discrete time systems by various methods and their representation by block diagram.**
		CO4	**Perform Fourier analysis for continuous and discrete time, linear time invariant systems.**
		CO5	**Apply Z-transform and properties of Z transform for the analysis of discrete time systems.**
18EE55	**ELECTRICAL MACHINE DESIGN**	**CO1**	**Identify and list, limitations, modern trends in design, manufacturing of electrical machines and properties of materials used in the electrical machines.**
		CO2	**Derive the output equation of DC machine, discuss selection of specific loadings and magnetic circuits of DC machines, design the field windings of DC machine, and design stator and rotor circuits of a DC machine.**
		CO3	**Derive the output equations of transformer, discuss selection of specific loadings, estimate the number of**

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			cooling tubes, no load current and leakage reactance of core type transformer.
		CO4	**Develop the output equation of induction motor, discuss selection of specific loadings and magnetic circuits of induction motor, design stator and rotor circuits of a induction motor.**
		CO5	**Formulate the output equation of alternator, design the field windings of Synchronous machine, discuss short circuit ratio and its effects on performance of synchronous machines, design salient pole and non-salient pole alternators for given specifications.**
18EE56	**HIGH VOLTAGE ENGINEERING**	**CO1**	**Explain conduction and breakdown phenomenon in gases, liquid dielectrics and breakdown phenomenon in solid dielectrics.**
		CO2	**Summarize generation of high voltages and currents**
		CO3	**Outline measurement techniques for high voltages and currents.**
		CO4	**Summarize overvoltage phenomenon and insulation coordination in electric power systems.**
		CO5	**Explain non-destructive testing of materials and electric apparatus, high-voltage testing of electric apparatus**
18EEL57	**MICROCONTROLLER LABORATORY**	**CO1**	**Write assembly language programs for data transfer, arithmetic, Boolean and logical instructions and code conversions.**
		CO2	**Write ALP using subroutines for generation of delays, counters, configuration of SFRs for serial communication and timers.**
		CO3	**Perform interfacing of stepper motor and dc motor for controlling the speed, elevator, LCD, external ADC and temperature control.**
		CO4	**Generate different waveforms using DAC interface.**
		CO5	**Work with a small team to carryout experiments using microcontroller concepts and prepare reports that present lab work.**
18EEL58	**POWER ELECTRONICS LABORATORY**	**CO1**	**Obtain static characteristics of semiconductor devices to discuss their performance.**
		CO2	**Trigger the SCR by different methods**
		CO3	**Verify the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.**
		CO4	**Control the speed of a DC motor, universal motor and**

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			stepper motors.
		CO5	**Verify the performance of single phase full bridge inverter connected to resistive load.**
18CIV59	**ENVIRONMENTAL STUDIES**	**CO1**	**Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,**
		CO2	**Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.**
		CO3	**Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.**
		CO4	**Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.**
18EE61	**CONTROL SYSTEMS**	**CO1**	**Analyze and model electrical and mechanical system using analogous.**
		CO2	**Formulate transfer functions using block diagram and signal flow graphs.**
		CO3	**Analyze the stability of control system, ability to determine transient and steady state time response.**
		CO4	**Illustrate the performance of a given system in time and frequency domains, stability analysis using Root locus and Bode plots.**
		CO5	**Discuss stability analysis using Nyquist plots, Design controller and compensator for a given specification.**
18EE62	**POWER SYSTEM ANALYSIS – 1**	**CO1**	**Model the power system components & construct per unit impedance diagram of power system.**
		CO2	**Analyze three phase symmetrical faults on power system.**
		CO3	**Compute unbalanced phasors in terms of sequence components and vice versa, also develop sequence networks.**
		CO4	**Analyze various unsymmetrical faults on power system.**
		CO5	**Examine dynamics of synchronous machine and determine the power system stability.**
18EE63	**DIGITAL SIGNAL PROCESSING**	**CO1**	**Apply DFT and IDFT to perform linear filtering techniques on given sequences to determine the output.**
		CO2	**Apply fast and efficient algorithms for computing DFT and inverse DFT of a given sequence**

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		CO3	**Design and realize infinite impulse response Butterworth and Chebyshev digital filters using impulse invariant and bilinear transformation techniques.**
		CO4	**Develop a digital IIR filter by direct, cascade, parallel, ladder and FIR filter by direct, cascade and linear phase methods of realization.**
		CO5	**Design and realize FIR filters by use of window function and frequency sampling method.**
18EE641	**INTRODUCTION TO NUCLEAR POWER**	**CO1**	**Explain the fission process in nuclear materials, basic components of nuclear reactors, types of nuclear reactors and their working.**
		CO2	**List different types of coolants, their features, and cooling of reactors**
		CO3	**Summarize loss of cooling accidents in different reactors.**
		CO4	**Discuss postulated severe accidents in reactors and cooling of reactor during removal of spent fuel.**
		CO5	**Discuss cooling and disposing the nuclear waste and prospect of fusion energy in the future.**
18EE642	**ELECTRICAL ENGINEERING MATERIALS**	**CO1**	**Discuss electrical and electronics materials, their importance, classification and operational requirement**
		CO2	**Discuss conducting, dielectric, insulating and magnetic materials used in engineering, their properties and classification.**
		CO3	**Explain the phenomenon superconductivity, super conducting materials and their application in engineering.**
		CO4	**Explain the plastic and its properties and applications**
		CO5	**Explain the Materials for Opto – Electronic Devices**
18EE643	**COMPUTER AIDED ELECTRICAL DRAWING**	**CO1**	**Develop armature winding diagram for DC and AC machines**
		CO2	**Develop a Single Line Diagram of Generating Stations and substation using the standard symbols.**
		CO3	**Construct sectional views of core and shell types transformers using the design data**
		CO4	**Construct sectional views of assembled DC and AC machine and their parts using the design data or the sketches**

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		CO5	**Construct sectional views of assembled AC machine and their parts using the design data or the sketches**
18EE644	**EMBEDDED SYSTEMS**	**CO1**	**Identify the Embedded system components.**
		CO2	**Apply technological aspects to various interfacing with devices.**
		CO3	**Elaborate various design tradeoffs.**
		CO4	**Apply software aspects and programming concepts to the design of Embedded System.**
		CO5	**Explain how to interface subsystems with external systems.**
18EE645	**OBJECT ORIENTED PROGRAMMING USING C++**	**CO1**	**Explain the basics of Object Oriented Programming concepts.**
		CO2	**Apply the object initialization and destroy concept using constructors and destructors.**
		CO3	**Apply the concept of polymorphism to implement compile time polymorphism in programs by using overloading methods and operators.**
		CO4	**Utilize the concept of inheritance to reduce the length of code and evaluate the usefulness.**
		CO5	**Apply the concept of run time polymorphism by using virtual functions, overriding functions and abstract class in programs. Utilize I/O operations and file streams in programs.**
18EEL66	**CONTROL SYSTEM LABORATORY**	**CO1**	**Utilize software package and discrete components in assessing the time and frequency domain response of a given second order system.**
		CO2	**Design, analyze and simulate Lead, Lag and Lag – Lead compensators for given specifications.**
		CO3	**Determine the performance characteristics of ac and DC servomotors and synchro-transmitter receiver pair used in control systems.**
		CO4	**Simulate the DC position and feedback control system to study the effect of P, PI, PD and PID controller and Lead compensator on the step response of the system.**
		CO5	**Develop a script files to plot Root locus, Bode plot and Nyquist plot to study the stability of Control system**
18EEL67	**DIGITAL SIGNAL PROCESSING LABORATORY**	**CO1**	**Explain physical interpretation of sampling theorem in time and frequency domains.**
		CO2	**Evaluate the impulse response of a system.**
		CO3	**Perform convolution of given sequences to evaluate**

