TECHNO INDIA UNIVERSITY
WEST BENGAL

Syllabus for 4 Years **B.Tech** (**Electrical and Computer Engineering**)

3rd Semester						
Sl no.	**Course Code**	**Course Name**	**Contact Periods per Week**			**Credits**
			L	T	P	
Theory						
2	TIU-UMA-T201	Mathematics-III (Transform Calculus and Numerical methods)	3	1	0	4
3	TIU-UEE-T203	Electrical Circuit Theory	3	1	0	4
4	TIU-UCS-T203	Computer Organization and Architecture	3	0	0	3
5	TIU-UEE-T207	Analog Electronics	3	1	0	4
6	TIU-UEN-T201	Career Advancement and Skill Development	2	1	0	3
Practical / Sessional						
7	TIU-UEE-L203	Electrical Circuit Theory Lab	0	0	3	1.5
8	TIU-UCS-L203	Computer Organization and Architecture Lab	0	0	3	1.5
9	TIU-UCS-L205	Mathematics –III Lab (Numerical Methods)	0	0	2	1
Total Credit Points						

Detailed Syllabus

3rd Semester - BTech (E&CE)		
Mathematics-III (Transform Calculus and Numerical methods)		
TIU-UMA-T201	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Laplace transform and its application ● Fourier series and its application ● Numerical methods	
Detailed Syllabus **UNIT – I: Transform Calculus** Laplace Transform: Laplace Transform, properties, Inverse, Convolution, Evaluation of some particular integrals by Laplace Transform, Solution of initial value problems. Fourier Series : Periodic functions, Fourier series representation of a function, half range series, sine and cosine series, Fourier integral formula, Parseval's identity. Fourier Transform: Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self-reciprocity of Fourier Transform, convolution theorem. Applications to boundary value problems. **UNIT II: Numerical Methods** Approximations and round off errors, Truncation errors and Taylor Series. Interpolation – Newton's Forward, Backward, Lagrange's Divided Difference. Numerical Integration – Trapezoidal, Simpson's 1/3rd . Determination of roots of polynomials and transcendental equations by Bisection, Iteration, Newton-Raphson, Regula-Falsi. Solutions of linear simultaneous linear algebraic equations by Gauss Elimination and GaussSiedel iteration methods. Curve fitting- linear and nonlinear regression analysis. Numerical solution of initial value problems by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method.		
Text / References	1. Introductory Methods of Numerical Analysis by SS Sastry 2. Numerical Anslysis by SA Mollah 3. Numerical Mathematical Analysis by JB Scarborough 4. Integral Transform by Goyal Gupta 5. Integral Transforms and their Applications by Lokenath Debnath, Dambaru Bhatta	

3rd Semester - BTech (E&CE)		
Electrical Circuit Theory		
TIU-UEE-T203	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● To understand basic electrical properties. ● To provide a methodical approach to problem solving. ● To analyze electrical circuits by using a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and several methods of simplifying networks. ● To understand the concept of graphical solution to electrical network ● To develop a clear understanding of the important parameters of a magnetic circuit. ● To analyze various types of filters and attenuators. ● Different types of two-port network analysis using network parameters, with different types of connections	

Detailed Syllabus

Module 1: Introduction (14 hours)
Linear and Nonlinear, Lumped and Distributed, Passive and Active networks, Independent & Dependent sources, Various parameters of a circuit, Network Theorems, Mesh and Node Analysis, Star- Delta conversion, Source conversion., Phasors, Impedance, Reactance Admittance, Impedance triangle, Power triangle, Resonance, Polyphase circuits.

Module 2: Laplace Transform (2 hours)
Concept of complex frequency, transform of standard periodic and non-periodic waveforms, Initial and Final value Theorems.

Module 3: Transient analysis (4 hours)
Transient and steady state response of RL, RC, LC and RLC circuits in transient with or without stored energy– solutions in t & s domains, Concept of natural frequency and damping. Sketching transient response, determination of peak values. Practical applications.

Module 4: Coupled Circuits (4 hours)
Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modelling of coupled circuits, Solution of problems.

Module 5: Graph Theory (4 hours)
Graph of network, Concept of tree branch, tree link, tie set and cut set, Incidence matrices

<table>
<tr><td colspan="2">and their properties, loop currents and node-pair potentials, formulation of equilibrium equations on the loop and node basis, Duality.

Module 5: Two Port Networks (5 hours)
Impedance and admittance parameters, transmission and inverse transmission parameters, hybrid and inverse hybrid parameters. Series, parallel and cascade connections of two port networks. Elements of realisability and synthesis of one port network.

Module 6: Filter Circuits (3 hours)
Analysis and synthesis of Low pass, High pass, Band pass, Band reject, All pass filters (first and second order only)

Module 7: Network Functions (4 hours)
Introduction, Transfer functions and Driving Point functions, analysis of ladder and non-ladder networks, poles and zeros of Network Functions, Time Domain Response from Pole- Zero Behaviour.</td></tr>
<tr><td>Text / References</td><td>1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
5. Bhattacharya and Singh, “Network Analysis and Synthesis”, Pearson,
6. A. Chakrabarti, :Circuit Theory: Analysis & Synthesis”, S. Chand</td></tr>
</table>

