JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE-R19

III Year – I SEMESTER

S. No	Course Code	Subjects	Category	L	T	P	Credits
1		Power Systems-II	EE	3	--	--	3
2		Power Electronics	EE	3	--	--	3
3		Linear IC Applications	ES	3	--	--	3
4		Digital Signal Processing	EE	3	--	--	3
5		Microprocessors and Microcontrollers	EE	3	--	--	3
6		Electrical Machines-II Laboratory	EE	--	--	3	1.5
7		Control Systems Laboratory	EE	--	--	2	1
8		Electrical Measurements & Instrumentation Laboratory	EE	--	--	3	1.5
9		Socially Relevant Projects	MC	--	--	1	1
		Total Credits		**15**	**0**	**9**	**20**

III Year – II SEMESTER

S. No	Course Code	Subjects	Category	L	T	P	Credits
1		Electric Drives	EE	3	--	--	3
2		Power System Analysis	EE	3	--	--	3
3		Data Structures	ES	3	--	--	3
4		Digital Control Systems	EE	3	--	--	3
5		**Elective - I**	EL	3	--	--	3
6		**Open Elective - I**	OE	3	--	--	3
7		Power Electronics Laboratory	EE	--	--	3	1.5
8		Microprocessors & Microcontrollers Laboratory	EE	--	--	3	1.5
9		Employability Skills	MC	3	--	--	0
		Total Credits		**18**		**6**	**21**

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
	POWER SYSTEMS–II				

Preamble:
This course is an extension of power systems–I course. It deals with basic theory of transmission lines modeling and their performance analysis. Transient in power system, improvement of power factor and voltage control are discussed in detail. It is important for the student to understand the mechanical design aspects of transmission lines, cables, insulators. These aspects are also covered in detail in this course.

Learning Objectives:
- To compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
- To study the short and medium length transmission lines, their models and performance.
- To study the performance and modeling of long transmission lines.
- To study the effect of travelling waves on transmission lines.
- To study the factors affecting the performance of transmission lines and power factor improvement methods.
- To discuss sag and tension computation of transmission lines as well as to study the performance of overhead insulators.

UNIT–I:
Transmission Line Parameters
Conductor materials - Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase and three phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors – Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for symmetrical and asymmetrical single and three phase–Single and double circuit lines- Bundled conductors.

UNIT–II:
Performance Analysis of Transmission Lines
Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T–Nominal-Pie and A, B, C, D Constants for symmetrical and Asymmetrical Networks.

Rigorous Solution for long line equations – Surge Impedance and SIL of Long Lines – Representation of Long lines – Equivalent T and Equivalent Pie network models - Mathematical Solutions to estimate regulation and efficiency of all types of lines.

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UNIT – III:
Power System Transients
Types of System Transients – Travelling or Propagation of Surges – Attenuation–Distortion– Reflection and Refraction Coefficients – Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions.

UNIT–IV:
Various Factors governing the Performance of Transmission line
Skin and Proximity effects – Description and effect on Resistance of Solid Conductors –Ferranti effect – Charging Current – Corona – Description of the phenomenon–Factors affecting corona– Critical voltages and power loss – Radio Interference.

UNIT–V:
Sag and Tension Calculations and Overhead Line Insulators
Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor – Stringing chart and sag template and its applications–Types of Insulators – String efficiency and Methods for improvement - Voltage distribution–Calculation of string efficiency – Capacitance grading and Static Shielding.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand parameters of various types of transmission lines during different operating conditions.
- understand the performance of short and medium transmission lines.
- understand travelling waves on transmission lines.
- understand various factors related to charged transmission lines.
- understand sag/tension of transmission lines and performance of line insulators.

Text Books:
1. Electrical power systems – by C.L.Wadhwa, New Age International (P) Limited, Publishers, 1998.
2. Modern Power System Analysis by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 2nd Edition

Reference Books:
1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition
2. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar A.Chakrabarthy, DhanpatRai& Co Pvt. Ltd.
4. Electrical Power Systems by P.S.R. Murthy, B.S.Publications.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
	POWER ELECTRONICS				

Preamble:
The usage of power electronics in day to day life has increased in recent years. It is important for student to understand the fundamental principles behind all these converters. This course covers characteristics of semiconductor devices, ac/dc, dc/dc, ac/ac and dc/ac converters. The importance of using pulse width modulated techniques to obtain high quality power supply (dc/ac converter) is also discussed in detail in this course.

Learning Objectives:
- To study the characteristics of various power semiconductor devices and to design firing circuits for SCR.
- To understand the operation of single phase full–wave converters and analyze harmonics in the input current.
- To study the operation of three phase full–wave converters.
- To understand the operation of different types of DC-DC converters.
- To understand the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.
- To analyze the operation of AC-AC regulators.

UNIT–I:
Introduction
Basic Theory of Operation - Static Characteristics-Two Transistors analogy -Turn on and Turn off Methods - Methods of SCR Triggering - Dynamic & Gate Characteristics of SCR - Series and Parallel Operation - Snubber circuit - Characteristics of Power MOSFET and IGBT.

UNIT–II:
Single Phase AC-DC Converters
Single Phase half wave controlled rectifiers - R load and RL load with and without freewheeling diode - Single Phase fully controlled bridge converter with R load, RL load and RLE load - Continuous and Discontinuous conduction - Effect of source inductance in 1-phase fully controlled bridge rectifier with continuous conduction – Expression for output voltages – Single Phase semi Converter with R load, RL load and RLE load – Continuous and Discontinuous conduction - Harmonic Analysis - Single Phase Dual Converters - Numerical Problems

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UNIT–III:
Three Phase AC-DC Converters & AC – AC Converters

Three Phase half wave Rectifier with R and RL load -Three Phase fully controlled rectifier with R and RL load - Three Phase semi converter with R and RL load - Expression for Output Voltage - Harmonic Analysis - Three Phase Dual Converters - Numerical Problems.

AC-AC power control by phase control with R and RL loads - Three phase AC voltage regulator with R load – Single phase step down Cycloconverter - Numerical Problems.

UNIT–IV:
DC–DC Converters

Operation of Basic Chopper - Classification - Control Techniques - Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple- Numerical Problems.

UNIT – V:
DC–AC Converters

Introduction - Classification - Single Phase half bridge and full bridge inverters with R and RL loads - Unipolar & Bipolar Switching - Quasi-square wave pulse width modulation - Three Phase square wave inverters - 120^0 conduction and 180^0 conduction modes of operation - PWM inverters - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Numerical Problems.

Learning Outcomes:
After the completion of the course the student should be able to:
- explain the characteristics of various power semiconductor devices and analyze the static and dynamic characteristics of SCR's.
- design firing circuits for SCR.
- explain the operation of single phase full–wave converters and analyze harmonics in the input current.
- explain the operation of three phase full–wave converters.
- analyze the operation of different types of DC-DC converters.
- explain the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.
- analyze the operation of AC-AC regulators.

Text Books:
1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons.

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2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:
1. Elements of Power Electronics–Philip T.Krein.oxford.
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New   Age International (P) Limited Publishers, 1996.
4. Power Electronics: by Daniel W.Hart, Mc Graw Hill.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
	LINEAR IC APPLICATIONS		

Preamble:

To understand the various possible applications of integrated circuits this course is proposed. To attend this course, it is assumed that all the students taking this course should have the basic electronic circuits' concepts. In the course content, basic characteristics required to use integrated circuits for various applications are included, followed by the linear and nonlinear applications of operational amplifiers. In addition, application of integrated circuits in filter design, modulators, analog multiplier, timer and phase locked loops applications. Application of integrated circuits for analog-to-digital and digital-to-analog conversion is also included.

Learning Objectives:

- To understand the basic operation &performance parameters of differential amplifiers.
- To understand & learn the measuring techniques of performance parameters of Op-Amp
- To learn the linear and non-linear applications of operational amplifiers.
- To understand the analysis & design of different types of active filters using Op-Amps
- To learn the internal structure, operation and applications of different analog ICs
- To Acquire skills required for designing and testing integrated circuits

UNIT I
Characteristics of OP-Amps:

Characteristics of OP-Amps, Integrated circuits-Types, Classification, Package Types and Temperature ranges, Power supplies, Op-Amp Block Diagram, ideal and practical Op-amp Specifications, DC and AC characteristics, 741 op-amp & its features, Op-Amp parameters & Measurement, Input & Out put Off set voltages & currents, slew rate, CMRR, PSRR, drift, Frequency Compensation techniques.

UNIT II
Linear And Non-Linear Applications Of Op-Amps:

Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. Non- Linear function generation, Comparators, Multivibrators, Triangular and Square wave generators, Log and Anti log Amplifiers, Precision rectifiers.