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			the response of a system.
		CO4	**Compute DFT and IDFT of a given sequence using the basic definition and/or fast methods.**
		CO5	**Provide a solution for a given difference equation. Design and implement IIR and FIR filters.**
18EE71	**POWER SYSTEM ANALYSIS – 2**	**CO1**	**Formulate network matrices and models for solving load flow problems.**
		CO2	**Perform steady state power flow analysis of power systems using numerical iterative techniques.**
		CO3	**Solve issues of economic load dispatch and unit commitment problems.**
		CO4	**Analyze short circuit faults in power system networks using bus impedance matrix.**
		CO5	**Apply Point by Point method and Runge Kutta Method to solve Swing Equation.**
18EE72	**POWER SYSTEM PROTECTION**	**CO1**	**Discuss performance of protective relays, components of protection scheme and relay terminology over current protection.**
		CO2	**Explain the working of distance relays and the effects of arc resistance, power swings, line length and source impedance on performance of distance relays.**
		CO3	**Discuss pilot protection, construction, operating principles and performance of differential relays and discuss protection of generators, motors, transformer and Bus Zone Protection.**
		CO4	**Explain the construction and operation of different types of circuit breakers.**
		CO5	**Outline features of fuse, causes of overvoltages and its protection, also modern trends in Power System Protection.**
18EE731	**SOLAR AND WIND ENERGY**	**CO1**	**Discuss the importance of the role of renewable energy, the concept of energy storage and the principles of energy storage devices.**
		CO2	**Discuss the concept of solar radiation data and solar PV system fabrication, operation of solar cell, sizing and design of PV system.**
		CO3	**Describe the process of harnessing solar energy and its applications in heating and cooling.**
		CO4	**Explain basic Principles of Wind Energy Conversion, collection of wind data, energy estimation and site selection.**

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		CO5	**Discuss the performance of Wind-machines, energy storage, applications of Wind Energy and environmental aspects.**
18EE732	**SENSORS AND TRANSDUCERS**	**CO1**	**Classify the transducers and explain the need of transducers, their classification, advantages and disadvantages.**
		CO2	**Explain the working of various transducers and sensors. Outline the recent trends in sensor technology and their selection.**
		CO3	**Analyze the signal conditioning and signal conditioning equipment.**
		CO4	**Illustrate different configuration of Data Acquisition System and data conversion. Show knowledge of data transmission and telemetry.**
		CO5	**Explain measurement of non-electrical quantities - temperature, flow, speed, force, torque, power and viscosity.**
18EE733	**INTEGRATION OF DISTRIBUTED GENERATION**	**CO1**	**Explain energy generation by wind power and solar power.**
		CO2	**Discuss the variation in production capacity at different time scales,the size of individual units, and the flexibility in choosing locations with respect to wind and solar systems.**
		CO3	**Explain the performance of the system when distributed generation is integrated to the system.**
		CO4	**Discuss effects of the integration of DG: the increased risk of overload, increased losses, increased risk of overvoltages and increased levels of power quality disturbances.**
		CO5	**Discuss effects of the integration of DG: incorrect operation of the protection. Discuss the impact the integration of DG on power system stability and operation.**
18EE734	**ADVANCED CONTROL SYSTEMS**	**CO1**	**Discuss state variable approach for linear time invariant systems in both the continuous and discrete time systems. Develop of state models for linear continuous – time and discrete – time systems.**
		CO2	**Apply vector and matrix algebra to find the solution of state equations for linear continuous – time and discrete – time systems. Define controllability and observability of a system and test for controllability and observability of a given system.**

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		CO3	**Design pole assignment and state observer using state feedback.**
		CO4	**Develop the describing function for the nonlinearity present to assess the stability of the system.**
		CO5	**Develop Lyapunov function for the stability analysis of nonlinear systems.**
18EE735	**REACTIVE POWER CONTROL IN ELECTRIC POWER SYSTEMS**	**CO1**	**Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads.**
		CO2	**Observe various compensation methods in transmission lines.**
		CO3	**Distinguish demand side reactive power management & user side reactive power management.**
		CO4	**Construct model for reactive power coordination and effects of harmonics on electrical equipments.**
		CO5	**Discuss the Reactive Power Planning for the electricity boards.**
18EE741	**INDUSTRIAL DRIVES AND APPLICATIONS**	**CO1**	**Explain the advantages, choice and control of electric drive**
		CO2	**Explain the dynamics, generating and motoring modes of operation of electric drives**
		CO3	**Explain the selection of motor power rating to suit industry requirements**
		CO4	**Analyze the performance & control of DC motor drives using controlled rectifiers**
		CO5	**Analyze the performance & control of converter fed Induction motor, synchronous motor & stepper motor drives.**
18EE742	**UTILIZATION OF ELECTRICAL POWER**	**CO1**	**Discuss different methods of electric heating & welding.**
		CO2	**Discuss the laws of electrolysis, extraction, refining of metals and electro deposition process.**
		CO3	**Discuss the laws of illumination, different types of lamps, lighting schemes and design of lighting systems.**
		CO4	**Analyze systems of electric traction, speed time curves and mechanics of train movement.**
		CO5	**Explain the motors used for electric traction, their control & braking and power supply system used for electric traction.**
18EE743	**PLC and SCADA**	**CO1**	**Discuss history of PLC, its sequence of operation, advantages and disadvantages, main parts and their**

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			functions.
		CO2	**Describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming.**
		CO3	**Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, Seal-In Circuits, and Latching Relays commonly used with I/O module.**
		CO4	**Convert relay schematics and narrative descriptions into PLC ladder logic programs.**
		CO5	**Analyse PLC timer and counter ladder logic programs. Understand about SCADA systems and its subsystems.**
18EE744	**SMART GRID**	**CO1**	**Explain the concept of Smart grid enables the ElectricNet and need of smart grid.**
		CO2	**Outline the benefits and drivers of DC Power delivery system.**
		CO3	**Summarize the Intelligrid Architecture for the smart grid.**
		CO4	**Explain the Efficient Electric End-use Technology Alternatives.**
		CO5	**Discuss Demand side planning and Evaluation.**
18EE745	**ARTIFICIAL NEURAL NETWORK WITH APPLICATIONS TO POWER SYSTEMS**	**CO1**	**Develop Neural Network and apply elementary information processing tasks that neural network can solve.**
		CO2	**Develop Neural Network and apply powerful, useful learning techniques.**
		CO3	**Develop and Analyze multilayer feed forward network for mapping provided through the first network layer and error back propagation algorithm.**
		CO4	**Analyze and apply algorithmic type problems to tackle problems for which algorithms are not available.**
		CO5	**Develop and Analyze supervised/unsupervised, learning modes of Neural Network for different applications.**
18EEL76	**POWER SYSTEM SIMULATION LABORATORY**	**CO1**	**Develop a program in suitable package to assess the performance of medium and long transmission lines.**
		CO2	**Develop a program in suitable package to obtain the power angle characteristics of salient and non-salient pole alternator.**

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		CO3	**Develop a program in suitable package to assess the transient stability under three phase fault at different locations in a of radial power systems.**
		CO4	**Develop programs in suitable package to formulate bus admittance and bus impedance matrices of interconnected power systems.**
		CO5	**Use suitable package to solve power flow problem for simple power systems, to study unsymmetrical faults at different locations in radial power systems and to study optimal generation scheduling problems for thermal power plants.**
18EEL77	**RELAY AND HIGH VOLTAGE LABORATORY**	**CO1**	**Verify the characteristics of over current, over voltage, under voltage and negative sequence relay both electromagnetic and static type.**
		CO2	**Verify the characteristics of microprocessor based over current, over voltage, under voltage relays and distance relay.**
		CO3	**Show knowledge of protecting generator, motor and feeders. Analyze the spark over characteristics for both uniform and non-uniform configurations using High AC and DC voltages**
		CO4	**Measure high AC and DC voltages and breakdown strength of transformer oil.**
		CO5	**Draw electric field and measure the capacitance of different electrode configuration models. Show knowledge of generating standard lightning impulse voltage to determine efficiency, energy of impulse generator and 50% probability flashover voltage for air insulation.**
18EEP78	**PROJECT PHASE – I**	**CO1**	**Demonstrate a sound technical knowledge of their selected project topic.**
		CO2	**Undertake problem identification, formulation and solution.**
		CO3	**Design engineering solutions to complex problems utilizing a systems approach.**
		CO4	**Communicate with engineers and the community at large in written an oral forms.**
		CO5	**Develop interactive, communication, organization, time management, and presentation skills.**
18EE81	**POWER SYSTEM OPERATION AND CONTROL**	**CO1**	**Describe various levels of controls in power systems, architecture and configuration of SCADA.**
		CO2	**Develop and analyze mathematical models of Automatic Load Frequency Control.**