3rd Semester - BTech (E&CE)		
Computer Organization and Architecture		
TIU-UCS-T203	**L-T-P: 3-0-0**	**Credits: 3**
Course Outcomes	At the end of the course, students will learn ● To understand the basic laws of electromagnetism. ● To obtain the electric and magnetic fields for simple configurations under static ● conditions. ● To analyse time varying electric and magnetic fields. ● To understand Maxwell's equation in different forms and different media. ● To understand the propagation of EM waves.	
Detailed Syllabus **Module 1: Introduction to computer organization (6 hours)** Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization. **Module 2: Memory organization (6 hours)** System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks. **Module 3: Input – output Organization (8 hours)** Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus. **Module 4: 16 and 32 microprocessors (8 hours)** 80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86 **Module 5: Pipelining (8 hours)** Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set. **Module 6: Different Architectures (8 hours)** VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming		
Text / References	1. V. Carl, G. Zvonko and S. G. Zaky, "Computer	

	organization",McGraw Hill, 1978. 2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education, 2000. 3. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kauffman, 2011. 4. W. Stallings, "Computer organization", PHI, 1987. 5. P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann, 2012. 6. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall, 2004. 7. Y. C. Lieu and G. A. Gibson, "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India, 1986. 8. J. Uffenbeck, "The 8086/8088 Design, Programming, Interfacing", Prentice Hall, 1987. 9. B. Govindarajalu, "IBM PC and Clones", Tata McGraw Hill, 1991. 10. P. Able, "8086 Assembly Language Programming", Prentice Hall India.

<table>
<tr><td colspan="3">3rd Semester - BTech (E&CE)</td></tr>
<tr><td colspan="3">Analog Electronics</td></tr>
<tr><td>TIU-UEE-T207</td><td>L-T-P: 3-1-0</td><td>Credits:</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">At the end of the course, students will learn to
Understand the characteristics of transistors.
Design and analyse various rectifier and amplifier circuits.
Design sinusoidal and non-sinusoidal oscillators.
Understand the functioning of OP-AMP and design OP-AMP based circuits.</td></tr>
<tr><td colspan="3">Detailed Syllabus

Module 1: Diode circuits (4 Hours)
P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module 2: BJT circuits (8 Hours)
Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Module 3: MOSFET circuits (8 Hours)
MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 4: Differential, multi-stage and operational amplifiers (8 Hours)
Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module 5: Linear applications of op-amp (8 Hours)
Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

Module 6: Nonlinear applications of op-amp (6 Hours)
Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.</td></tr>
<tr><td>Text / References</td><td colspan="2">1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.</td></tr>
</table>

	2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U.S., 1992. 3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988. 4. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.

4th Semester						
Sl no.	**Course Code**	**Course Name**	**Contact Periods per Week**			**Credits**
			L	T	P	
Theory						
1	TIU-UEN-T200	Career Advancement and Skill Development	2	1	0	3
2	TIU-UMA-T202	Mathematics-IV(Probability & Statistics)	3	0	0	3
3	TIU-UCS-T208	Automata Theory and Logic	3	1	0	4
4	TIU-UEE-T206	Signals & Systems	3	1	0	4
5	TIU-UCS-T302	Data Structure and Algorithms	3	0	0	3
6	TIU-UEE-T303	Digital Electronics	3	1	0	4
Practical / Sessional						
7	TIU-UCS-L302	Data Structure and Algorithms Lab	0	0	3	1.5
8	TIU-UEE-L206	Digital Electronics Circuits Lab	0	0	3	1.5
9	TIU-UES-S298	Entrepreneurship Skill Development	0	0	2	2
Total Credit Points						

Detailed Syllabus

4th Semester - BTech (E&CE)		
Mathematics-IV (Probability & Statistics)		
TIU-UMA-T202	**L-T-P: 3-0-0**	**Credits: 3**
Course Outcomes	At the end of the course, students will learn to ● Develop problem-solving techniques needed to accurately calculate probabilities. ● Apply problem-solving techniques to solving real-world events. ● Apply selected probability distributions to solve problems. ● Present the analysis of derived statistics to all audiences.	
Detailed Syllabus **Module-1: Probability (8 hours)** Classical, relative frequency and axiomatic definitions of probability, Mutually exclusive events, Independent events, conditional probability, Bayes' Theorem. **Module-2: Random Variables (6 hours)** Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments. **Module-3: Distributions (6 hours)** Uniform, Binomial, Geometric, Poisson, Negative binomial, Exponential, Normal distributions. **Module-4: Joint Distributions (4 hours)** Joint and marginal distribution. **Module-5: Random process (4 hours)** Stationary processes. Mean and covariance functions. Ergodicity. **Module-6: Statistics (6 hours)** Graphical representation of data, Frequency distributions, measures of central tendencies – mean, median, mode, measures of dispersion – standard deviation, variance, Measures of skewness and kurtosis, Bivariate data, Principle of Least Squares, curve fitting.		
Text / References	1. Probability Statistics for Engineers and Scientists by Sheldon Ross	

4th Semester - BTech (E&CE)		
Automata Theory and Logic		
TIU-UCS-T208	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn to ● Develop a formal notation for strings, languages and machines. ● Design finite automata to accept a set of strings of a language. ● Prove that a given language is regular and apply the closure properties of languages. ● Design context free grammars to generate strings from a context free language and convert them into normal forms. ● Prove equivalence of languages accepted by Push Down Automata and languages generated by context free grammars ● Identify the hierarchy of formal languages, grammars and machines. ● Distinguish between computability and non-computability and Decidability and undecidability.	
Detailed Syllabus Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages. Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata. Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs. Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. Turing machines: The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators. Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.		
Text / References	1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia. 2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.	

	3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer. 4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing. 5. John Martin, Introduction to Languages and The Theory of Computation, McGraw Hill.

4th Semester - BTech (E&CE)		
Signals and Systems		
TIU-UEE-T206	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Understand the concepts of continuous time and discrete time systems. ● Analyse systems in complex frequency domain. ● Understand sampling theorem and its implications.	