UNIT III

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Active Filters, Analog Multipliers And Modulators:
Design & Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters.
Four Quadrant Multiplier, IC 1496, Sample & Hold circuits.

UNIT IV
Timers & Phase Locked Loops:
Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger; PLL - introduction, block schematic, principles and description of

individual blocks, 565 PLL, Applications of PLL – frequency multiplication, frequency translation, AM, FM & FSK demodulators. Applications of VCO (566).

UNIT V
Digital To Analog And Analog To Digital Converters:
Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC.DAC and ADC Specifications, Specifications AD 574 (12 bit ADC).

Learning Outcomes:
After the completion of the course the student should be able to:
- design circuits using operational amplifiers for various applications.
- analyze and design amplifiers and active filters using Op-amp.
- diagnose and trouble-shoot linear electronic circuits.
- understand the gain-bandwidth concept and frequency response of the amplifier configurations.
- understand thoroughly the operational amplifiers with linear integrated circuits.

Text Books:
1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI,1987.
3. Operational Amplifiers–C.G. Clayton, Butterworth & Company Publ. Ltd./Elsevier, 1971

References Books:
1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ;SK Kataria &Sons;2nd Edition,2010
2. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill, 1988.

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3. OP AMPS and Linear Integrated Circuits concepts and Applications, James M Fiore, Cenage Learning India Ltd.
4. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin & Fredrick Driscoll, PHI, 6th Edition.
5. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
	DIGITAL SIGNAL PROCESSING				

Preamble:
The course has been designed to cater to the needs of electronic industry transforms. This course covers basic concepts of signal processing, various transformation techniques. It provides students to relies about different filter structure and also coding of speech signals.

Learning Objectives:

- To explore the basic concepts of digital signal processing.
- To connect the time domain signal to frequency domain signals using fourier transform.
- To understand the basic structures of IRR systems.
- To understand and design FIR Digital filters.
- To explore the concepts of multiple sampling rates for DSP.

UNIT-I:
Introduction
Introduction to Digital Signal Processing: Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, Invertability, Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms, solution of difference equations using Z-transforms, System function.

UNIT-II:
Discrete Fourier Series & Fourier Transforms
Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear filtering methods based on DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.

UNIT-III:
Design of IIR Digital Filters& Realizations
Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms.

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UNIT-IV:
Design of FIR Digital Filters & Realizations
Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique, Comparison of IIR & FIR filters.
Basic structures of FIR systems, Lattice structures, Lattice-ladder structures
UNIT-V:
Multirate Digital Signal Processing
Introduction, Decimation, Interpolation Sampling rate conversion, Implementation of sampling rate converters, Applications – Sub-band Coding of Speech Signals, Implementation of Digital Filter Banks, Trans-multiplexers.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the concepts of signal processing& transforms.
- appraise the Fat Fourier algorithm.
- design FIR and IIR filters.
- appreciate the concepts of multirate signal processing.

Text Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis Dimitris G.Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PHI.
3. Digital Signal Processing – K Raja Rajeswari, I.K. International Publishing House.

Reference Books:

1. Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006
2. Digital Signal Processing: MH Hayes, Schaum's Outlines, TATA Mc-Graw Hill, 2007.
3. DSP Primer - C. Britton Rorabaugh, Tata McGraw Hill, 2005.
4. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling, Sandra L. Harris,Thomson, 2007.
5. Digital Signal Processing – Alan V. Oppenheim, Ronald W. Schafer, PHI Ed., 2006

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		L	T	P	C
III Year – I SEMESTER		**3**	**0**	**0**	**3**
	MICROPROCESSORS AND MICROCONTROLLERS				

Preamble:
Microprocessor and Microcontroller have become important building blocks in digital electronics design. It is important for student to understand the architecture of a microprocessor and its interfacing with various modules. 8086 microprocessor architecture, programming, and interfacing is dealt in detail in this course. Interfacing, PIC, architecture, programming in C.

Learning objectives:
- To understand the organization and architecture of Microprocessor
- To understand addressing modes to access memory
- To understand 8051 micro controller architecture
- To understand the programming principles for 8086 and 8051
- To understand the interfacing of MP with IO as well as other devices
- To understand how to develop cyber physical systems

UNIT–I:
Introduction to Microprocessor Architecture
Introduction and evolution of Microprocessors – Architecture of 8086 – Memory Organization of 8086 – Register Organization of 8086 – Instruction sets of 8086 – Addressing modes – Assembler directives – Introduction to 80286, 80386, 80486 and Pentium (brief description about architectural advancements only).

UNIT–II:
Minimum and Maximum Mode Operations
General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

Microprocessors I/O interfacing – I
8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255–Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086.

UNIT–III:

Microprocessors I/O interfacing – II
Architecture and interfacing of 8251 USART – Architecture and interfacing of 8254 Timer/counter – Architecture and interfacing of DMA controller (8257) – Architecture 8259 Programmable Interrupt Controller (8259) – Command words and operating modes of 8259 –

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Interfacing of 8259 – Architecture of Keyboard/display controller (8279) – Modes of operation – Command words of 8279 – Interfacing of 8279.

UNIT–IV:
8051 Microcontroller:
Overview of 8051 Microcontroller – Architecture– Memory Organization – Register set – I/O ports and Interrupts – Timers and Counters – Serial Communication – Interfacing of peripherals-Instruction set.

UNIT– V:
PIC Architecture
Block diagram of basic PIC 18 micro controller – registers I/O ports – Programming in C for PIC: Data types, I/O programming, logical operations, data conversion.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the Microprocessor capability in general and explore the evaluation of microprocessors.
- understand the addressing modes of Microprocessors
- understand the Microcontroller capability
- program Microprocessors and Microcontrollers.
- interface Microprocessors and Microcontrollers with other electronic devices
- develop cyber physical systems

Text Books:
1. Ray and Burchandi, "Advanced Microprocessors and Interfacing", Tata McGraw–Hill.
2. Kenneth J Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Thomson Publishers, 2nd Edition.
3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18, - Muhammad Ali Mazidi, RolindD.Mckinay , Danny causey -Pearson Publisher 21st Impression.

Reference Books:
1. Microprocessors and Interfacing, Douglas V Hall, Mc–Graw Hill, 2nd Edition.
2. R.S. Kaler, " A Text book of Microprocessors and Micro Controllers", I.K. International Publishing House Pvt. Ltd.
3. Ajay V. Deshmukh, "Microcontrollers – Theory and Applications", Tata McGraw–Hill Companies –2005.
4. Ajit Pal, "Microcontrollers – Principles and Applications", PHI Learning Pvt Ltd, 2011.

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		L	T	P	C
III Year – I SEMESTER		0	0	3	1.5

ELECTRICAL MACHINES – II LABORATORY

Learning objectives:
- To control the speed of three phase induction motors.
- To determine /predetermine the performance three phase and single phase induction motors.
- To improve the power factor of single phase induction motor .
- To predetermine the regulation of three–phase alternator by various methods, find X_d/ X_q ratio of alternator and asses the performance of three–phase synchronous motor.

Any 10 of the following experiments are to be conducted:
1. Brake test on three phase Induction Motor
2. No–load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three –phase alternator by synchronous impedance &m.m.f. Methods
4. Regulation of three–phase alternator by Potier triangle method
5. V and Inverted V curves of a three—phase synchronous motor.
6. Determination of X_d and X_q of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three-phase alternator by loading with three phase induction motor.
10. Power factor improvement of single-phase induction motor by using capacitors and load test on single-phase induction motor.
11. Parallel operation of three-phase alternator.
12. Brake test on single-phase AC series Motor.
13. Starting methods of a capacitor start and capacitor start run single-phase Induction motor.
14. Brake test on single-phase Induction Motor.

Learning outcomes:
After the completion of the course the student should be able to:
- assess the performance of single phase and three phase induction motors.
- control the speed of three phase induction motor.
- predetermine the regulation of three–phase alternator by various methods.
- find the X_d/ X_q ratio of alternator and asses the performance of three–phase synchronous motor.
- determine the performance single phase AC series motor.

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		L	T	P	C
III Year – I SEMESTER		0	0	2	1
	CONTROL SYSTEMS LABORATORY				

Learning Objectives:
- To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, A.C. Servo motors and Synchros.
- To understand time and frequency responses of control system with and without controllers and compensators.

Any 10 of the following experiments are to be conducted:
1. Time response of Second order system
2. Characteristics of Synchros
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag and lead compensation – Magnitude and phase plot
5. Transfer function of DC motor
6. Bode Plot, Root locus, Nyquist Plots for the transfer functions of systems up to 5th order using MATLAB.
7. Controllability and Observability Test using MAT LAB.
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Characteristics of DC servo motor
12. Block Diagram Representation of Field Controlled DC servo Motor Using Simulink.