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		CO3	**Develop mathematical model of Automatic Generation Control in Interconnected Power system**
		CO4	**Discuss the Control of Voltage , Reactive Power and Voltage collapse.**
		CO5	**Explain security, contingency analysis, state estimation of power systems**
18EE821	**FACTS AND HVDC TRANSMISSION**	**CO1**	**Discuss transmission interconnections, flow of Power in an AC System, limits of the loading capability, dynamic stability considerations of a transmission interconnection and controllable parameters.**
		CO2	**Explain the basic concepts, definitions of flexible ac transmission systems and benefits from FACTS technology. Describe shunt controllers, Static Var Compensator and Static Compensator for injecting reactive power in the transmission system in enhancing the controllability and power transfer capability.**
		CO3	**Describe series Controllers Thyristor-Controlled Series Capacitor (TCSC) and the Static Synchronous Series Compensator (SSSC) for control of the transmission line current.**
		CO4	**Explain advantages of HVDC power transmission, overview and organization of HVDC system.**
		CO5	**Describe the basic components of a converter, the methods for compensating the reactive power demanded by the converter. Explain converter control for HVDC systems, commutation failure, control**
18EE822	**ELECTRICAL ESTMATION AND COSTING**	**CO1**	**Explain general principles of estimation and major applicable I.E. rules.**
		CO2	**Discuss wiring methods, cables used, design of lighting points and sub-circuits, internal wiring, wiring accessories and fittings, fuses and types.**
		CO3	**Discuss estimation of service mains and power circuits.**
		CO4	**Discuss estimation of overhead transmission and distribution system its components.**
		CO5	**Discuss types of substation, main components and estimation of substation.**
18EE823	**ELECTRIC VEHICLE TECHNOLOGIES**	**CO1**	**Explain the working of electric vehicles and recent trends**
		CO2	**Analyze different power converter topology used for**

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			electric vehicle application.
		CO3	Develop the electric propulsion unit and its control for application of electric vehicles.
		CO4	Design Electric and Hybrid Electric Vehicles
		CO5	Design converters for battery charging and explain transformer less topology.
18EE824	POWER SYSTESMEMPELSATNENRIN-VG	CO1	Discuss primary components of power system planning, planning methodology for optimum power system expansion and load forecasting.
		CO2	Understand economic appraisal to allocate the resources efficiently and appreciate the investment decisions. Discuss expansion of power generation and planning for system energy in the country, evaluation of operating states of transmission system, their associated contingencies and the stability of the system.
		CO3	Discuss principles of distribution planning, supply rules, network development and the system studies
		CO4	Discuss reliability criteria for generation, transmission, distribution and reliability evaluation and analysis, grid reliability, voltage disturbances and their remedies
		CO5	Discuss planning and implementation of electric – utility activities, market principles and the norms framed.
18EE825	ELECTRICAL POWER QUALITY	CO1	Define Power quality; evaluate power quality procedures and standards.
		CO2	Estimate voltage sag performance; explain principles of protection and Sources of transient over voltages.
		CO3	Identify various sources of harmonics, explain effects of harmonic distortion.
		CO4	Evaluate harmonic distortion, control harmonic distortion.
		CO5	Estimate power quality in distribution planning. Identify power quality issues in utility system.
18EEI85	INTERNSHIP	CO1	Gain practical experience within industry in which the internship is done. Acquire knowledge of the industry in which the internship is done.
		CO2	Apply knowledge and skills learned to classroom work.
		CO3	Develop a greater understanding about career options while more clearly defining personal

			career goals.
		CO4	Experience the activities and functions of professionals.
		CO5	Develop and refine oral and written communication skills.
18EE651	INDUSTRIAL SERVO CONTROL SYSTEMS(Open Elective)	CO1	Explain the evolution and classification of servos, with descriptions of servo drive actuators, amplifiers, feedback transducers, performance, and troubleshooting techniques.
		CO2	Discuss system analogs, vectors and transfer functions of differential equations. Discuss mathematical equations for electric servo motors, both DC and brushless DC servo motors.
		CO3	Represent servo drive components by their transfer function, to combine the servo drive buildingblocks into system block diagrams.
		CO4	Determine the frequency response techniques for proper servo compensation.
		CO5	Explain perform indices and performance criteria for servo systems and discuss the mechanical considerations of servo systems.
18EE652	PLC and SCADA (Open Elective)	CO1	Discuss history of PLC and describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming.
		CO2	Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, Seal-In Circuits, and Latching Relays commonly used with I/O module.
		CO3	Analyze PLC timer and counter ladder logic programs and describe the operation of different program control instructions
		CO4	Discuss the execution of data transfer instructions, data compare instructions and the basic operation of PLC closed-loop control system.
		CO5	Describe the operation of mechanical sequencers, bit and word shift registers, processes and structure of control systems and communication between the processes.
18EE653	RENEWABLE ENERGY RESOURCES(Open	CO1	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.

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	Elective)	CO2	Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
		CO3	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
		CO4	Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
		CO5	Discuss production of energy from biomass, biogas. Summarize tidal energy resources, sea wave energy and ocean thermal energy.
18EE654	TESTING AND COMMISSIONING OF POWER SYSTEM APPARATUS (Open Elective)	CO1	Describe the process to plan, control and implement commissioning of electrical equipment's.
		CO2	Differentiate the performance specifications of transformer and induction motor.
		CO3	Demonstrate the routine tests for synchronous machine, induction motor, transformer & switchgears.
		CO4	Describe corrective and preventive maintenance of electrical equipment's
		CO5	Explain the operation of an electrical equipment's such as isolators, circuit breakers, induction motor and synchronous machines.
18EE751	INDUSTRIAL MOTORS & CONTROL (Open Elective)	CO1	Basic principles of electric motors explain the procedure of selecting rating of the motor for any application.
		CO2	Classify DC motors, explain the torque speed characteristics and select a motor for an application.
		CO3	Classify Induction Motors, explain the torque speed characteristics and select a motor for an application.
		CO4	Explain the types of Starting and Breaking of Motors. Explain the different types of Speed Control of Motors
		CO5	Selection of Motors for Industrial Drives & Economic Selection of Electric Motors. Discuss Electrical Drawings, Installation, Maintenance & Safety
18EE752	SENSORS AND TRANSDUCERS (Open Elective)	CO1	Classify the transducers and explain the need of transducers, their classification, advantages and disadvantages.
		CO2	Explain the working of various transducers and sensors. Outline the recent trends in sensor technology and their selection.