Detailed Syllabus

Module 1: Introduction to Signals and Systems (3 hours)
Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Module 2: Behavior of continuous and discrete-time LTI systems (8 hours)
Impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Module 3: Fourier, Laplace and z- Transforms (10 hours)
Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behaviour. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Module 4: Sampling and Reconstruction (4 hours)
The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text / References	1. Oppenheim, Willsky and Nawab, “Signals and systems”, Prentice Hall India 2. Haykin and Veen, “Signals and Systems”, John Wiley and Sons 3. Oppenheim and Schafer, “Discrete-Time Signal Processing”, Prentice Hall

4th Semester - BTech (E&CE)		
Data Structure and Algorithms		
TIU-UCS-T302	**L-T-P: 3-0-0**	**Credits: 3**
Course Outcomes	At the end of the course, students will learn ● about the fundamental data types and structures used in different programming environments ● about the construction and operational behaviours of arrays, linked-lists, stacks, queues, trees, etc.; ● about discrete structures like sets, graphs, etc. ● how to analyse algorithms and compute their complexities ● how to compute optimal paths in graphs ● about data flow and management in a programme	

Detailed Syllabus

Basic Concepts of Data Representation (2 Hours)
Abstract Data Types, Fundamental and Derived Data Types, Representation, Primitive Data Structures.

Introduction to Algorithm Design and Data Structures (4 Hours)
Design and Analysis of Algorithm: Algorithm Definition, Comparison of Algorithms, Top-Down and Bottom Up Approaches to Algorithm Design, Analysis of Algorithm, Complexity Measures in Terms of Time and Space, Structured Approach to Programming.

Arrays (6 Hours)
Representation of Arrays, Single and Multidimensional Arrays, Address Calculation Using Column and Row Major Ordering, Various Operations on Arrays; Application of Arrays Matrix Multiplication, Sparse Polynomial Representation and Addition.

Stacks and Queues (8 Hours)
Representation of Stacks and Queues, Using Arrays and Linked-List; Circular Queues Priority Queue and D-Queue; Applications of Stacks, Conversion from Infix to Postfix and Prefix Expressions, Evaluation of Postfix Expression Using Stacks.

Linked Lists: (8 Hours)
Singly Linked List, Operations on List, Linked Stacks and Queues, Polynomial Representation and Manipulation Using Linked Lists, Circular Linked Lists, Doubly Linked Lists, Generalized List Structure, Sparse Matrix Representation Using Generalized List Structure.

Trees (10 Hours)
Binary Tree Traversal Methods, Preorder, In-Order, Post-Order Traversal (Recursive And Non-Recursive), Algorithms for Above Mentioned Traversal Methods; Representation of

Trees and Its Applications Binary Tree Representation of a Tree, Conversion of Forest into Tree, Threaded Binary Trees, Lexical Binary Trees, Decision and Game Trees, Binary Search Tree: Height Balanced (AVL) Tree, B-Trees, B+ Tree. **Searching, Sorting and Complexity (6 Hours)** Searching: Sequential and Binary Searches, Indexed Search, Hashing Schemes. Sorting: Insertion, Selection, Bubble, Quick, Merge, Radix, Shell, Heap Sort. Comparison of Time Complexity. **Graphs (2 Hours)** Graph Representation, Adjacency Matrix, Adjacency Lists, Traversal Schemes, Depth First Search and Breadth First Search**.**	
Text / References	1. Horowitz and Sahani, Data Structure using C, 2. Lipshutz, Data Structures with C, Mc-Graw Hill. 3. Robert Lafore, Data Structures and Algorithms In Java, Sams. 4. A.M. Tennenbaum, Y. Langsam and M. J. Augenstein, Data Structures Using C, PHI, 1996. 5. D. E. Knuth, The Art of Computer Programming-Vol-I & Vol-II, Narosa Publication.

4th Semester - BTech (E&CE)		
Digital Electronic Circuits		
TIU-UEE-T303	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Understand working of logic families and logic gates. ● Design and implement Combinational and Sequential logic circuits. ● Understand the process of Analog to Digital conversion and Digital to Analog conversion. ● Be able to use PLDs to implement the given logical problem.	

Detailed Syllabus

Module 1: Fundamentals of Digital Systems and logic families (7Hours)
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

Module 2: Combinational DigitalCircuits (7Hours)
Standard representation for logic functions, K-map representation, simplification of Logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/ generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems (7Hours)
A 1-bit memory, the circuit properties of bistable latch, the clocked SR flip flop, J- K-T And D types flipflops, applications of flipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Module 4: A/D and D/A Converters (7Hours)
Digital to analog converters: weighted resistor/ converter, R-2R Ladder D/A converter specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage of frequency and voltage to time conversion, specifications of A/D converter example of A/D converter ICs.

Module 5: Semiconductor memories and Programmable logic devices. (7Hours)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	
Text / References	1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009. 2. Mano, "Digital logic and Computer design", Pearson Education India, 2016. 3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

5th Semester						
Sl no.	**Course Code**	**Course Name**	**Contact Periods per Week**			**Credits**
			L	T	P	
Theory						
6	TIU-UEE-T301	Career Advancement & Skill Development (C and Python)	2	1		3
1	TIU-UEE-T307	Control Systems	3	1		4
2	TIU-UEE-T309	Microprocessors & Microcontrollers	3	0		3
3	TIU-UEE-T321	Electrical Machines	3	1		4
4	TIU-UEE-T323	Electrical Power Systems	3	1		4
5	TIU-UCS-T303	Operating Systems	3	1		4
Practical / Sessional						
7	TIU-UEE-L309	Microprocessor & Microcontroller Lab			3	1.5
8	TIU-UEE-L323	Electrical Power Systems Lab			3	1.5
9	TIU-UEE-L307	Control Systems Lab			3	1.5
10	TIU-UEE-L321	Electrical Machines Lab			3	1.5
11	TIU-UES-S397	Entrepreneurship Skill Development			3	2
Total Credit Points						