Learning Outcomes:
After the completion of the course the student should be able to:
- analyze the performance and working Magnetic amplifier, D.C and A.C. servo motors and synchros.
- design P,PI,PD and PID controllers
- design lag, lead and lag–lead compensators
- control the temperature using PID controller
- determine the transfer function of D.C Motor
- control the performance of D.C and A.C Servo Motor.
- test the controllability and observability.
- judge the stability in time and frequency domain.

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		L	T	P	C
III Year – I SEMESTER		**0**	**0**	**3**	**1.5**

ELECTRICAL MEASUREMENTS & INSRUMENTATION LABORATORY

Learning Objectives:

- To understand the correct function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy, and measurement of electrical characteristics of resistance, inductance and capacitance of a circuits through appropriate methods.
- To understand the calibration of DC and AC Potentiometers.
- To understand the testing of CT and PT.
- To Understand and the characteristics of Thermo couples, LVDT, Capacitive transducer, piezoelectric transducer.
- To understand the measurement of strain, Phase difference and frequency.

Any 10 of the following experiments are to be conducted

1. Calibration of dynamometer wattmeter using phantom loading
2. Crompton D.C. Potentiometer - Calibration of PMMC ammeter and PMMC voltmeter
3. Kelvin's double Bridge - Measurement of resistance - Determination of tolerance.
4. Capacitance Measurement using Schering Bridge.
5. Inductance Measurement using Anderson Bridge.
6. Calibration of LPF Wattmeter – by direct loading.
7. Measurement of 3 phase power with single watt meter and 2 No's of C.T.
8. Testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.
9. P.T. testing by comparison – V.G as Null detector – Measurement of % ratio error and phase angle of the given P.T.
10. AC Potentiometer – Polar form/Cartesian form – Calibration of AC Voltmeter, Parameters of Choke
11. Thermocouple – characteristics
12. LVDT – characteristics.
13. Capacitive transducers characteristics.
14. Piezoelectric transducer characteristics.
15. Measurement of strain using strain gauge
16. Measurement of phase difference, frequency using Lissajous patterns in CRO.

Learning Outcomes:

After the completion of the course the student should be able to:

- measure the electrical parameters voltage, current, power, energy and electrical characteristics of resistance, inductance and capacitance.
- known the characteristics of transducers.
- measure the strains, frequency and phase difference.

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III Year – I SEMESTER		L	T	P	C
		0	0	1	1
SOCIALLY RELAVENT PROJECTS					

Preamble:

There is lot of scientific and technological changes in the nation during last few decades in almost all the sectors. The state and central governments are introducing many schemes to all classes of people of the nation to increase the productivity in various sectors. India is a rural centric nation and the fruits of the scientific inventions and new technology shall be shared among all remote corners of the nation. With this aim, a socially relevant project is newly introduced in the curriculum with an objective of taking up the projects relevant to the societal needs.

Objectives:

(1) The student(s) shall explore the technological needs of society
(2) The student(s) shall understand the technological problems of society

General guidelines:

- A socially relevant project shall be a community service based project and it shall be innovative.
- A student has to pursue the socially relevant project to solve real life and pressing problems of society.
- The pursued socially relevant projects shall contribute to national development goals and priorities.
- Socially relevant project can be carried out by an individual student or by a team of maximum 5 of concerned department.
- The student(s) shall visit the society (Villages/Hospitals/Social Service Organizations etc) to identify the problem and conduct literature survey and provide a feasible solution.
- The socially relevant project selected shall be in the broad area of concerned discipline of course. Preference shall be given to rural societal problems.
- Each team shall work under the supervision of a faculty member of the concerned department.
- If the course is offered in II Year I Semester, the student or team of students shall complete this project during the vacation after I Year and so on.
- The duration of the project is about 15 to 20 hrs in total and students may split total duration into 2 to 3 hrs per day based convenience. The attendance shall be maintained by the supervisor.

Sample Projects (but not limited to):

(i) Energy Auditing in a rural village (ii) Smart starting and control of motors in agriculture and aqua fields (iii) TV Remote Operated Domestic Appliances Control (iv) Solar Powered Auto Irrigation System (v) Auto Intensity Control of Street Lights (vi) Hidden Active Cell Phone Detector (vii) Railway Track Security System (viii) Solar

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Power Charge Controller (ix) Home Automation System Using Digital Control (x) Intelligent Overhead Tank Water Level Indicator (xi) Pre Stampede Monitoring and Alarm System (xii) Detect Rash Driving Speed Checker System on Highways

Outcomes

(1) The student(s) are be able to provide a solutions the technological problems of society

(1) The student(s) is able suggest technological changes which suits current needs of society

(2) The student(s) are able to explain new technologies available for problems of the society.

Reference:

(1) Web Link: http://iitk.ac.in/new/socially-relevant-research

(2) https://csie.iitm.ac.in/SocialProjectsIITM.html

(3) http://www.iitkgp.ac.in/files/csr/csr_education.pdf

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRIC DRIVES				

Preamble:
This course is an extension of power electronics applications to electric drives. This course covers in detail the basic and advanced speed control techniques using power electronic converters that are used in industry. It is equally important to understand the four quadrant operation of electric drives and slip power recovery schemes in induction motors.

Learning Objectives:
- To learn the fundamentals of electric drive and different electric braking methods.
- To analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.
- To discuss the converter control of dc motors in various quadrants.
- To understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- To learn the principles of static rotor resistance control and various slip power recovery schemes.
- To understand the speed control mechanism of synchronous motors

UNIT–I:
Fundamentals of Electric Drives
Electric drive – Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic – Plugging – Regenerative methods.

UNIT–II:
Controlled Converter Fed DC Motor Drives
1-phase half and fully controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics – Principle of operation of dual converters and dual converter fed DC motor drives -Numerical problems.

UNIT–III:
DC–DC Converters Fed DC Motor Drives
Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current operation – Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics – Four quadrant operation – Closed loop operation (qualitative treatment only).

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UNIT–IV:
Stator side control of 3-phase Induction motor Drive
Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop v/f control of induction motor drives (qualitative treatment only).

UNIT–V:
Rotor side control of 3-phase Induction motor Drive & Synchronous Motor Drives
Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.

Separate control of synchronous motor – self control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive – PMSM (Basic operation only).

Learning Outcomes:
After the completion of the course the student should be able to:
- explain the fundamentals of electric drive and different electric braking methods.
- analyze the operation of three phase converter fed dc motors and four quadrant operations of dc motors using dual converters.
- describe the converter control of dc motors in various quadrants of operation
- know the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- differentiate the stator side control and rotor side control of three phase induction motor, explain the speed control mechanism of synchronous motors.

Text Books:
1. Fundamentals of Electric Drives – by G K Dubey, Narosa Publications
2. Power Semiconductor Drives, by S.B.Dewan, G.R.Slemon, A.Straughen, Wiley-India Edition.

Reference Books:
1. Electric Motors and Drives Fundamentals, Types and Apllications, by Austin Hughes and Bill Drury, Newnes.
2. Thyristor Control of Electric drives – VedamSubramanyam Tata McGraw Hill Publications.
3. Power Electronic Circuits, Devices and applications by M.H.Rashid, PHI
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3

POWER SYSTEM ANALYSIS

Preamble:
The course is designed to give students the required knowledge for the design and analysis of electrical power grids. Calculation of power flow in a power system network using various techniques, formation of Z_{bus} and its importance are covered in this course. It also deals with short circuit analysis and analysis of power system for steady state and transient stability.

Learning Objectives:
- To development the impedance diagram (p.u) and formation of Y_{bus}
- To study the different load flow methods.
- To study the concept of the Z_{bus}building algorithm.
- To study short circuit calculation for symmetrical faults
- To study the effect of unsymmetrical faults and their effects.
- To study the rotor angle stability of power systems.

UNIT –I:
Circuit Topology & Per Unit Representation
Graph theory definition – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Y_{bus} matrix by singular transformation and direct inspection methods - Per Unit Quantities–Single line diagram– Impedance diagram of a power system.

UNIT –II:
Power Flow Studies
Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) –Decoupled and Fast Decoupled methods – Algorithmic approach –Problems on 3–bus system only.

UNIT – III:
Z-Bus Algorith & Symmetrical Fault Analysis:
Formation of Z_{bus}: Algorithm for the Modification of Z_{bus} Matrix (without mutual impedance).

Symmetrical Fault Analysis:
Reactances of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems.