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		CO3	**Analyze the signal conditioning and signal conditioning equipment. Illustrate different configuration of Data Acquisition System and data conversion.**
		CO4	**Show knowledge of data transmission and telemetry.**
		CO5	**Explain measurement of non-electrical quantities - temperature, flow, speed, force, torque, power and viscosity.**
18EE753	**ELECTRIC VEHICLES (Open Elective)**	**CO1**	**Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.**
		CO2	**Explain the working of electric vehicles and hybrid electric vehicles in recent trends.**
		CO3	**Model batteries, Fuel cells, PEMFC and super capacitors.**
		CO4	**Analyze DC and AC drive topologies used for electric vehicle application.**
		CO5	**Develop the electric propulsion unit and its control for application of electric vehicles.**
18EE754	**ELECTRICAL ENERGY CONSERVATION AND AUDITING (Open Elective)**	**CO1**	**Analyze about energy scenario nationwide and worldwide , also outline Energy Conservation Act and its features.**
		CO2	**Discuss load management techniques and energy efficiency.**
		CO3	**Understand the need of energy audit and energy audit methodology. Understand various pillars of electricity market design.**
		CO4	**Conduct energy audit of electrical systems and buildings.**
		CO5	**Show an understanding of demand side management and energy conservation.**

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Course Code	Course Name	CO Code	CO
18MAT31	Transform Calculus,Fourier series and Numerical Techniques	CO1	Use Laplace transform and inverse Laplace transform in solving differ integral equation arising in network analysis, control systems and fields of engineering.
		CO2	Demonstrate Fourier series to study the behaviour of periodic func and their applications in system communications, digital signal proce and field theory.
		CO3	Make use of Fourier transform and Z-transform to illustrate disc continuous function arising in wave and heat propagation, signals systems.
		CO4	Solve first and second order ordinary differential equations arising engineering problems using single step and multistep numerical methods
		CO5	Determine the extremals of functionals using calculus of variations solve problems arising in dynamics of rigid bodies and vibrational analysis
18EC32	Network Theory	CO1	Determine currents and voltages using source transformation/ source shifting/mesh/nodal analysis and reduce given network using star delta transformation/source transformation/ source shifting.
		CO2	Solve network problems by applying Superposition/ Thevenin's/Norton's/ Maximum Power Transfer/Millman's Network Theorems and electrical laws to reduce circuit complexities and to arrive at feasible solutions.
		CO3	Calculate current and voltages for the given circuit under transient condi tions and Apply Laplace transform to solve the given network.
		CO4	Solve the given network using specified two port network parameters - Z, Y ,T&h.
		CO5	Understand the concept of resonance and determine the parameters that characterize series/parallel Resonant Circuits.
18EC33	Electronic Devices	CO1	Understand the principles of semiconductor Physics
		CO2	Understand the principles and characteristics of different types of semiconductor devices
		CO3	Understand the fabrication process of semiconductor semiconductor Devices
		CO4	Utilize the mathematical models of semiconductor junctions for circuits and systems.
		CO5	Identify the mathematical models of MOS transistors for circuits and systems
18EC34	Digital System Design	CO1	Simplify and implement the Algebraic equations.
		CO2	Design the combinational logic circuits.
		CO3	Design the sequential circuits using SR, JK, D, T flip-flops.
		CO4	Analyze and design Mealy & Moore machines.
		CO5	Design applications of Combinational & Sequential Circuits.
18EC35	Computer Organization and Architecture	CO1	Explain the basic organization of a computer system.
		CO2	Describe the addressing modes, instruction formats and program control statement.
		CO3	Explain different ways of accessing an input/output device including interrupts.
		CO4	Illustrate the organization of different types of semiconductor and other

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			secondary storage memories.
		CO5	Illustrate simple processor organization based on hardwired control and micro programmed control.
18EC36	Power Electronics and Instrumentation	CO1	Build and test circuits using power electronic devices.
		CO2	Analyse and design-controlled rectifier, DC to DC converters, DC to AC inverters and SMPS.
		CO3	Define instrument errors. Develop circuits for multirange Ammeters, Voltmeters and Bridges to measure passive component values and frequency.
		CO4	Describe the principle of operation of Digital instruments.
		CO5	Use Instrumentation amplifier for measuring physical parameters & PLCs.
18ECL37	Electronic Devices and Instrumentation Laboratory	CO1	Recognize and demonstrate functioning of semiconductor power devices.
		CO2	Evaluate the characteristics, switching, power conversion and control by semiconductor power devices.
		CO3	Analyze the response and plot the characteristics of transducers such as LDR, Photo diode, etc.
		CO4	Design and test simple electronic circuits for measurement of temperature and resistance.
		CO5	Use circuit simulation software for the implementation and characterization of electronic circuits and devices.
18ECL38	Digital System Design Laboratory	CO1	Design, realize and verify De Morgan's Theorem, SOP, POS forms
		CO2	Demonstrate the truth table of various expressions and combinational circuits using logic gates.
		CO3	Design various combinational circuits such as adders, subtractors, com parators, multiplexers and demultiplexers.
		CO4	Construct flips-flops, counters and shift registers.
		CO5	Simulate Serial adder and Binary Multiplier.

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18CPC39	Constitution of India,Professional Ethics and Cyber Law	CO1	Describe and analyze the role and salient features of the Indian Constitution.
		CO2	Understand the structure and powers of the Union and State Executives.
		CO3	Relate to the procedures and provisions in the electoral process.
		CO4	Develop Engineering and Professional ethics and adopt the responsibilities expected of an Engineer
		CO5	Identify the Cybercrimes and describe laws for cyber safety measures.
18MAT41	Complex Analysis Probability & Statistical Methods	CO1	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
		CO2	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
		CO3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
		CO4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
		CO5	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.
18EC42	Analog Circuits	CO1	Understand the characteristics of BJTs and FETs.
		CO2	Design and analyze BJT and FET amplifier circuits
		CO3	Design sinusoidal and non-sinusoidal oscillators.
		CO4	Understand the functioning of linear ICs
		CO5	Design of Linear IC based circuits.
18EC43	Control Systems	CO1	Develop the mathematical model for electrical and mechanical systems
		CO2	Develop transfer function for a given control system using block diagram reduction techniques and signal flow graph method
		CO3	Determine time domain specificification for first and second order system.
		CO4	Determine stability of a system in the time domain using Routh Hurwitz criterion and root locus technique.
		CO5	Determine the stability of a system in the frequency domain using nyquist and bode plot.
18EC44	Engineering Statistics & Linear Algebra	CO1	Analyze and evaluate single and multiple random variables.
		CO2	Identify and associate Random Variables and Random Processes in Com munication events.
		CO3	Analyze and model the Random events in typical communication events to extract quantitative statistical parameters.
		CO4	Analyze and model typical signal sets in terms of a basis function set of Amplitude, phase and frequency.
		CO5	Demonstrate by way of simulation or emulation the ease of analysis em ploying basis functions, statistical representation and Eigen values.

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18EC45	Signals & Systems	CO1	Analyze the different types of signals and systems
		CO2	Determine the linearity, causality, time-invariance and stability proper ties of continuous and discrete time systems.
		CO3	Evaluate the convolution sum and integral
		CO4	Represent continuous and discrete signals & systems in frequency domain using Fourier representations
		CO5	Analyze discrete time signals and systems using Z-transforms
18EC46	Microcontroller	CO1	Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051
		CO2	Write 8051 Assembly level programs using 8051 instruction set.
		CO3	Explain the Interrupt system, operation of Timers/Counters and Serial port of 8051.
		CO4	Write 8051 Assembly language programs to generate square wave on 8051 I/O port pin using interrupt and C Programme to send & receive serial data using 8051 serial port.
		CO5	Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to 8051 using 8051 I/O ports
18ECL47	Microcontroller Laboratory	CO1	Enhance programming skills using Assembly language and C
		CO2	Write Assembly language programs in 8051 for solving simple problems that manipulate input data using different instructions of 8051.
		CO3	Interface different input and output devices to 8051 and control them using Assembly language programs.
		CO4	Interface the serial devices to 8051 and do the serial transfer using C programming.
		CO5	Develop applications based on Microcontroller 8051.
18ECL48	Analog Circuits Laboratory	CO1	Analyze Frequency response of JFET/MOSFET amplifier.
		CO2	Design BJT/FETs amplifier with and without feedback and evaluate their performance characteristics.
		CO3	Apply the knowledge gained in the design of BJT/FET circuits in Oscillators.
		CO4	Design analog circuits using OPAMPS for different applications.
		CO5	Simulate and analyze analog circuits that uses ICs for different electronic applications
18ES51	Technological Innovation Management and Entrepreneurship	CO1	Understand the fundamental concepts of Management and Entrepre neurship and opportunities in order to setup a business
		CO2	Identify the various organizations' architecture
		CO3	Describe the functions of Managers, Entrepreneurs and their social responsibilities
		CO4	Understand the components in developing a business plan
		CO5	Recognize the various sources of funding and institutions supporting entrepreneurs
		CO1	Determine response of LTI systems using time domain and DFT techniques.
		CO2	Compute DFT of real and complex discrete time signals.
		CO3	Compute DFT using FFT algorithms and linear filtering approach.