Detailed Syllabus

<table>
<tr><td colspan="3">5th Semester - BTech (E&CE)</td></tr>
<tr><td colspan="3">Career Advancement & Skill Development (C and Python)</td></tr>
<tr><td>TIU-UEE-T301</td><td>L-T-P: 3-0-0</td><td>Credits: 3</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">At the end of the course, students will
● have a refresher on the C programming language
● learn to programme in Python
● learn to tackle real-life scientific problems and challenges with Python</td></tr>
<tr><td colspan="3">Detailed Syllabus

Part 1: Refresher on Programming with C
Introduction to C and standard C compilers like GCC, Clang, etc.; C data types; built-in functions; conditionals; loops; arrays; functions; pointers; structures and unions; C pre-processors; file operations;

Part 2: Programming with Python
Basics of Python; fundamental data types and classes; lists, sets, dictionaries, etc.; conditionals, loops, etc.; functions, iterators, generators, list comprehension, etc.; overview of the built-in modules and classes; file operations;
Basics of scientific computing with Python; introduction to NumPy; array manipulation and basic linear algebra with NumPy; introduction to SciPy; calculating derivatives, integrals, etc. and solving algebraic equations, ODEs, etc.; introduction to plotting with matplotlib;</td></tr>
<tr><td>Text / References</td><td colspan="2">1. C Programming Language by Kernighan and Ritchie
2. Learning Python by Mark Lutz
3. Learning Scientific Programming with Python by Hill
4. Elegant SciPy: The Art of Scientific Python by Nunez-Iglesias, van der Walt</td></tr>
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5th Semester - BTech (E&CE)		
Control systems		
TIU-UEE-T307	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Understand the modelling of linear-time-invariant systems using transfer function and state-space representations. ● Understand the concept of stability and its assessment for linear-time invariant systems. ● Design simple feedback controllers.	

Detailed Syllabus

Module 1: Introduction to control problem (4 hours)
Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Module 2: Time Response Analysis (10 hours)
Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module 3: Frequency-response analysis (6 hours)
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Module 4: Introduction to Controller Design (10 hours)
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Module 5: State variable Analysis (6 hours)
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear

discrete-time systems.

Module 6: Introduction to Optimal Control and Nonlinear Control (5 hours)
Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

Text / References	1. K. Ogata, "Modern Control Engineering", Prentice Hall 2. H K Khalil, "Nonlinear Control", PHI 3. M Gopal, "Digital Control and State Variable Methods", McGraw Hill

5th Semester - BTech (E&CE)		
Microprocessors and microcontrollers		
TIU-UEE-T309	**L-T-P: 3-0-0**	**Credits: 3**
Course Outcomes	At the end of the course, students will learn ● Understand the architecture and timing diagram of 8085 and 8086 microprocessor. ● Understand programmable logic and peripheral devices. ● Understand the architecture of 8051 microcontroller. ● Understand the basic interfacing devices.	

Detailed Syllabus

Module-1: Introduction (08 hours)
Introduction to 8085 microprocessor, pin descriptions, internal architecture, buses, vector interrupts circuit, instruction sets and addressing modes, programming examples.

Module-2: Timing Diagram (02 hours)
Timing state diagrams for some 8085 based instructions.

Module-3: Memory and I/O address (04 hours)
Memory and I/O address mapping, partial and full address decoding.

Module-4: Programmable devices (08 hours)
Programmable peripheral devices like 8255A, 8253, 8259, 8257, 8279 and 8251, 8-bit ADC and DAC.

Module-5: 8051 microcontroller (06 hours)
Introduction to 8051 microcontroller, pin descriptions, internal architecture, buses, internal and external vector interrupts, instruction sets and addressing modes, programming examples. Memory mapped external memory and I/O addresses decoding.

Module-6: PIC microcontroller (06 hours)
Introduction to 8-bit PIC microcontroller, pin descriptions, instruction sets, programming examples.

Module-7: 8086 microprocessor (06 hours)
Introduction to 8086 microprocessor, pin descriptions, internal architecture, buses, minimum mode and maximum mode of operations, description of various interrupts, instruction sets and addressing modes, programming examples.

Module-8: Interfacing (06 hours)
Applications- LED, LCD, and keyboard interfacing, stepper motor interfacing, DC motor interfacing, sensor interfacing, illumination control, alternator excitation controller, temperature controller.

Text / References	1. Microprocessor Architecture, Applications: Ramesh S. Gaonkar 2. 8051 Microcontrollers: Mazidi, Mazidi 3. Intel Microprocessors: B Bray

5th Semester - BTech (E&CE)		
Electrical Machines		
TIU-UEE-T321	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● To understand the basic laws of electromagnetism, Fleming's rule and Lenz's Law, ● Principle of operation and construction of D.C Generators and Motors, Emf equation, Torque Equation etc. ● All the functional characteristic and use of D.C Generator and Motors ● Functional and constructional details of single phase and three phase transformers. ● Vector group and all types of connections. ● This course shall have Lectures and Tutorials. Most of the students find difficult to visualize Electrical Machines and their windings and finally machine laboratory will help to clear most of the doubts.	

Detailed Syllabus

Module 1: **General introduction to electrical machines (5 hours)**
Faraday's laws of electromagnetic induction, Fleming's rule and Lenz's Law. Principle of operation of generators and motors. Space distribution of flux density and time variation of voltage. Flux wave in DC and AC machines. Magnetic curves and their relevance.