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UNIT –IV:
Symmetrical Components & Fault analysis

Definition of symmetrical components - symmetrical components of unbalanced three phase systems – Power in symmetrical components – Sequence impedances: Synchronous generator – Transmission line and transformers – Sequence networks –Various types of faults LG– LL– LLG and LLL on unloaded alternator–unsymmetrical faults on power system for numerical problems only.

UNIT – V:
Power System Stability Analysis

Elementary concepts of Steady state – Dynamic and Transient Stabilities – Description of Steady State Stability Power Limit –Transfer Reactance–Synchronizing Power Coefficient – Power Angle Curve and Determination of Steady State Stability – Derivation of Swing Equation–Determination of Transient Stability by Equal Area Criterion –Applications of Equal Area Criterion – Methods to improve steady state and transient stability.

`Learning Outcomes:

After the completion of the course the student should be able to:

- draw impedance diagram for a power system network and to understand per unit quantities.
- form a Y_{bus} and Z_{bus} for a power system networks.
- understand the load flow solution of a power system using different methods.
- find the fault currents for all types faults to provide data for the design of protective devices.
- find the sequence components of currents for unbalanced power system network.
- analyze the steady state, transient and dynamic stability concepts of a power system.

Text Books:

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Modern Power system Analysis – by I.J.Nagrath & D .P.Kothari: Tata McGraw–Hill Publishing Company, 2nd edition.

Reference Books:

1. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
2. Power System Analysis by HadiSaadat – TMH Edition.
3. Power System Analysis by B.R.Gupta, Wheeler Publications.
4. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J.Overbye – Cengage Learning publications.

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COURSE STRUCTURE-R19

III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	DATA STRUCTURES				

Preamble:
This course is core subject developed to help the student understand the data structure principles used in power systems, machines and control systems. This subject covers linear data structures, linked lists, trees, graphs, searching and sorting.

Course Objectives:
- Operations on linear data structures and their applications.
- The various operations on linked lists.
- The basic concepts of Trees, Traversal methods and operations.
- Concepts of implementing graphs and its relevant algorithms.
- Sorting and searching algorithms.

Unit-1:
Linear Data Structures: Arrays, Stacks And Queues
Data Structures -Operations-Abstract Data Types-Complexity of Algorithms-Time and Space-Arrays-Representation of Arrays-Linear Arrays-Insertion–Deletion and Traversal of a Linear Array-Array as an Abstract Data Type-Multi-Dimensional arrays-Strings-String Operations-Storing Strings-String as an Abstract Data Type

Stack -Array Representation of Stack-Stack Abstract Data Type-Applications of Stacks: Prefix-Infix and Postfix Arithmetic Expressions-Conversion-Evaluation of Postfix Expressions-Recursion-Towers of Hanoi-Queues-Definition-Array Representation of Queue-The Queue Abstract Data Type-Circular Queues-Dequeues-Priority Queues.

Unit-II:
Linked Lists
Pointers-Pointer Arrays-Linked Lists-Node Representation-Single Linked List-Traversing and Searching a Single Linked List-Insertion into and Deletion from a Single Linked List-Header Linked Lists-Circularly Linked Lists-Doubly Linked Lists-Linked Stacks and Queues-Polynomials-Polynomial Representation-Sparse Matrices.

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Unit-III:
Trees
Terminology-Representation of Trees-Binary Trees-Properties of Binary Trees-Binary Tree Representations-Binary Tree Traversal-Preorder-Inorder and Postorder Traversal-Threads-Thread Binary Trees-Balanced Binary Trees-Heaps-Max Heap-Insertion into and Deletion from a Max Heap-Binary Search Trees-Searching-Insertion and Deletion from a Binary Search Tree-Height of Binary Search Tree, m-way Search Trees, B-Trees.

Unit-IV:
Graphs
Graph Theory Terminology-Graph Representation-Graph Operations-Depth First Search-Breadth First Search-Connected Components-Spanning Trees-Biconnected Components-Minimum Cost Spanning Trees-Kruskal's Algorithm-Prism's Algorithm-Shortest Paths-Transitive Closure-All-Pairs Shortest Path-Warshall's Algorithm.

Unit-V:
Searching And Sorting
Searching -Linear Search-Binary Search-Fibonacci Search-Hashing-Sorting-Definition-Bubble Sort-Insertion sort-Selection Sort-Quick Sort-Merging-Merge Sort-Iterative and Recursive Merge Sort-Shell Sort-Radix Sort-Heap Sort.

Course Outcomes:
After the completion of the course the student should be able to:
- data structures concepts with arrays, stacks, queues.
- linked lists for stacks, queues and for other applications.
- traversal methods in the Trees.
- various algorithms available for the graphs.
- sorting and searching in the data ret retrival applications.

Text Books:

1. Fundamentals of Data Structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan Anderson Freed, Universities Press Pvt. Ltd.
2. Data Structures With C, Seymour Lipschutz, Schaum's Outlines, Tata McGraw Hill.

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
DIGITAL CONTROL SYSTEMS					

Preamble:
In recent years digital controllers have become popular due to their capability of accurately performing complex computations at high speeds and versatility in leading nonlinear control systems. In this context, this course focuses on the analysis and design of digital control systems.

Learning objectives:
- To understand the concepts of digital control systems and assemble various components associated with it. Advantages compared to the analog type.
- The theory of z–transformations and application for the mathematical analysis of digital control systems.
- To represent the discrete–time systems in state–space model and evaluation of state transition matrix, the design of state feedback control by "the pole placement method.", design of state observers.
- To examine the stability of the system using different tests.
- To study the conventional method of analyzing digital control systems in the w–plane.

UNIT – I:
Introduction and signal processing
Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Continuous and Discrete Time Signals – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

UNIT–II:
z–transformations
z–Transforms – Theorems – Finding inverse z–transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

UNIT–III:
State space analysis and the concepts of Controllability and observability
State space representation of discrete time systems – Solving Discrete Time state space equations – State transition matrix and its properties – Discretization of continuous time state equations – Concepts of controllability and observability – Tests(without proof).

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State Feedback Controllers and State Observers
Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula – Design of state observers (Full Order and Reduced Order).

UNIT – IV:
Stability analysis
Mapping between the s–Plane and the z–Plane – Primary strips and Complementary strips – Stability criterion – Modified Routh's stability criterion and Jury's stability test.

UNIT – V:
Design of discrete–time control systems by conventional methods
Transient and steady state specifications – Design using frequency response in the w–plane for lag and lead compensators – Root locus technique in the z–plane.

Learning outcomes:
After the completion of the course the student should be able to:
- learn the advantages of discrete time control systems and the "know how" of various associated accessories.
- understand z–transformations and their role in the mathematical analysis of different systems(like Laplace transforms in analog systems).
- learn the stability criterion for digital systems and methods adopted for testing the same are explained.
- understand the conventional and state space methods of design are also introduced.

Text Book:
1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. Digital Control and State Variable Methods by M.Gopal, TMH, 4th Edition.

Reference Books:
1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.

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COURSE STRUCTURE-R19

III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	DIGITAL IC APPLICATIONS **(ELECTIVE-I)**				

Preamble:

This course introduces digital logic families and interfacing concepts for digital design and introduces VHDL fundamentals to model digital system design blocks. Behavioral modeling of digital circuits is discussed. Design and implementation of combinational, synchronous and asynchronous sequential digital logic circuits are introduced.

Learning Objectives:

- Introduction of digital logic families and interfacing concepts for digital design is considered.
- VHDL fundamentals were discussed to modeling the digital system design blocks.
- VHDL compilers, simulators and synthesis tools are described, which are used to verify digital systems in a technology-independent fashion.
- Design and implementation of combinational and sequential digital logic circuits is explained.

UNIT-I:
Digital Logic Families, Interfacing and Introduction to VHDL
Introduction to logic families, CMOS logic, CMOS steady state and dynamic electrical behavior, CMOS logic families. Bipolar logic, transistor-transistor logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, Emitter coupled logic.
Design flow, program structure, levels of abstraction, Elements of VHDL: Data types, data objects, operators and identifiers. Packages, Libraries and Bindings, Subprograms. VHDL Programming using structural and data flow modeling.

UNIT-II:
Behavioral Modeling
Process statement, variable assignment statement, signal assignment statement, wait statement , if statement, case statement ,null statement, loop statement, exit statement, next statement ,assertion statement, more on signal assignment statement ,Inertial Delay Model, Transport Delay Model ,Creating Signal Waveforms, Signal Drivers , Other Sequential Statements , Multiple Processes. Logic Synthesis, Inside a logic Synthesizer.