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18EC52	Digital Signal Processing	CO4	Design and realize FIR and IIR digital filters.
		CO5	Understand the DSP processor architecture
18EC53	Principles of Communication Systems	CO1	Analyze and compute performance of AM and FM modulation in the presence of noise at the receiver
		CO2	Analyze and compute performance of digital formatting processes with quantization noise.
		CO3	Multiplex digitally formatted signals at Transmitter
		CO4	Demultiplex the signals and reconstruct digitally formatted signals at the receiver
		CO5	Design /Demonstrate the use of digital formatting in Multiplexers, Vocoders and Video transmission
18EC54	Information theory & coding	CO1	Explain concept of Dependent & Independent Source, measure of information, Entropy, Rate of Information and Order of a source
		CO2	Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms
		CO3	Model the continuous and discrete communication channels using input, output and joint probabilities
		CO4	Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes
		CO5	Design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.
18EC55	Electromagnetic Waves	CO1	Evaluate problems on electrostatic force, electric field due to point, linear, volume charges by applying conventional methods and charge in a volume.
		CO2	Apply Gauss law to evaluate Electric fields due to different charge distributions and Volume Charge distribution by using Divergence Theorem.
		CO3	Determine potential and energy with respect to point charge and capacitance using Laplace equation and Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations.
		CO4	Calculate magnetic force, potential energy and Magnetization with respect to magnetic materials and voltage induced in electric circuits.
		CO5	Apply Maxwell's equations for time varying fields, EM waves in free space and conductors and Evaluate power associated with EM waves using Poynting theorem
18EC56	Verilog HDL	CO1	Write Verilog programs in gate, dataflow (RTL), behavioral and switch modeling levels of Abstraction.
		CO2	Design and verify the functionality of digital circuit/system using test benches
		CO3	Identify the suitable Abstraction level for a particular digital design.
		CO4	Write the programs more effectively using Verilog tasks, functions and directives
		CO5	Perform timing and delay Simulation and Interpret the various constructs in logic synthesis.
18ECL57	Digital Signal Processing Laboratory	CO1	Understand the concepts of analog to digital conversion of signals and frequency domain sampling of signals.
		CO2	Model the discrete time signals and systems and verify its properties and results.
		CO3	Implement discrete computations using DSP processor and verify the results.
		CO4	Realize the digital filters using a simulation tool and analyze the re sponse of the

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			filter for an audio signal
		CO5	Write programs using Matlab/Scilab/Octave to illustrate DSP concepts.
18ECL58	HDL Lab	CO1	Write the Verilog/VHDL programs to simulate Combinational circuits in Dataflow, Behavioral and Gate level Abstractions.
		CO2	Describe sequential circuits like flip flops and counters in Behavioral description and obtain simulation waveforms.
		CO3	Use FPGA/CPLD kits for down loading Verilog codes and check output.
		CO4	Synthesize Combinational and Sequential circuits on programmable ICs and test the hardware.
		CO5	Interface the hardware to the programmable chips and obtain the required output
18CIV59	Environmental Studies	CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
		CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
		CO3	Demonstrate ecology knowledge of a complex relationship between biotic and a biotic components.
		CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
		CO5	Relate to the latest Developments in Environmental Pollution Mitigation Tools.
18EC61	Digital Communication	CO1	Associate and apply the concepts of Bandpass sampling to well specified signals and channels
		CO2	Analyze and compute performance parameters and transfer rates for low pass and bandpass symbol under ideal and corrupted non band limited channels.
		CO3	Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels.
		CO4	Demonstrate that bandpass signals subjected to corruption and dis tortion in a bandlimited channel can be processed at the receiver to meet specified performance criteria.
		CO5	Understand the principles of spread spectrum communications
18EC62	Embedded Systems	CO1	Describe the architectural features and instructions of 32 bit microcontroller ARM Cortex M3.
		CO2	Apply the knowledge gained for Programming ARM Cortex M3 for different applications.
		CO3	Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
		CO4	Develop the hardware software co-design and firmware design approaches.
		CO5	Explain the need of real time operating system for embedded system applications.
18EC63	Microwave & Antennas	CO1	Describe the use and advantages of microwave transmission
		CO2	Analyze various parameters related to microwave transmission lines and waveguides
		CO3	Identify microwave devices for several applications
		CO4	Analyze various antenna parameters necessary for building a RF system

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		CO5	Recommend various antenna configurations according to the applications.
18EC641	Operating Systems	CO1	Explain the goals, structure, operation and types of operating systems
		CO2	Apply scheduling techniques to find performance factors.
		CO3	Explain organization of file systems and IOCS
		CO4	Apply suitable techniques for contiguous and non-contiguous memory allocation.
		CO5	Describe message passing, deadlock detection and prevention methods.
18EE653	Renewable Energy Sources	CO1	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
		CO2	Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications
		CO3	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
		CO4	Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
		CO5	Discuss production of energy from biomass, biogas
18ECL66	Embedded Systems Laboratory	CO1	Understand the instruction set of 32 bit microcontroller ARM Cortex M3, and the software tool required for programming in Assembly and C language.
		CO2	Develop assembly language programs using ARM Cortex M3 for different applications.
		CO3	Interface external devices and I/O with ARM Cortex M3.
		CO4	Develop C language programs and library functions for Embedded system applications.
		CO5	Analyze the functions of various peripherals, peripheral registers and power saving modes of ARM Cortex M3
18ECL67	Communication Systems	CO1	Design and test circuits for analog modulation and demodulation schemes viz., AM, FM, etc.
		CO2	Determine the characteristics and response of microwave waveguide
		CO3	Determine characteristics of microstrip antennas and devices & compute the parameters associated with it.
		CO4	Design and test the digital and analog modulation circuits and display the waveforms.
		CO5	Simulate the digital modulation systems and compare the error performance of basic digital modulation schemes.

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Course Code	Course Name	CO Code	CO
18MAT31	ENGINEERING MATHEMATICS III	CO1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
		CO2	Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
		CO3	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
		CO4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
		CO5	Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.
18ME32	MECHANICS OF MATERIALS	CO1	Understand simple, compound, thermal stresses and strains their relations and strain energy.
		CO2	Analyse structural members for stresses, strains and deformations.
		CO3	Analyse the structural members subjected to bending and shear loads.
		CO4	Analyse shafts subjected to twisting loads.
		CO5	Analyse the short columns for stability.
18ME33	Basic Thermodynamics	CO1	Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems.
		CO2	Evaluate the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics.
		CO3	Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers and change in properties.
		CO4	Interpret the behavior of pure substances and its application in practical problems.
		CO5	Recognize differences between ideal and real gases and evaluate thermodynamic properties of ideal and real gas mixtures using various relations.
18ME34	MATERIAL SCIENCE	CO1	Understand the mechanical properties of metals and their alloys.
		CO2	Analyze the various modes of failure and understand the microstructures of ferrous and non-ferrous materials.
		CO3	Describe the processes of heat treatment of various alloys.
		CO4	Acquire the Knowledge of composite materials and their production process as well as applications.
		CO5	Understand the properties and potentialities of various materials available and material selection procedures.
18ME35A/ 45A	Metal Cutting and Forming	CO1	Explain the construction & specification of various machine tools.