Module 2: DC Machines (8 hours)
Detailed construction and operating principle. Materials used for D.C. machines. Function of commutator and brush system. Induced emf in DC machine. Separate, Shunt, Series and Compound excitation. Losses and efficiency. Voltage builds up of DC shunt generator. DC motoring action. Torque developed in DC motor. Armature windings, Equalisers. Armature reaction & its effects, mmf distribution,
Compensating windings, Interpoles, Laminated yoke construction. Commutation, sparking, brushes, interface film. DC Generators – Characteristics with different excitation systems, voltage regulation, parallel operation. DC Motors – Characteristics and applications of Separate, Shunt, Series and Compound motors, methods of starting, speed control, equivalent circuit. Series-parallel operation of motors. Introduction to Permanent Magnet DC machines. Testing of DC machines – Swinburne test, Hopkinson's test, Brake test, Tests specified as per standards.

Module 3: 1-phase Transformers (8 hours)
Construction and basic principle of operation. Core type and shell type. Materials used for core, winding and insulation. EMF equation. Core loss, copper loss and Leakage reactances. Harmonics in magnetizing current and magnetizing in-rush current. Generalized derivation of electrical equivalent circuit from magnetic structure. Equivalent

circuit referred to primary. Phasor diagram. Parallel operation. Effects of changes of frequency and voltage on transformer performance. Dry-type and oil cooled type. Natural and forced types of cooling. Tank and radiator construction, operation. Transformer oil. Transformer accessories, e.g., conservator, breather, Bucholtz relay, bushing, etc. Power and Distribution Transformers, all-day efficiency. Testing of transformers: Polarity of windings, OC and SC test, separation of losses, determination of equivalent circuit parameters. Regulation, efficiency, Single phase auto-transformers, principle of operation, phasor diagram. Comparison of weight, copper loss equivalent reactance with 2-winding transformer.

Module 4 : 3-phase Transformers (6 hours)
As a single unit with name plate rating and as a bank of three single phase transformers; Vector groups for various connections; per phase analysis; Qualitative explanation for origin of harmonic current and voltage and its suppression tertiary winding. Parallel operation conditions and load sharing. Autotransformer: Basic constructional features; VA conducted magnetically and electrically. Comparative study with two winding transformer.

Module 5: Induction Machines (8 Hours)
Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque, Equivalent circuit, Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances,
stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Module 6: Synchronous machines (8 Hours)
Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text / References

1. Performance and Design of Alternating Current Machines: M.G. Say
2. Performance and Design of DC machines: Clayton & Hancock.
3. Principles of Alternating Current machinery: Lawrence
4. Electrical Machinery : A. E. Fitzgerald & C. Kingsley
5. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
6. M. G. Say, "Performance and design of AC machines",CBS Publishers, 2002.
7. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
8. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
9. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.

5th Semester - BTech (E&CE)		
Power Systems		
TIU-UEE-T323	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Students will be able to learn the basics of various fundamentals of electrical power generation, transmission & distribution. ● Students will be able to learn electrical characteristics of transmission line such as types of transmission lines, various effects on transmission & per unit representation of power system. ● Students will be able to learn load flow studies and its equation, Comparison of various methods like GS & NR. ● Students will be able to learn Mechanical design along with the types of insulators also ● The knowledge of voltage distribution across the string and introduction to HV, LV and EHV. ● Students will be able to learn information regarding conductors and insulation, different types of underground cable parameters.	

Detailed Syllabus

Module1: Overhead transmission lines (12 hours)
Overhead transmission line: Types of conductors, Inductance and Capacitance of a single phase and three phase symmetrical and unsymmetrical configurations. Bundle conductors. Transposition. Concept of GMD and GMR. Influence of earth on conductor capacitance. Overhead line construction: Line supports, Towers, Poles, Sag, Tension and Clearance, Effect of Wind and Ice on Sag. Dampers.

Module 2 : Insulators, Corona and Cables (10 hours)
Insulators: Types, Voltage distribution across a suspension insulator string, String efficiency, Arching shield & rings, Methods of improving voltage distribution across Insulator strings, Electrical tests on line Insulators. Corona: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona. Methods of reduction of Corona. Cables: Types of cables, cable components, capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.

Module 3 : Performance of lines (8 hours)
Performance of lines: Short, medium (nominal, T) and long lines and their representation. A.B.C.D constants, Voltage regulation, Ferranti effect, Power equations and line compensation, Power Circle diagrams.

Module 4 : Generation of Electric Power, Tariff and Electricity rules (10 hours) Generation of Electric Power: General layout of a typical coal fired power station, hydroelectric power station, Nuclear power station, their components and working principles, comparison of different methods of power generation. Introduction to Solar & Wind energy system. Tariff: Guiding principle of Tariff, different types of tariff. Indian Electricity Rule-1956: General Introduction.	
Text / References	1. Power System Engineering by D Kothari, I Nagrath. 2. Electrical Power Systems by C.L.Wadhwa. 3. A Course in Power Systems by J.B. Gupta.

5th Semester - BTech (E&CE)		
Operating Systems		
TIU-UCS-T303	**L-T-P: 3-1-0**	**Credits:4**
Course Outcomes	At the end of the course, students will ● learn the mechanisms of OS to handle processes and threads and their communication ● learn the mechanisms involved in memory management in contemporary OS ● gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols ● know the components and management aspects of concurrency management ● learn to implement simple OS mechanisms	
Detailed Syllabus **Module 1** Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System. **Module 2** Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of Multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling		

criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Module 3

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Module 4

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Module 5

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.
Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Module 6

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Text / References	1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition. 2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

6th Semester						
Sl no.	**Course Code**	**Course Name**	**Contact Periods per Week**			**Credits**
			L	T	P	
Theory						
1	TIU-UCS-T304	Computer Networks	2			3
2	TIU-UCS-T306	Web Technologies	3	1		4
3	TIU-UCS-E306	Soft Computing	3	1		4
4	TIU-UEE-T306	Digital Signal Processing	3	1		4
5	TIU-UEE-T308	Power Electronics	3	1		4
6	TIU-UCS-T202	Object Oriented Programming and Design	3	1		4
Practical / Sessional						
7	TIU-UCS-L304	Computer Networks Lab			3	1.5
8	TIU-UCS-L306	Web Technologies Lab			3	1.5
9	TIU-UEE-L306	Digital Signal Processing Lab			3	1.5
10	TIU-UCS-L202	Object Oriented Programming and Design Lab			3	1.5
11	TIU-UES-S398	Entrepreneurship Skill Development			2	2
Total Credit Points						