UNIT-III:
Combinational Logic Design
Binary Adder-Subtractor, Ripple Adder, Look Ahead Carry Generator, ALU, Decoders, encoders, multiplexers and demultiplexers, parity circuits, comparators, Barrel Shifter, Simple

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Floating-Point Encoder, Dual Priority Encoder, Design considerations of the above combinational logic circuits with relevant Digital ICs, modeling of above ICs using VHDL.

UNIT-IV
Sequential Logic Design
SSI Latches and flip flops, Ring Counter, Johnson Counter, Design of Modulus N Synchronous Counters, Shift Registers, Universal Shift Registers, Design considerations of the above sequential logic circuits with relevant Digital ICs, modeling of above ICs using VHDL**.**

UNIT-V:
Synchronous and Asynchronous Sequential Circuits
Basic design steps: State diagram, state table, state assignment, choice of flip flops and derivation of next state and output expressions, timing diagram. State assignment problem: One hot encoding. Mealy and Moore type FSM for serial adder, VHDL code for the serial adder. Analysis of Asynchronous circuits, State Reduction, State Assignment. A complete design example: The vending machine controller.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the structure of commercially available digital integrated circuit families.
- learn the IEEE Standard 1076 Hardware Description Language (VHDL).
- model complex digital systems at several levels of abstractions, behavioral, structural, simulation, synthesis and rapid system prototyping.
- analyze and design basic digital circuits with combinatorial and sequential logic circuits using VHDL.

Text Books:

1. Digital Design Principles & Practices – John F. Wakerly, PHI/ Pearson Education Asia, 3rd Ed., 2005.
2. VHDL Primer – J. Bhasker, Pearson Education/ PHI, 3rd Edition.

References:

1. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, ZvonkoVranesic, McGrawHill, 3rd Edition.

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
COMMUNICATION SYSTEMS					

Preamble:
Awareness on the concepts and working of communication blocks is inevitable for an electrical engineering student to excel in smart grid applications.
.
Learning Objectives:
- To develop a fundamental understanding on communication systems with emphasis on analog and digital modulation techniques.
- To get introduced to the basics of error control coding techniques.

Unit – I:
Basic blocks of Communication System. Analog Modulation - Principles of Amplitude Modulation, DSBSC, SSB-SC and VSB-SC, AM transmitters and receivers.

Unit- II:
Angle Modulation - Frequency and Phase Modulation. Transmission Bandwidth of FM signals, Methods of generation and detection, FM Transmitters and Receivers.

Unit–III:
Sampling theorem - Pulse Modulation Techniques - PAM, PWM and PPM concepts - PCM system – Data transmission using analog carriers (BASK, BFSK, BPSK, QPSK).

UNIT IV:
Error control coding techniques – Linear block codes- Encoder and decoder, Cyclic codes – Encoder, Syndrome Calculator, Convolution codes.

UNIT V:
Modern Communication Systems – Microwave communication systems - Optical communication system - Satellite communication system - Mobile communication system.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the basics of communication system, analog and digital modulation techniques.

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- apply the knowledge of digital electronics and understand the error control coding techniques.
- summarize different types of communication systems and its requirements.

Text Books:
1. Simon Haykins, 'Communication Systems', John Wiley, 3rd Edition, 1995.
2. D.Roddy & J.Coolen, 'Electronic Communications', Prentice Hall of India, 4th Edition, 1999.
3. Kennedy G, 'Electronic Communication System', McGraw Hill, 1987.

Reference Books:
1. Shulin Daniel, 'Error Control Coding', Pearson, 2nd Edition, 2011.
2. B.P. Lathi and Zhi Ding, 'Modern Digital and Analog Communication Systems', OUP USA Publications, 4th Edition, 2009.

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	COMPUTER NETWORKS **(ELECTIVE-I)**				

Preamble:
This course is designed to impart the knowledge in computer networks used for data transmission through internet. The topics covered in this subject are LAN, WAN, TCP/ICP models, Digital modulation and multiplexing, Layers of computer networks, Protocol, Routing algorithms, etc.

Learning Objectives:
- Understand state-of-the-art in network protocols, architectures, and applications.
- Process of networking research
- Constraints and thought processes for networking research
- Problem Formulation—Approach—Analysis—

UNIT – I:
INTRODUCTION COMPUTER NETWORKS:
Network Topologies WAN, LAN, MAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models

Physical Layer – Fourier Analysis – Bandwidth Limited Signals – The Maximum Data Rate of a Channel - Guided Transmission Media, Digital Modulation and Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing
Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols

UNIT – II:
THE DATA LINK LAYER: Services Provided to the Network Layer – Framing – Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – Error Detecting Codes, Elementary Data Link Protocols- A Utopian Simplex Protocol-A Simplex Stop and Wait Protocol for an Error free channel-A Simplex Stop and Wait Protocol for a Noisy Channel, Sliding Window Protocols-A One Bit Sliding Window Protocol-A Protocol Using Go-Back-N- A Protocol Using Selective Repeat

UNIT – III:
MEDIUM ACCESS CONTROL SUBLAYER-The Channel Allocation Problem-Static Channel Allocation-Assumptions for Dynamic Channel Allocation, Multiple Access Protocols-

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Aloha-Carrier Sense Multiple Access Protocols-Collision-Free Protocols-Limited Contention Protocols-Wireless LAN Protocols, Ethernet-Classic Ethernet Physical Layer-Classic Ethernet MAC Sublayer Protocol-Ethernet Performance-Fast Ethernet Gigabit Ethernet-10-Gigabit Ethernet-Retrospective on Ethernet, Wireless Lans-The 802.11 Architecture and Protocol Stack-The 802.11 Physical Layer-The802.11 MAC Sublayer Protocol-The 805.11 Frame Structure-Services

UNIT – IV:
DESIGN ISSUES-The Network Layer Design Issues – Store and Forward Packet Switching-Services Provided to the Transport layer- Implementation of Connectionless Service-Implementation of Connection Oriented Service-Comparison of Virtual Circuit and Datagram Networks, Routing Algorithms-The Optimality principle-Shortest path Algorithm, Congestion Control Algorithms-Approaches to Congestion Control-Traffic Aware Routing-Admission Control-Traffic Throttling-Load Shedding.

UNIT – V:
TRANSPORT LAYER: The Internet Transport Protocols: Udp, the Internet Transport Protocols: TCP Application Layer –The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery

Learning Outcomes:
After the completion of the course the student should be able to:
- understand OSI and TCP/IP models
- analyze MAC layer protocols and LAN technologies
- design applications using internet protocols
- understand routing and congestion control algorithms
- understand how internet works

Text Books:
1. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010
2. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education

Reference Books:
1. Larry L. Peterson and Bruce S. Davie, "Computer Networks - A Systems Approach" (5th ed), Morgan Kaufmann/ Elsevier, 2011

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		L	T	P	C
III Year – II SEMESTER		3	0	0	3

INTERNET OF THINGS APPLICATIONS TO ELECTRICAL ENGINEERING
(ELECTIVE-I)

Preamble:
Importance to the development of miniature devices for monitoring and sensing of data using internet is increasing day by day. In view of this, to give an insight about these technologies to the students of electrical engineering this course in designed. In this course, introduction to Internet of Things, various architectures of IoT, Communication protocols are introduced. In addition, data acquisition, data communication, introduction to data analytics, sensors and actuators are also presented. To give a view about the IoT implementations, few case studies about Smart Home, Smart Cities, Environment monitoring and smart agriculture practices are also presented.

Learning Objectives:
- To understand fundamentals, architecture and various technologies of Internet of Things.
- To know various communication technologies used in the Internet of Things.
- To know the connectivity of devices using web and internet in the IoT environment.
- To know various data acquisition methods, data handling using cloud for IoT applications.
- To understand the implementation of IoT by studying case studies like Smart Home, Smart city, etc.

UNIT - I:
The Internet of Things: An Overview of Internet of Things (IoT) – IoT framework – Architecture – Technology behind IoT – Sources of the IoT – M2M Communication – Examples ofIoT.

UNIT – II:
Design Principles For Connected Devices: Introduction –IoT/M2M systems, Layers and Designs Standardization – Communication Technologies – Data Enrichment, Consolidation and Device Management at Gateway – Ease of designing and affordability.

UNIT – III:
Design Principles for the Web Connectivity: Introduction – Web Communication protocols for Connected Devices - Message Communication protocols for Connected Devices – Web Connectivity for connected devices network.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE-R19

Introduction to Internet Connectivity Principles, Internet connectivity, Internet based communication – IP addressing in the IoT – Application Layer Protocols: HTTP, HTTPS, FTP, Telnet, WAP (Wireless Application Protocol).