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		CO2	Discuss different cutting tool materials, tool nomenclature & surface finish.
		CO3	Apply mechanics of machining process to evaluate machining time.
		CO4	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.
		CO5	Understand the concepts of different metal forming processes.
		CO6	Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal components

18ME35B/ 45B	METAL CASTING AND WELDING	CO1	Describe the casting process and prepare different types of cast products.
		CO2	Acquire knowledge on Pattern, Core, Gating, Riser system and to use Jolt, Squeeze, Sand Slinger Moulding machines.
		CO3	Compare the Gas fired pit, Resistance, Coreless, Electrical and Cupola Metal Furnaces.
		CO4	Compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mold castings.
		CO5	Understand the Solidification process and Casting of Non-Ferrous Metals.
		CO6	Describe the Metal Arc, TIG, MIG, Submerged and Atomic Hydrogen Welding processes etc. used in manufacturing.
		CO7	Describe methods for the quality assurance of components made of casting and joining process
18ME36A/ 46A	Computer Aided Machine Drawing	CO1	Identify the national and international standards pertaining to machine drawing.
		CO2	Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings
		CO3	Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.
		CO4	Interpret the Machining and surface finish symbols on the component drawings.
		CO5	Preparation of the part or assembly drawings as per the conventions.

18ME36B/ 46B	Mechanical Metrology and Measurements	CO1	Understand the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters.
		CO2	Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design
		CO3	Understand the working principle of different types of comparators.
		CO4	Explain measurement systems, transducers, intermediate modifying devices and terminating devices..
		CO5	Describe functioning of force, torque, pressure, strain and temperature measuring devices.
18ME37A/47A	Material testing lab	CO1	Acquire experimentation skills in the field of material testing.
		CO2	Develop theoretical understanding of the mechanical properties of materials by performing experiments.
		CO3	Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.

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		CO4	Apply the knowledge of testing methods in related areas.
		CO5	Know how to improve structure/behavior of materials for various industrial applications.
18ME37B/47B	MECHANICAL MEASUREMENTS AND METROLOGY LAB	CO1	Understand Calibration of pressure gauge, thermocouple, LVDT, load cell, micrometre.
		CO2	Apply concepts of Measurement of angle using Sine Centre/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set.
		CO3	Demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
		CO4	Analyse tool forces using Lathe/Drill tool dynamometer.
		CO5	Analyse Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth Vernier/Gear tooth micrometer
		CO6	Understand the concepts of measurement of surface roughness..

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18MEL38A /48A	WORKSHOP AND MACHINE SHOP PRACTICE	CO1	To read working drawings, understand operational symbols and execute machining operations.
		CO2	Prepare fitting models according to drawings using hand tools- V-block, marking gauge, files, hack drills etc.
		CO3	Understand integral parts of lathe, shaping and milling machines and various accessories and attachments used.
		CO4	Select cutting parameters like cutting speed, feed, depth of cut, and tooling for various machining operations.
		CO5	Perform cylindrical turning operations such as plain turning, taper turning, step turning, thread Cutting, facing, knurling, internal thread cutting, eccentric turning and estimate cutting time.
		CO6	Perform machining operations such as plain shaping, inclined shaping, keyway cutting, Indexing
18ME38B/ 48B	FOUNDRY, FORGING AND WELDING LAB	CO1	Demonstrate various skills in preparation of molding sand for conducting tensile, shear and compression tests using Universal sand testing machine.
		CO2	Demonstrate skills in determining permeability, clay content and Grain Fineness Number of base sands.
		CO3	Demonstrate skills in preparation of forging models involving upsetting, drawing and bending operations.
18CPC39/4 9	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)	CO1	Have constitutional knowledge and legal literacy.
		CO2	Understand Engineering and Professional ethics and responsibilities of Engineers.
		CO3	Understand the the cybercrimes and cyber laws for cyber safety measures.
18MAT41	ENGINEERING MATHEMATICS -IV	CO1	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
		CO2	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
		CO3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
		CO4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
		CO5	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

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18ME42	APPLIED THERMODYNAMICS	CO1	Apply thermodynamic concepts to analyze the performance of gas power cycles.
		CO2	Apply thermodynamic concepts to analyze the performance of vapour power cycles.
		CO3	Understand combustion of fuels and performance of I C engines.
		CO4	Understand the principles and applications of refrigeration systems.
		CO5	Apply Thermodynamic concepts to determine performance parameters of refrigeration and air-conditioning systems.
		CO6	Understand the working principle of Air compressors and Steam nozzles, applications, relevance of air and identify methods for performance improvement.
18ME43	FLUID MECHANICS	CO1	Identify and calculate the key fluid properties used in the analysis of fluid behavior.
		CO2	Explain the principles of pressure, buoyancy and floatation
		CO3	Apply the knowledge of fluid statics, kinematics and dynamics while addressing problems ofmechanical and chemical engineering.
		CO4	Describe the principles of fluid kinematics and dynamics.
		CO7	Explain the concept of boundary layer in fluid flow and apply dimensional analysis to form dimensionless numbers in terms of input output variables.
		CO6	Illustrate and explain the basic concept of compressible flow and CFD

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18ME44	KINEMATICS OF MACHINES	CO1	Knowledge of mechanisms and their motion.
		CO2	Understand the inversions of four bar mechanisms.
		CO3	Analyse the velocity, acceleration of links and joints of mechanisms.
		CO4	Analysis of cam follower motion for the motion specifications.
		CO5	Understand the working of the spur gears.
		CO6	Analyse the gear trains speed ratio and torque.
18ME51	MANAGEMENT AND ENGINEERING ECONOMICS	CO1	Understand needs, functions, roles, scope and evolution of Management
		CO2	Understand importance, purpose of Planning and hierarchy of planning and also54nalyse its types.
		CO3	Discuss Decision making, Organizing, Staffing, Directing and Controlling.
		CO4	Select the best economic model from various available alternatives.
		CO7	Understand various interest rate methods and implement the suitable one.
		CO6	Estimate various depreciation values of commodities.
18ME52	DESIGN OF MACHINE ELEMENTS I	CO1	Apply the concepts of selection of materials for given mechanical components.
		CO2	List the functions and uses of machine elements used in mechanical systems.
		CO3	Apply codes and standards in the design of machine elements and select an element based on the Manufacturer's catalogue.
		CO4	Analyse the performance and failure modes of mechanical components subjected to combined loading and fatigue loading using the concepts of theories of failure..
		CO5	Demonstrate the application of engineering design tools to the design of machine components like shafts, couplings, power screws, fasteners, welded and riveted joints.
		CO6	Understand the art of working in a team.
18ME53	DYNAMICS OF MACHINES	CO1	Determine the forces and couples for static and dynamic conditions of four bar and slider crank mechanisms to keep the system in equilibrium.
		CO2	Determine magnitude and angular position of balancing masses under static and dynamic condition of rotating masses in same and different planes.
		CO3	Determine unbalanced primary, secondary forces and couples in single and multi-cylinder engine.
		CO4	Determine sensitiveness, isochronism, effort and power of porter and hartnell governors.
		CO5	Determine gyroscopic couple and effects related to 2, 4 wheeler, plane disc, ship and aeroplanes.
		CO6	Understand types of vibration, SHM and methods of finding natural frequencies of simple mechanical systems.