Detailed Syllabus

<table>
<tr><td colspan="3">6th Semester - BTech (E&CE)</td></tr>
<tr><td colspan="3">Computer Networks</td></tr>
<tr><td>TIU-UCS-T304</td><td>L-T-P: 3-1-0</td><td>Credits: 4</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">At the end of the course, students will learn
● To develop an understanding of modern network architectures from a design and performance perspective.
● To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
● To provide an opportunity to do network programming
● To provide a WLAN measurement ideas.</td></tr>
<tr><td colspan="3">Detailed Syllabus

Module 1
Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Module 2
Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Module 3
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Module 4
Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Module 5
Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography</td></tr>
<tr><td>Text / References</td><td colspan="2">1. Data Communication and Networking, 4th Edition, Behrouz A.</td></tr>
</table>

	Forouzan, McGraw-Hill. 2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India. 3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition. 4. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India. 5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

6th Semester - BTech (E&CE)		
Soft Computing		
TIU-UCS-E306	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn to •	
Detailed Syllabus		
Text / References	1. .	

6th Semester - BTech (E&CE)		
Web Technologies		
TIU-UCS-T306	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn to •	
Detailed Syllabus		
Text / References	2. .	

6th Semester - BTech (EE)		
Digital Signal Processing		
TIU-UEE-T306	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Represent signals mathematically in continuous and discrete-time, and in the frequency domain. ● Analyse discrete-time systems using z-transform. ● Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms. ● Design digital filters for various applications. ● Apply digital signal processing for the analysis of real-life signals.	

Detailed Syllabus

Module 1: Discrete-time signals and systems (6 hours)
Discrete time signals and systems: Sequences, representation of signals on orthogonal basis, Representation of discrete systems using difference equations, Sampling and reconstruction of signals-aliasing, Sampling theorem and Nyquist rate.

Module 2: Z-transform (6 hours)
z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

Module 3: Discrete Fourier Transform (10 hours)
Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Module 4: Design of Digital filters (12 hours)
Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations, Low-pass, Band-pass, Band-stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Module 5: Applications of Digital Signal Processing (6 hours)
Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Text / References	1. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall 2. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications"

6th Semester - BTech (EE)		
Power Electronics		
TIU-UEE-T308	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Understand the differences between signal level and power level devices. ● Analyse controlled rectifier circuits. ● Analyse the operation of DC-DC choppers. ● Analyse the operation of voltage source inverters.	

Detailed Syllabus

Module 1: Power switching devices (12 Hours)
Introduction, Concept of Power Electronics, Applications of power electronics, Advantages and disadvantages of power-electronic converters, Power electronic systems, Power semiconductor devices, Types of power electronic converters, Power electronic modules, Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers (6 Hours)
Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module 3: DC-DC buck converter (6 Hours)
Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module 4: DC-DC boost converter (4 Hours)
Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 5: Single-phase voltage source inverter (6 Hours)
Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

Module 6: Three-phase voltage source inverter (6 Hours)
Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation.

Text / References	1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education, India, 2009. 2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007. 3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007. 4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009. 5. M D Singh and K B Khanchandani, “Power Electronics”, McGraw Hill. 6. P. S. Bimbhra, “Power Electronics”, Khanna Publishers.

6th Semester - BTech (EE)		
Object Oriented Programming and Design		
TIU-UCS-T202	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests.	
Detailed Syllabus Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example. Features of object-oriented programming. Encapsulation, object identity, polymorphism – but not inheritance. Inheritance in OO design. Design patterns. Introduction and classification. The iterator pattern. Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features. Memory management. Generic types and collections GUIs. Graphical programming with Scala and Swing The software development process. The concepts should be practised using C++ and Java.		
Text / References	1. Barbara Liskov, Program Development in Java, Addison-Wesley, 2001	

7th Semester						
Sl no.	**Course Code**	**Course Name**	**Contact Periods per Week**			**Credits**
			L	T	P	
Theory						
1		Electric Drives	3	1		4
2		Power Systems - III	3	1		4
3		Utilization of Electric Power	3			3
4		Elective-II A) Special Electrical Machines B) AI and Soft Computing	3			3
5		Career Advancement & Skill Development (Electrical Safety)	3			2
Practical / Sessional						
6		Electric Drives Lab			3	1.5
7		Electrical Machine Design			3	1.5
8		Elective Project and Seminar			3	2
Total Credit Points						**21**

7th Semester - BTech (EE)		
Electric Drives		
TIU-	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Classify electrical drives, and justify multi-quadrant operation of drives along with load equalization. ● Analyze the thermal model and determine the motor rating for different duty cycles considering the effect of load inertia and environmental factors. ● Appraise different starting and braking methods of electric motors. ● Appraise the speed and frequency control method of Induction motor and synchronous motor. ● Identify suitable form of electrical drives system in Industry.	

Detailed Syllabus

Module 1: Electric Drive (05 Hours)
Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multi quadrant operation of drives. Load equalization.

Module 2: Motor power rating: (05 Hours)
Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors.

Module 3: Stating of Electric Drives and Braking of Electric Drives (08 Hours)
Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time Energy relation during stating, methods to reduce the Energy loss during starting.
Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking.

Module 4: DC motor drives (06 Hours)
Modeling of DC motors, State space modeling, block diagram & Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor current chopper controlled DC motor drives.

Module 5: Induction motor drives (06 Hours)

Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.