UNIT–IV:
Data Acquiring, Organizing, Processing and Analytics: Introduction – Data Acquiring and Storage – Organizing the Data – Analytics.
Data Collection, Storage and Computing Using a Cloud Platform: Introduction – Cloud computing paradigm for data collection, storage and computing – IoTas a service and Cloud Service Models - IoT cloudbased services using the Xively (Pachube/COSM), Nimbits and other platforms.

UNIT– V:
Sensor technology: Actuator, Sensor data communication protocols, Radio Frequency Identification technology, Wireless Sensor Network Technology.
IoT application case studies: Smart Home, Smart Cities, Environment monitoring and Agriculture practices.

 Learning Outcomes:
After the completion of the course the student should be able to:
- know the various fundamentals, architectures and technologies of Internet of Things.
- understand various communication technologies used in the Internet of Things.
- understand the various device connectivity methods using web and internet in the IoT environment.
- understand various data acquisition methods, data handling using cloud for IoT applications.
- know the implementation of IoT from the case studies like Smart Home, Smart city, etc.

Text Books:
1. Internet of Things: Architecture, Design Principles, Raj Kamal, McGraw Hill Education (India) Pvt. Limited, 2017.

Reference Books:
1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley, First edition, 2013.
2. Getting Started with the Internet of Things, CunoPfister, O'reilly, 2011.
3. Internet of Things : A Hands-on Approach, ArshdeepBahga, and Vijay Madisetti, 2014.

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COURSE STRUCTURE-R19

III Year –II SEMESTER		L	T	P	C
		3	0	0	3
	VLSI DESIGN **(ELECTIVE-I)**				

Preamble:

This is an elective course designed to impart the knowledge in VLSI design principles. This course covers MOS devices and fabrication, CMOS logic circuits and applications of logic circuits.

Learning Objective:

- MOS and CMOS circuits features and characteristics.
- Fabrication principles of CMOS.
- Implementation of CMOS logic circuits.
- Memory design with CMOS family.
- Applications of CMOS circuits.

UNIT – I:

Introduction to MOS Devices

MOS characteristics: NMOS characteristics, inverter action – CMOS characteristics, inverter action - models and second order effects of MOS transistors – Current equation – MOSFET Capacitances - MOS as Switch, Diode/ resistor – current source and sink – Current mirror.

UNIT – II:

MOS Fabrication

CMOS Fabrication – n-well, p-well, twin-tub processes – fabrication steps – crystal growth – photolithography – oxidation – diffusion – Ion implantation – etching – metallization.

UNIT – III:

CMOS Logic Circuits

CMOS Logic Circuits: Implementation of logic circuits using nMOS and CMOS, Pass transistor and transmission gates – Implementation of combinational circuits – parity generator – magnitude comparator – stick diagram – Design rules and layout design.

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UNIT – IV:
Higher order digital Logic Circuits
Memory design – SRAM cell – 6T SRAM – DRAM – 1T, 3T, 4T cells, CMOS Sequential circuits: Static and Dynamic circuits – True Single-phase clocked registers – Clocking schemes.

UNIT – V:
Application Specific Integrated Circuits
ASIC - Types of ASICs - Design flow – Design Entry – Simulation – Synthesis – Floor planning – Placement – Routing - Circuit extraction – Programmable ASICs.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the insights of the MOS devices and its characteristics.
- appreciate the different VLSI process technologies.
- design the CMOS combinational logic circuits and its layout.
- develop the sequential circuits and clocking schemes.
- realize the Design flow of application-specific Integrated circuit.

Text Books:
1. Neil Weste, David Harris, 'CMOS VLSI Design: A Circuits and Systems Perspective', AddisonWesley, 4th Edition, 2020.
2. Debaprasad Das, 'VLSI Design', Oxford University Press, 2010.
3. Ken Martin, 'Digital Integrated Circuits', Oxford University Press, 1999.
4. Peter Van, 'Microchip Fabrication', Mc-Graw Hill Professional, 6th Edition, 2014.

Reference Books:
1. M. J. S. Smith, 'Application Specific Integrated Circuits', Addison Wesley, 1997.
2. Uyemura, 'Introduction to VLSI Circuits and Systems', Wiley, 1st Edition, 2012.

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III Year –II SEMESTER		L	T	P	C
		3	0	0	3
	CLOUD COMPUTING **(ELECTIVE-I)**				

Preamble:
This is an elective subject designed to known principles of clod computing. Inthis subject systems modeling, clustering, visualization, virtual machines, Data centres, Cloud architecture, cloud programming, resource management and scheduling and storage will be explained.

Learning Objectives:
- The cloud environment, building software systems.
- Components that scale to millions of users in modern internetcloud concepts capabilities across the various cloud service models including Iaas, Paas, Saas,
- Developing cloud based software applications on top of cloud platforms.

UNIT -I:
Systems modeling, Clustering and virtualization
Scalable Computing over the Internet, Technologies for Network based systems, System models for Distributed and Cloud Computing, Software environments for distributed systems and clouds, Performance, Security And Energy Efficiency

UNIT- II:
Virtual Machines and Virtualization of Clusters and Data Centers
Implementation Levels of Virtualization, Virtualization Structures/ Tools and mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.

UNIT- III:
Cloud Platform Architecture
Cloud Computing and service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms, Inter Cloud Resource Management, Cloud Security and Trust Management. Service Oriented Architecture, Message Oriented Middleware.

Cloud Programming and Software Environments
Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments.

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UNIT-IV:

Cloud Resource Management and Scheduling

Policies and Mechanisms for Resource Management Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds, Fair Queuing, Start Time Fair Queuing, Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines, Scheduling MapReduce Applications Subject to Deadlines.

UNIT- V:

Storage Systems

Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore, Amazon Simple Storage Service (S3)

Learning Outcomes:

After the completion of the course the student should be able to:

- understanding the key dimensions of the challenge of Cloud Computing
- assessment of the economics , financial, and technological implications for selecting cloud computing for own organization
- assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications.
- assessment of own organizations' needs for capacity building and training in cloud computing-related IT areas

Text Books:

1. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
3. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madisetti, University Press

Reference Books:

1. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
2. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH

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III Year –II SEMESTER		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
RENEWABLE ENERGY SOURCES **(OPEN ELECTIVE-I)**					

Preamble:
This course gives a flavor of renewable sources and systems to the students. It introduces solar energy its radiation, collection, storage and its applications. This covers generation, design, efficiency and characteristics of various renewable energy sources including solar, wind, hydro, biomass, fuel cells and geothermal systems.

Learning Objectives:
- To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
- To study solar photo voltaic systems.
- To study maximum power point techniques in solar pv and wind energy.
- To study wind energy conversion systems, Betz coefficient, tip speed ratio.
- To study basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

UNIT–I:
Fundamentals of Energy Systems and Solar energy
Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation**:** Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces – Numerical problems.

UNIT–II:
Solar Photovoltaic Systems
Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Applications and systems – Balance of system components - System design**:** storage sizing – PV system sizing – Maximum power point tracking.

UNIT–III:
Wind Energy
Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator(synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

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UNIT–IV:
Hydro and Tidal power systems
Basic working principle – Classification of hydro systems**:** Large, small, micro – measurement of head and flow – Energy equation – Types of turbines – Numerical problems.
Tidal power – Basics – Kinetic energy equation – Turbines for tidal power - Numerical problems – Wave power – Basics – Kinetic energy equation – Wave power devices – Linear generators.

UNIT–V:
Biomass, fuel cells and geothermal systems
Biomass Energy**:** Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing.
Fuel cell**:** Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics.
Geothermal**:** Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation

Learning Outcomes:
After the completion of the course the student should be able to:
- analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.
- design solar photo voltaic systems.
- develop maximum power point techniques in solar PV and wind energy systems.
- explain wind energy conversion systems, wind generators, power generation.
- explain basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

Text Books:
1. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition,2013.
2. Non Conventional sources of Energy by G.D.Rai, Kanna Publications.

Reference Books:
1. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
3. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition,2013.
4. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
5. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
6. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
7. Non conventional energy source –B.H.khan- TMH-2nd edition.

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
ESSENTIALS OF ANALOG AND DIGITAL ELECTRONICS **(OPEN ELECTIVE-I)**					

Preamble:
This is an open elective course designed to give the basic knowledge od analog and digital electronics to core engineering students. This course covers analog devices, digital components, signal generator circuits, decoders, programmable logic devices LCD, LED displays, Analog to Digital & Digital to Analog converters.

Learning Objectives:
- To understand the concepts of analog and digital devices & circuits.
- To understand signal generation circuits.
- To understand the digital & analog quantities and conversion from one to the other.
- To design and control LCD and LED displays.