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18ME54	TURBO MACHINES	CO1	Model studies and thermodynamics analysis of turbomachines.
		CO2	Analyse the energy transfer in Turbo machine with degree of reaction and utilisation factor.
		CO3	Classify, analyse and understand various type of steam turbine.
		CO4	Classify, analyse and understand various type of hydraulic turbine.
		CO5	Understand the concept of radial power absorbing machine and the problems involved during its operation
18ME55	FLUID POWER ENGINEERING	CO1	Explain the concept and scope of operations management in a business context
		CO2	Recognize the role of Operations management among various business functions and its role in the organizations' strategic planning and gaining competitive advantage.
		CO3	Analyze the appropriateness and applicability of a range of operations management systems/models in decision making.
		CO4	Assess a range of strategies for improving the efficiency and effectiveness of organizational operations.
		CO5	Evaluate a selection of frameworks used in the design and delivery of operations
18ME56	OPERATIONS MANAGEMENT	CO1	Explain the concept and scope of operations management in a business context
		CO2	Recognize the role of Operations management among various business functions and its role in the organizations' strategic planning and gaining competitive advantage.
		CO3	Analyze the appropriateness and applicability of a range of operations management systems/models in decision making.
		CO4	Assess a range of strategies for improving the efficiency and effectiveness of organizational operations.
		CO5	Evaluate a selection of frameworks used in the design and delivery of operations
18MEL57	FLUID MECHANICS AND MACHINES LAB	CO1	Perform experiments to determine the coefficient of discharge of flow measuring devices.
		CO2	Conduct experiments on hydraulic turbines and pumps to draw characteristics.
		CO3	Test basic performance parameters of hydraulic turbines and pumps and execute the knowledge in real life situations.
		CO4	Determine the energy flow pattern through the hydraulic turbines and pumps.
		CO5	Exhibit his competency towards preventive maintenance of hydraulic machines.
18MEL57	ENERGY CONVERSION LABORATORY	CO1	Perform experiments to determine the properties of fuels and oils.
		CO2	Conduct experiments on engines and draw characteristics.
		CO3	Test basic performance parameters of I.C. Engine and implement the knowledge in industry.
		CO4	Identify exhaust emission, factors affecting them and exhibit his competency towards preventive maintenance of IC engines.

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18CIV59	ENVIRONMENTAL STUDIES	CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,.
		CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
		CO3	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
		CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
18ME61	FINITE ELEMENT METHODS	CO1	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements..
		CO2	Develop element characteristic equation and generation of global equation.
		CO3	Formulate and solve Axi-symmetric and heat transfer problems.
		CO4	Apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi-symmetric and dynamic problems
18ME62	DESIGN OF MACHINE ELEMENTS II	CO1	Apply design principles for the design of mechanical systems involving springs, belts, pulleys, and wire ropes.
		CO2	Design different types of gears and simple gear boxes for relevant applications.
		CO3	Understand the design principles of brakes and clutches.
		CO4	Apply design concepts of hydrodynamic bearings for different applications and select Anti friction bearings for different applications using the manufacturers, catalogue.
		CO5	Apply engineering design tools to product design.
		CO6	Become good design engineers through learning the art of working in a team.
18ME63	HEAT TRANSFER	CO1	Understand the modes of heat transfer and apply the basic laws to formulate engineering systems.
		CO2	Understand and apply the basic laws of heat transfer to extended surface, composite material and unsteady state heat transfer problems.
		CO3	Analyze heat conduction through numerical methods and apply the fundamental principle to solve radiation heat transfer problems.
		CO4	Analyze heat transfer due to free and forced convective heat transfer.
		CO5	Understand the design and performance analysis of heat exchangers and their practical applications, Condensation and Boiling phenomena.
18ME641	NON-TRADITIONAL MACHINING	CO1	Understand the compare traditional and non-traditional machining process and recognize the need for Non- traditional machining process.
		CO2	Understand the constructional features, performance parameters, process characteristics, applications ,advantages and limitations of USM, AJM and WJM.
		CO3	Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations.
		CO4	Understand the constructional feature of the equipment, process parameters, process characteristics,applications, advantages and limitations EDM & PAM.
		CO5	Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM & EBM.
18ME642	REFRIGERATION AND AIR CONDITIONING	CO1	Illustrate the principles, nomenclature and applications of refrigeration systems.
		CO2	Explain vapour compression refrigeration system and identify methods for performance improvement
		CO3	Study the working principles of air, vapour absorption, thermoelectric and steam-jet and thermoacoustic refrigeration systems.
		CO4	Estimate the performance of air-conditioning systems using the principles of psychrometry.
		CO5	Compute and Interpret cooling and heating loads in an air-conditioning system.
		CO6	Identify suitable refrigerant for various refrigerating systems.
18ME643	THEORY OF ELASTICITY	CO1	Understand the Basic field equations of linear elastic solids, force, stress, strain and equilibrium in solids.
		CO2	Analyse the 2D structural elements, beams, cylinders.
		CO3	Use analytical techniques to predict deformation, internal force and failure of simple solids and structural components
		CO4	Analyse the axisymmetric structural elements.
		CO5	Analyse the structural members subjected to torsion

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		CO6	Determine the thermal stresses in plain stress and plane stain conditions.
18ME644	VIBRATIONS AND NOISE ENGINEERING	CO1	CO1: Characterize the single and multi-degrees of freedom systems subjected to free and forced vibrations with and without damping.
		CO2	Apply the method of vibration measurements and its controlling.
		CO3	Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation
		CO4	Analyze the mathematical model of a linear vibratory system to determine its response.
		CO5	Obtain linear mathematical models of reallife engineering systems.
		CO5	Apply the principles of vibration and noise reduction techniques to real life engineering problems.
18ME645	COMPOSITE MATERIALS TECHNOLOGY	CO1	Use different types of manufacturing processes in the preparation of composite materials
		CO2	Analyze the problems on macro mechanical 88ehavior of composites
		CO3	Analyze the problems on micromechanical 88ehavior of Composites
		CO4	Determine stresses and strains relation in composites materials.
		CO5	Understand and effective use of properties in design of composite structures
		CO6	Perform literature search on a selected advanced material topic.
18ME646	ENTREPRENEURSHIP DEVELOPMENT	CO1	understand the concept of Entrepreneur and Entrepreneurship and relevant roles
		CO2	learn creativity and entrepreneurial plan including Project Feasibility and Project Appraisal.
		CO3	understand Corporate entrepreneurship and issues related to Corporate entrepreneurship
		CO4	understand Family and Non Family Entrepreneur & Women entrepreneurs and women entrepreneurs in India.
		CO5	understand International Entrepreneurship Opportunities and Case studies on Indian Start ups
18ME651	NON CONVENTIONAL ENERGY SOURCES	CO1	Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations..
		CO2	Know the need of renewable energy resources, historical and latest developments.
		CO3	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation, drying, cooking etc.
		CO4	Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
		CO5	Understand the concept of Biomass energy resources and their classification, types of biogas Plants-applications
		CO6	Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.
		CO7	Acquire the knowledge of fuel cells, wave power, tidal power and geothermal principles and applications.