Module 6: Synchronous motor drives (05 Hours)
Variable frequency control, Self-Control, Voltage source inverter fed synchronous motor drive, Vector control.

Module 7: Industrial application (05 Hours)
Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive.
Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.

Text / References	1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication. 2. Electric Drives, Vedam Subrahmanyam, TMH. 3. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication.

7th Semester - BTech (EE)		
Power Systems - III		
TIU-	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Understand methods to control the voltage, frequency and power flow. ● Understand the concepts of monitoring and control of a power system and solve state estimation problems. ● Understand the basics of power system economics and solve scheduling problems. ● Understand the concepts of power system transients.	

Detailed Syllabus

Module 1: Control of Frequency and Voltage (16 hours)
Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters. Reactive Power Sensitivity and Voltage Control; Load

Compensation with Capacitor Banks; Line Compensation with Reactors; Shunt and Series Compensation; Fixed Series Capacitors; Thyristor Controlled Series Capacitors; **Module 2: Monitoring and Control (6 hours)** Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control. **Module 3: Power System Economics and Management (16 hours)** Basic Pricing Principles: Generator Cost Curves, Economic Operation of Thermal System; Plant Scheduling; Transmission Loss and Penalty Factor; Hydro-Thermal Scheduling; Concept of Reserves and Constraints; Unit Commitment; Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework. **Module 4: Power System Transients (8 hours)** Types of System Transients; Overvoltage in Transmission Lines; Propagation of Surges and Travelling Waves; Protection against Lightning and Surges;	
Text / References	1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994. 2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995. 3. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003. 4. Wood and Wollenberg, “Electric Power generation, operation and control”, Willey 5. P. Kundur, “Power System Stability and Control”.

7th Semester - BTech (EE)		
Utilization of Electric Power & Illumination Engineering		
TIU-	**L-T-P: 3-0-0**	**Credits: 3**
Course Outcomes	At the end of the course, students will learn to ● Understand the basics of lighting and illumination and its parameters. ● Study the basic principles of illumination and its measurement. ● Acquaint with the different types of heating and welding techniques. ● Understand the basic principles of electric traction including speed–time curves of different traction services.	

Detailed Syllabus

Module 1: Traction: (10 hours)
System of Traction Electrification, Train movement & energy consumption (Speed-time curves, Crest speed, Average speed & Schedule speed), Tractive effort, Factors affecting energy consumption (Dead weight, Acceleration weight & Adhesion weight), Protective devices.

Module 2: Electric Traction motor & their control (10 hours)
Starting, braking with special emphasis on power electronic controllers, Current collector, Interference with telecommunication circuit. A brief outline of linear Induction motor principle in Traction.

Module 3: Illumination (10 hours)
Laws of illumination, Polar cuvees, Photometry, Integrating sphere, Types of Lamps: Conventional and Energy Efficient, Basic principle of Light control, Different lighting scheme & their design methods, Flood and Street lighting.

Module 4: Heating (6 hours)
Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating

Module 5: Welding (6 hours)
Resistance welding, Arc welding, Ultrasonic welding, Electron bean welding, Laser beam welding, Requirement for good welding, Power supplies for different welding schemes.

Text / References	1. Utilization of Electric Energy: Taylor. 2. Art & Science of Utilization of Electrical Energy: Partab 3. Modern Utilization of Electric Power Including Electric Drives and Electric Traction: Pradip Kumar Sadhu, Soumya Das.

7th Semester - BTech (EE)		
Elective - II **A) Special Electrical Machines**		
TIU-	**L-T-P: 3-0-0**	**Credits: 3**
Course Outcomes	At the end of the course, students will learn to ● Understand the open loop and closed loop systems stepper motors. ● Describe construction, working principle and characteristics of Switched Reluctance Motor (SRM). ● Describe construction, working principle and characteristics of Permanent Magnet Brushless DC (BLDC) Motors.	

	• Analyze the torque speed characteristics and transfer function of Permanent Magnet Synchronous Motors (PMSM) • Understand the open loop and closed loop systems for servo motors. • Describe construction, working principle and characteristics of Tacho generators, Synchros & resolvers, Linear Induction motor

Detailed Syllabus

Module 1: STEPPER MOTORS (12 hours)
Stepper motor Constructional features, Principle of operation, Special features of stepper motors, Variable reluctance, Permanent magnet stepping motor, Torque versus stepping rate characteristics.

Module 2: SWITCHED RELUCTANCE MOTORS (12 hours)
Switched Reluctance Motor Constructional features, Principle of operation, Torque equation,
Characteristics, Control Techniques, and Drive Concept.

Module 3: PERMANENT MAGNET BRUSHLESS DC MOTORS (12 hours)
Commutation in DC motors, Difference between mechanical- and electronic-commutators, Torque and EMF equation, Rotor position sensors, Multiphase Brushless DC motor, square wave permanent magnet brushless DC motor drives and their torque-speed characteristics.

Module 4: PERMANENT MAGNET SYNCHRONOUS MOTORS (12 hours)
Principle of operation, EMF, Power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics.

Module 5: SERVOMOTORS (12 hours)
Servomotor, Constructional features, Principle of Operation, Types, Characteristics, Control Tacho generators, Synchros & resolvers, Linear Induction motor.

Text / References	1. Electrical Machinery, P.S. Bhimra, Khanna Publishers. 2. Electrical Machines, Nagrath & Kothary, TMH 3. Electrical Machines, Theory & Applications, M.N. Bandyopadhyay, PHI

7th Semester - BTech (EE)		
Elective - II B) **AI and soft computing**		
TIU-	**L-T-P: 3-0-0**	**Credits: 3**

Course Outcomes	At the end of the course, students will learn ●
Detailed Syllabus	
Text / References	1.