UNIT -I
Review of Analog devices- Diode – P-N Diode- Zener Diode – V-I Characteristics - Rectifier Circuits –Wave Shaping Circuits – Clippers and Clampers – Zener regulator Circuits.
Op-amp –Inverting & non-inverting - Operation – Differentiator, integrator, precision rectifier, square waveform for generator, passive components – TTL, CMOS devices.

UNIT II
Oscillators & Signal generator circuits – Function generator circuit – Pulse generator circuit – AM/FM signal generator circuit – Qualitative analysis.

UNIT –III
Review of Digital components – Code converters: Binary to Gray Code – BCD to Seven segment decoder –Programmable Logic Devices: PROM, PAL, PLA. Sequential Logic: Latch & Flip flop, MOD- Counters – Shift Registers - Asynchronous 3-Bit Counter
.
UNIT -IV
Display Units – Optoelectronic devices –Seven segment displays – LCD and LED display units and applications –I^2C, SIP Protocol.

UNIT -V
Special electronic circuits- Schmitt trigger – Analog to Digital converter – Digital to Analog converter units.

Learning Outcomes:
After the completion of the course the student should be able to:

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- design and develop circuits using analog and digital components.
- understand the different generators and analyzers.
- appreciate the use of display units.
- design Analog to Digital and Digital to Analog Converters.

Text Books:

1. David A Bell, 'Fundamentals of Electronic Devices and Circuits', Oxford University Press, Incorporated, Recent Edition.
2. Kalsi H.S,'Electronic Instrumentaion', Tata McGraw-Hill Education, 3rd Edition, 2010.
3. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rd Edition, Recent version..

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRICAL ESTIMATION AND COSTING **(OPEN ELECTIVE-I)**				

Preamble:
This course covers the topics on simple electrical connections design considerations of electrical installations and study of different types of electrical installations. It also covers the components of substations and various motor control circuits.

Learning Objectives:
- Introduce the electrical symbols and simple electrical circuits
- Able to learn the design of electrical installations.
- Able to learn the design of electrical installation for different types of buildings and small industries.
- Learn the basic components of electrical substations.
- Familiarize with the motor control circuits

UNIT -I:
Electrical Symbols and Simple Electrical Circuits
Need of electrical symbols, list of symbols, Electrical Diagrams, Methods of representation for wiring diagrams, introduction to simple light and fan circuits, system of connection of appliances and accessories, simple examples on light and fan circuits.

Unit-II:
Design Considerations of Electrical Installations
Electric supply system, Three-phase four wire distribution system, protection of electric installation against overload, short circuit and earth fault, earthing, neutral and earth wire, types of loads, systems of wiring, permissible of voltage drops and sizes of wires , estimating and costing of electrical installations

Unit-III:
Electrical Installation for Different Types of Buildings and Small Industries
Electrical installations for electrical buildings, estimating and costing of material, simple examples on electrical installation for residential buildings, electrical installations for commercial buildings, electrical installation for small industries

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Unit-IV:
Substations
Introduction, types of substations, outdoor substations-pole mounted type, indoor substations-floor mounted type, simple examples on quantity estimation.

Unit-V: Motor control circuits
Introduction to AC motors, starting of three phase squirrel cage induction motors, starting of wound rotor motors, starting of synchronous motors, contractor control circuit components, basic control circuits, motor protection

Learning Outcomes:
After the completion of the course the student should be able to:
- identify the various electrical apparatus and their interconnections.
- select suitable electrical supply system and design earthing systems of various electric loads.
- estimate the cost for installation of wiring for different types of building and small industries.
- identify the components of electrical substations.
- design suitable control circuit for starting of three phase induction motor and synchronous motor.

Text Books:
1. Electrical Design and Estimation Costing - K. B. Raina and S.K.Bhattacharya – New Age International Publishers.

References Books:
1. Electrical wiring estimating and costing – S.L.Uppal and G.C.Garg – Khanna publishers, sixth edition, 1987.
2. A course in electrical installation estimating and costing – J.B.Gupta –Kataria SK & Sons.

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III Year – II SEMESTER		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
POWER ELECTRONICS DEVICES & CIRCUITS **(Open Elective-I)**					

Preamble

The course is intended to make the difference between signal and power semiconductor devices in their physical operation and characteristics.

Learning Objectives:

- To understand the physics of basic semiconductor devices and power diode.
- To study the physics and operating characteristics of BJT and power MOSFET.
- To understand the operation and characteristics of thyristor and GTOs.
- To understand the physics and characteristics of IGBT.
- To study the operation of emerging devices and their integrated circuits.

UNIT -I:

Basic Semiconductor Physics & Power Diodes

Basic Semiconductor Physics: Introduction - Conduction Process in Semiconductors - pn junction - Avalanche Breakdown -

Power Diodes: Introduction - Basic Structures and I-V Characteristics - Breakdown Voltage Considerations - Switching Characteristics.

UNIT -II:

Bipolar Junction Transistors & Power MOSFET

Bipolar Junction Transistors: Introduction - Vertical Power Transistor Structures - Characteristics - Physics of BJT Operation - Switching Characteristics - Breakdown Voltages - Second Breakdown - On-State Losses - Safe Operating Areas.

Power MOSFET: Introduction – Basic Structure - I-V Characteristics - Physics of Device Operation - Switching Characteristics - Operating Limitations and Safe Operating Areas.

UNIT -III:

Thyristors & GTO

Thyristors: Introduction - Basic Structure – I-V Characteristics – Physics of Device Operation – Switching Characteristics - Methods of Improving di/dt and dv/dt Ratings

GTO: Introduction - Basic Structure – I-V Characteristics - Physics of Turn-off Operation – Switching Characteristics.

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UNIT -IV:
Insulated Gate Bipolar Transistors
Introduction – Basic structure – I-VCharacteristics – Physics of Devices Operation – Latchup in IGBTs – Switching Characteristics.

UNIT -V:
Emerging Devices and Circuits
Introduction – Power Junction Field Effect Transistors – Field-controlled Thyristor – JFET – Based Devices versus Other Power Devices – MOS-controlled Thyristor – Power Integrated Circuits.

Learning Outcomes:
After the completion of the course the student should be able to:

- explain the basics of semiconductor devices and use of Power diode.
- know the operation and characteristics of BJT and power MOSFETs.
- explain the basic difference of thyristors and GTOs in their physics and characteristics.
- know the operation of IGBT, emerging devices and circuits.

Text Books:
1. Power Electronics: converters, applications & design -by Nedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
3. Power Electronics – by P.S.Bhimbra, Khanna Publishers.

Reference Books:
1. Elements of Power Electronics–Philip T.Krein. oxford.
2. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.
5. Power Converter Circuits -by William Shepherd, Li zhang, CRC Taylor & Francis Group.

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
FUNDAMENTALS OF ELECTRICAL MACHINES **(OPEN ELECTIVE-I)**					

Preamble:
This course introduces the fundamentals of basic electrical circuits and topics related to principles, performance, applications and design considerations of dc machines and transformers. The course also covers the topics of different types of 3-phase induction motors and synchronous machines synchronous machines and their applications.

Learning Objectives:
- Understand the fundamentals in electrical machines.
- Know the characteristics of DC machines.
- Understand the operation and performance of Transformer.
- Understand the operation and starting methods of Induction motors.
- Understand the operation and application of Synchronous machine.

UNIT -I:
Introduction
Active and passive elements- Ohm's Law – Kirchhoff's Laws –Electromagnetic Induction– Faraday's Laws - Series – Parallel circuits- Self and Mutual Inductance-Numerical problems. Purpose of Earthing – Methods of Earthing – Merits of Earthing. Different types of Electrical Machines.

UNIT -II:
DC Machines
Principle of operation of DC generator - Types of DC machines – EMF equation –- Open Circuit Characteristics- Principle of operation of DC Motor- Torque Equation- speed control methods of DC motor – Losses in DC machines - Swinburne's Test-Brake test on DC shunt motor – Performance Characteristics - Numerical problems.

UNIT -III:
Transformers
 Principle of operation and construction Details – Classification of Transformers - EMF equation – Losses in a Transformer – Open Circuit & Short Circuit Test – Calculation of efficiency and regulation -Numerical Problems.

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UNIT -IV:
Induction Motors
Principle of operation- Constructional Details - Classification – Revolving Magnetic Fields–
Starting Methods – Numerical Problems. Principle of operation of Single Phase Induction Motor
- Starting Methods- Applications.

UNIT -V:
Synchronous Machines
Principle of operation and construction of alternators –EMF Equation - Regulation of alternator
by Synchronous Impedance Method – Numerical Problems.
Principle of operation of synchronous motor - Synchronous Condenser – Applications.