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18ME652	WORLD CLASS MANUFACTURING	CO1	Understand recent trends in manufacturing.
		CO2	Demonstrate the relevance and basics of World Class Manufacturing.
		CO3	Understand customization of product for manufacturing.
		CO4	Understand the implementation of new technologies.
		CO5	Compare the existing industries with WCM industries.
18ME653	SUPPLY CHAIN MANAGEMENT	CO1	Understand the framework and scope of supply chain management.
		CO2	Build and manage a competitive supply chain using strategies, models, techniques and information technology
		CO3	To comprehend the working of steering and suspension systems
		CO4	Plan the demand, inventory and supply and optimize supply chain network.
		CO5	Understand the emerging trends and impact of IT on Supply chain.
18ME654	ADVANCED MATERIALS TECHNOLOGY	CO1	Explain the concepts and principles of advanced materials and manufacturing processes.
		CO2	Understand the applications of all kinds of Industrial materials.
		CO3	Apply the material selection concepts to select a material for a given application.
		CO4	Define Nanotechnology, Describe nano material characterization.
		CO5	Understand the behaviour and applications of smart materials, ceramics, glasses and non-metallic materials
18MEL66	COMPUTER AIDED MODELLING AND ANALYSIS LAB	CO1	Use the modern tools to formulate the problem, create geometry, descritize, apply boundary conditions to solve problems of bars, truss, beams, and plate to find stresses with different-loading conditions.
		CO2	Demonstrate the ability to obtain deflection of beams subjected to point, uniformly distributed and varying loads and use the available results to draw shear force and bending moment diagrams.
		CO3	Analyze and solve 1D and 2D heat transfer conduction and convection problems with different boundary conditions.
		CO4	Carry out dynamic analysis and finding natural frequencies of beams, plates, and bars for various boundary conditions and also carry out dynamic analysis with forcing functions.
18MEL67	HEAT TRANSFER LAB	CO1	Determine the thermal conductivity of a metal rod and overall heat transfer coefficient of composite slabs.
		CO2	Determine convective heat transfer coefficient for free and forced convection and correlate with theoretical values.
		CO3	Evaluate temperature distribution characteristics of steady and transient heat conduction through solid cylinder experimentally.
		CO4	Determine surface emissivity of a test plate and Stefan Boltzmann constant
		CO5	Estimate performance of a refrigerator and effectiveness of a fin and Double pipe heat exchanger
		CO5	Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function.

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Course Code	Course Name	CO Code	CO
18PHY12/22	ENGINEERING PHYSICS	CO1	Understand various types of oscillations and their implications,the role of Shock waves in various fields and recognize the elastic properties of materials for Engineering Applications
		CO2	Realize the interrelation between time varying electric field and magnetic field, the transverse nature of EM waves and their role in optical fiber communication
		CO3	Compute Eigen values ,Eigen FUnctions ,momentum of Atomic and subatomic particales using Time Independent 1-D Schrodinger's wave equatin.
		CO4	Apprehend theoretical background of laser, construction and working of different types of laser and its applications in different fields
		CO5	Understand various electrical and thermal properties of materials like conductors, semiconductors and dielectrics using different theoretical models
18PHYL16/26	ENGINEERING PHYSICS LAB	CO1	Develop skills to impart practical knowledge in real time solution.
		CO2	Understand principle, concept working and application of new technology and comparison of results with theoretical calculations.
		CO3	Design new instruments with practical knowledge.
		CO4	Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoretical problems.
		CO5	Understand measurement technology, usage of new instruments and real time applications in engineering studies.
18ELE13/23	BASIC ELECTRICAL ENGINEERING	CO1	Analysis of DC and AC circuits.
		CO2	Principle and operation of Dc machines
		CO3	Analysis single phase and 3 phase AC circuits. concept of electrical wiring and protective
		CO4	Principle and operation of synchronous machines
		CO5	Principle and operation of single phase transformer ,concept of electrical wiring and protective devices
18EGDL15/25	ENGINEERING GRAPHICS	CO1	Understand the BIS conventions use of Standard tools, coordinate system and reference plane. Apply the concept of orthographic Projection of Points
		CO2	Apply the concept of Orthographic projection for solving Problems on Straight Lines in different position in reference planes
		CO3	Apply the concept of Orthographic projection for solving Problems on Plane Surfaces in different positions
		CO4	Apply the concept of Orthographic projection for solving Problems on 3D elements such as Solids in different
		CO5	Analyse the 2D sketch represent in 3D solids in combination and apply the principle of section of solids for developing the lateral surfaces.
18CIV14/24	ELEMENTS OF CIVIL ENGINEERING AND MECHANICS	CO1	Know basics of Civil Engineering, its scope of study, knowledge about Roads, Bridges and Dams.
		CO2	Comprehend the action of Forces, Moments and other loads on systems of rigid bodies.
		CO3	Compute the reactive forces and the effects that develop as a result of the external loads..
		CO4	Locate the Centroid and compute the Moment of Inertia of regular crosssections

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		CO5	Express the relationship between the motion of bodies.
18CHE12/22	Engineering Chemistry	CO1	use of free energy in equillibria, rationalise bulk properties and processes using thermodynamic considerations, electrochemical energy systems
		CO2	Causes and effects of corrosion of metals and control of corrosion. Modification of surface properties of metals to develop resistance to corrosion, wear, tear, impact etc, by electroplating and electroless plating
		CO3	Solve problems using recurrence relations and generating functions. : Production and consumption of energy for industrialization of country and living standards of people. Electrochemical and concentration cells. Classical. Modern batteries and fuel cells. Utilization of solar energy for different useful forms of energy
		CO4	Environmental pollution, waste management and water chemistry
		CO5	Different techniques of instrumental methods of analysis. Fundamental principles of nano materials
18CHEL16/26	Engineering Chemistry Lab	CO1	Handling different types of Instruments & techniques for analysis including pH measurement, Conductivity, Redox titrations
		CO2	Key spectroscopic techniques including Flame photometry & colorimetry
		CO3	Handling apparatus such as Viscometer in determining Viscosity of Various Liquids.
		CO4	Carrying out types of titrations for Estimation of concerned materials using Internal indicator method
		CO5	Carrying out types of titrations for Estimation of concerned materials using comparatively more quantities of materials involved for good results by External indicator or Iodometric method
18MAT11	Engineering Mathematics I	CO1	Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of a curve
		CO2	Learn the notion of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and Jacobians
		CO3	Apply the concept of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes
		CO4	Solve first order linear/ nonlinear differential equation analytically using standard methods
		CO5	Make use of matrix theory for solving system of linear equations and compute eigenvalues and eigenvectors required for matrix diagonalization process
18MAT21	Engineering Mathematics 2	CO1	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.
		CO2	Demonstrate various physical models through higher order differential equations and solve such linear ordinary differential equations.
		CO3	Construct variety of Partial differential equations and solution by exact methods/method of separation of variables.
		CO4	Explain the applications of infinite series and obtain series solution of ordinary differential equations
		CO5	Apply the knowledge of numerical methods in the modeling of various physical and engineering phenomena.
18CPS13/23	C Programming for Problem Solving	CO1	Understand the fundamentals of Computer, algorithm, Flowchart, Basic of C Program.
		CO2	Understand the concepts of Conditional Branching, Looping and I/O Operations.
		CO3	Understand the Concepts of Arrays and how to implement in real time Problems

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		CO4	Understand the Concepts of functions and Recursions and how to implement in real time problems.
		CO5	Understand the Concepts of Structures, Pointers and Preprocessor directives
18CPL17/27	COMPUTER PROGRAMMING LAB	CO1	Understand the basic concepts of Computers.
		CO2	Develop the program for mathematical operations and Real time applications.
		CO3	Develop the program for mathematical operations using arrays and functions
		CO4	Develop the program for Real time applications using strings.
		CO5	Develop the program for mathematical operations using pointers.
18ELN14/24	BASIC ELECTRONICS	CO1	Understand the significance of electronics in different applications &applications of diode in rectifiers, filter circuits and wave shaping and Apply the concept of diode in rectifiers, filters circuits.
		CO2	Design simple circuits like amplifiers (inverting and non inverting), comparators, adders, integrator and differentiator using OPAMPS,
		CO3	Compile the different building blocks in digital electronics using logic gates and implement simple logic function using basic universal gates
		CO4	Understand the functioning of a communication system, and different modulation technologies, and
		CO5	Understand the basic principles of different types of Transducers.
18ELEL27/17	BASIC ELECTRICAL ENGINEERING LAB-CO	CO1	Identifying the common electrical components and measuring instruments
		CO2	compare power factor of lamp
		CO3	determination of impedance of an electrical circuits power consumed by 3 phase load
		CO4	determination of two way and three way lamp
		CO5	understanding of earthing.