7th Semester - BTech (EE)		
Career Advancement & Skill Development (Electrical Safety)		
TIU-	**L-T-P: 3-0-0**	**Credits: 2**
Course Outcomes	At the end of the course, students will learn ●	
Detailed Syllabus		
Text / References	1.	

7th Semester - BTech (EE)		
Electric Drives Lab		
TIU-UEE-L	**L-T-P: 0-0-3**	**Credits: 1.5**
List of Experiments		

7th Semester - BTech (EE)		
Electrical Machine Design		
TIU-UEE-L	**L-T-P: 0-0-3**	**Credits: 1.5**

List of Experiments

7th Semester - BTech (EE)		
Elective Project and Seminar		
TIU-UEE-L	**L-T-P: 0-0-3**	**Credits: 2**
List of Experiments		

8th Semester						
Sl no.	**Course Code**	**Course Name**	**Contact Periods per Week**			**Credits**
			L	T	P	
Theory						
1		Elective - III A) HVDC and FACTS B) EC and AUDIT	3	1		4
2		Principles of Management	3			3
3		Career Advancement and Skill Development (Renewable Energy Systems)	3			2
Practical / Sessional						
4		Elective Project and Seminar			3	2
5		General Viva-Voce				2
Total Credit Points						**13**

8th Semester - BTech (EE)		
Elective - III **A) HVDC and FACTS**		
TIU-	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn ● Understand the advantages of DC transmission over ac transmission. ● Understand the control strategies used in HVDC transmission system. ● Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation. ● Understand the working principles of FACTS devices and their operating characteristics.	

Detailed Syllabus

Module 1: Analysis of Line Commutated and Voltage Source Converters (10 hours)
Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Module 2: Control of HVDC Converters: (10 hours)
Principles of Link Control in a LCC HVDC system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVDC system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Module 3: Components of HVDC systems: (8 hours)
Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC systems DC line: Corona Effects. Insulators, Transient Over-voltages. Dc line faults in LCC systems. DC line faults in VSC systems. DC breakers. Monopolar Operation. Ground Electrodes.

Module 4: Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours)
Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Module 5: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)
Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Configurations/Modes

of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter. **Module 6: Voltage Source Converter based (FACTS) controllers (8 hours)** Voltage Source Converters (VSC): Six Pulse VSC, STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller.	
Text / References	1. P. Kundur, "Power System Stability and Control". 2. K. R. Padiyar, "HVDC Power Transmission Systems". 3. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems". 4. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution". 5. T. J. E. Miller, "Reactive Power Control in Electric Systems". 6. Xiao-Ping Zhang, Christian Rehtanz,Bikash Pal "Flexible AC Transmission Systems: Modelling and Control".

8th Semester - BTech (EE)		
Elective - III **B) Energy Conservation and Audit**		
TIU-	**L-T-P: 3-1-0**	**Credits: 4**
Course Outcomes	At the end of the course, students will learn to ● To enable the students to understand the concept of energy management and energy management opportunities ● To understand the different methods used to control peak demand ● To know energy auditing procedure ● To understand the different methods used for the economic analysis of energy projects. ● This course shall have Lectures only.	
Detailed Syllabus **Module 1**: **(2 hours)** **Principles of Energy Management:** General principles of Energy management and Energy management planning. **Module 1**: **(6 hours)** **Industrial Energy Management** Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal Load		

scheduling-Case studies. Energy management opportunities in Lighting and Motors. Electrolytic Process and Electric heating, Case studies. **Module 3**: **(10 hours)** **Energy conservation in Power plants** Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler. Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery. **HVAC system** **Module 4**: **(8 hours)** HVAC system: Coefficient of performance, Capacity, Factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Classification and Advantages of Waste Heat Recovery system, analysis of waste heat recovery for Energy saving opportunities **Energy Audit** **Module 5**: **(10 hours)** Energy audit - Definition, Need, Types of energy audit, Energy audit Instruments. Cogeneration-Types and Schemes, Optimal operation of cogeneration plants- Case study. Computer aided energy management Economic analysis methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.

Text / References	1. Albert Thumann, William J. Younger, “Handbook of Energy Audits”, CRC Press, 2003. 2. Charles M. Gottschalk, “Industrial energy conservation”, John Wiley & Sons, 1996. 3. Craig B. Smith, “Energy management principles”, Pergamon Press. 4. D. Yogi Goswami, Frank Kreith, “Energy Management and Conservation Handbook”, CRC Press, 2007 5. G.G. Rajan, “Optimizing energy efficiencies in industry”, Tata McGraw Hill, Pub.Co., 2001.

8th Semester - BTech (EE)		
Principles of Management		
TIU-	**L-T-P: 3-1-0**	**Credits:**

Course Outcomes	At the end of the course, students will learn to ●
Detailed Syllabus	
Text / References	1.

8th Semester - BTech (EE)		
Career Advancement and Skill Development (Renewable Energy Systems)		
TIU-	**L-T-P: 3-1-0**	**Credits: 2**
Course Outcomes	At the end of the course, students will learn to ● Understand the energy scenario and the consequent growth of the power generation from renewable energy sources. ● Understand the basic physics of wind and solar power generation. ● Understand the power electronic interfaces for wind and solar generation. ● Understand the issues related to the grid-integration of solar and wind energy systems.	

Detailed Syllabus

Module 1: Physics of Wind Power: (5 Hours)
History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and
power-cumulative distribution functions.

Module 2: Wind generator topologies: (12 Hours)
Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Module 3: The Solar Resource: (3 Hours)
Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Module 4: Solar photovoltaic: (8 Hours)
Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point

Tracking (MPPT) algorithms. Converter Control. **Module 5: Network Integration Issues: (8 Hours)** Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems. **Module 6: Solar thermal power generation: (3 Hours)** Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.	
Text / References	1. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005. 2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004. 3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.