Learning Outcomes:
After the completion of the course the student should be able to:
- Apply fundamentals in various electrical circuits.
- Explain the operation and characteristics of DC machines.
- Determine the efficiency and regulation of transmission.
- Explain the operation and starting methods of Induction Motors.
- Apply the applications of Synchronous Machines.

Text Books:
1. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand publications
2. Theory & performance of Electrical Machines by J.B.Guptha, S.K.Kataria & Sons
3. Circuit Theory (Analysis and Synthesis) by A. Chakrabarti, Dhanpat Rai & Co.

Reference Books:
1. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah,TMH Publications
2. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
3. Basic Electrical Engineering by Nagsarkar,Sukhija, Oxford Publications,2nd edition

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		L	T	P	C
III Year –II SEMESTER		**0**	**0**	**3**	**1.5**
	POWER ELECTRONICS LABORATORY				

Learning objectives:
- To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive and inductive loads.
- To understand the working of Buck converter, Boost converter and inverters.

Any 10 of the Following Experiments are to be conducted
1. Characteristics of Thyristor, MOSFET & IGBT.
2. R, RC & UJT firing circuits for SCR.
3. Single -Phase semi converter with R & RL loads.
4. Single -Phase full converter with R & RL loads.
5. Three- Phase full converter with R &RL loads.
6. Single Phase dual converter in circulating current & non circulating current mode of operation.
7. Single -Phase AC Voltage Regulator with R & RL Loads.
8. Single Phase step down Cycloconverter with R & RL Loads.
9. Boost converter in Continuous Conduction Mode operation.
10. Buck converter in Continuous Conduction Mode operation.
11. Single -Phase square wave bridge inverter with R & RL Loads.
12. Single - Phase PWM inverter.

Learning outcomes:
After the completion of the course the student should be able to:
- study the characteristics of various power electronic devices.
- analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- understand the operation of single phase AC voltage regulator with resistive and inductive loads.
- understand the working of Buck converter, Boost converter, single–phase square wave inverter and PWM inverter.

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III Year –II SEMESTER		L	T	P	C
		0	0	3	1.5
	MICRO PROCESSORS AND MICRO CONTROLLERS LAB				

Learning Objectives:
- To study programming based on 8086 microprocessor and 8051 microcontroller.
- To study 8086 microprocessor based ALP using arithmetic, logical and shift operations.
- To study to interface 8086 with I/O and other devices.
- To study parallel and serial communication using 8051& PIC 18 micro controllers.

Any 10 of the following experiments are to be conducted:

I. Microprocessor 8086&Microcontroller 8051

Introduction to MASM/TASM.
1. Arithmetic operation – Multi byte addition and subtraction, multiplication and division – Signed and unsigned arithmetic operation, ASCII – Arithmetic operation.
2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
3. By using string operation and Instruction prefix: Move block, Reverse string Sorting, Inserting, Deleting, Length of the string, String comparison.
4. Interfacing 8255–PPI with 8086.
5. Interfacing 8259 – Interrupt Controller with 8086.
6. Interfacing 8279 – Keyboard Display with 8086.
7. Stepper motor control using 8253/8255.
8. Reading and Writing on a parallel port using 8051
9. Timer in different modes using 8051
10. Serial communication implementation using 8051
11. Understanding three memory areas of 00 – FF Using 8051 external interrupts.
12. Traffic Light Controller using 8051.

Learning Outcomes:
After the completion of the course the student should be able to:
- write assembly language program using 8086 micro based on arithmetic, logical, and shift operations.
- interface 8086 with I/O and other devices.
- do parallel and serial communication using 8051 & PIC 18 micro controllers.

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		L	T	P	C
III Year –II SEMESTER		**3**	**0**	**0**	**0**
	EMPLOYABILITY SKILLS				

Preamble: This course is introduced to enhance the soft and hard skills of students based on industry needs and helping the student to get the employment in the competitive industrial environment.

Course Objective: In the this course the student should understand:
(i) Aptitude skill (ii) Soft skills (iii) Skills required for campus placement interview

Unit 1: Aptitude Skills
Quantitative Aptitude:
Numbers, HCF and LCM, Problems on ages, Averages, Ratio and Proportion, Percentages, Profit and Loss, Partnership, Interest calculations, Time and Work, Time and Distance, Pipes and Cisterns, Mensuration
Reasoning:
Number and Letter Analogy, Coding and decoding, Odd Man out, Symbols and Notations, Permutations and Combinations, Probability, Data Interpretation, Data Sufficiency, Clocks and Calendars, Deductions, Logical Connectives, Venn Diagrams, Cubes, Binary Logic, Ordering and Sequencing, Blood relations – Syllogisms - Seating arrangement, Analytical Reasoning

Unit 2: Skills - I
Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development. **Self-Discovery:** Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue. Goal Setting-Vision Vs Mission Vs Goals, SMART Technique to Goal Setting, SWOT Analysis. **Self Esteem:** Types of Self Esteem, Causes of Low Self Esteem, Merits of Positive Self Esteem and Steps to build a positive Self Esteem; Art of Compromise, Learn to Say:'I Don't Know', Being organized, Showing Self-awareness, Self-Assessment for Attainable Career Objectives. **Attitude & Confidence:** Attitude Vs Skills Vs Knowledge, Attitude Vs Behaviour, Developing Positive Attitude and Confidence; Fear-Public Speaking, Steps to Overcome Fear, developing Positive Thinking and Attitude; Driving out Negativity; Meaning and Theories of Motivation; Enhancing Motivation Levels, Adjusting Your Attitude‑Arrogance has no Place in the Workplace, Cultural Sensitivity in the Workplace, Corporate Culture: Learning How to Fit in. **Motivational Talk:** Team Work, Team Vs Group, Stages in Team Building, Mistakes to avoid and Lessons to Learn.

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Unit 3: Skills – II:
Interpersonal Communication: Interpersonal relations; communication models, process and barriers; team communication; developing interpersonal relationships through effective communication; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation. **Listening:** Listening Vs Hearing, Possible reasons for why people do not Listen at times, Active Listening Vs Passive Listening, Listening effect on relationships. **Public Speaking:** Skills, Methods, Strategies and Essential tips for effective public speaking. **Group Discussion:** Importance, Planning, Elements, Skills assessed; Effectively disagreeing, Initiating, Summarizing and Attaining the Objective. **Non-Verbal Communication:** Importance and Elements; Body Language-Postures, gestures, eye contact. **Teamwork and Leadership Skills:** Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills. **Presentation Skills:** Types, Content, Audience Analysis, Essential Tips – Before, During and After, Overcoming Nervousness. **Etiquette and Manners:** Social and Business. **Time Management** – Concept, Essentials, Tips.

Unit 4: Personality Development: Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills. **Decision-Making and Problem-Solving Skills:** Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills. **Conflict Management:** Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resolution. **Stress Management:** Stress - Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models and Impact of Stress; Measurement and Management of Stress. **Leadership and Assertiveness Skills:** A Good Leader; Leaders and Managers; Leadership Theories; Types of Leaders; Leadership Behaviour; Assertiveness Skills. **Emotional Intelligence:** Meaning, History, Features, Components, Intrapersonal and Management Excellence; Strategies to enhance Emotional Intelligence.

Unit 5: Group Discussions (GD):
Stages of a GD, GD Vs Debate, Skills assessed in a GD, Blunders to be avoided, Dos & Don'ts, GD-Practice: Conducting practice sessions and Brain Storming Sessions, Evaluation, feedback on their performance
Resume Preparation: Resume Templates, Steps followed for resume preparation, Common mistakes in a resume; Covering letter
Campus Placements Skills: Stages of Campus Placement, Skills assessed in Campus Placements, Changing scenario and its Challenges & How to get ready, Motivational Talk on Positive Thinking: Beliefs, Thoughts, Actions, Habits & Results (Success);
Interview Skills: Types of Interview, Interviewer and Interviewee – in-depth perspectives; Before, During and After the Interview; Tips for Success, Dress code and Grooming, Dos & Don'ts, Skills assessed in an Interview, Mistakes to be avoided, How to equip oneself to excel;

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How to handle the Typical Interview Questions; Mock Interviews: Unconventional HR questions, Practice sessions with Feedback, **Simulated Testing:** Previous model papers of companies,
Business Terminology: Financial Terms such as Debt, Equity, Share, Working Capital, Turnover, Net worth etc; Vision, Mission, Objectives, Goals, Targets

Course Outcomes: After studying this course the student should able to
(i) solve aptitude and reasoning problems (ii) apply the soft skills in dealing the issues related to employability (iii) successful in getting employment in campus placement interview

References:
1) B. K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
2) S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.
3) R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand & Company Ltd., 2018.
4) Raman, Meenakshi & Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.