K.S.R.M. College of Engineering - KADAPA

(AUTONOMOUS)

Department of Electrical & Electronics Engineering

B. Tech – V Semester (Theory - 5, Lab - 3)

S. No.	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	1814501	Microprocessor	PCC	3	0	0	30	70	3
2	1814502	Linear Digital IC Applications	PCC	3	0	0	30	70	3
3	1802503	Power Electronics	PCC	3	0	0	30	70	3
4	1802504	Power System Operation & Control	PCC	3	1	0	30	70	4
5		**Professional Elective-I (PE-I)**							
	1802505	Energy Auditing & Demand Side Management	PEC	3	0	0	30	70	3
	1802506	Electrical Machine Design	PEC	3	0	0	30	70	3
	1802507	Advanced Control Systems	PEC	3	0	0	30	70	3
	1802508	Instrumentation	PEC	3	0	0	30	70	3
	1802509	Energy Conversion Systems	PEC	3	0	0	30	70	3
6	1802510	Electrical Machines - II Lab	PCC	0	0	3	50	50	1.5
7	1802511	Control Systems & Simulation Lab	PCC	0	0	3	50	50	1.5
8	1824512	Advanced English Communication Lab	HS MC	0	0	2	50	50	1
10	1802513	Mini Project (60 hrs/Semester)	PROJ	-	-	-	100	-	2
Total				15	01	08	400	500	22

B.Tech., V Semester

Course Title	Microprocessors & Microcontrollers				B. Tech. ECE V Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
1804506	EC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	--	--	3	30	70	100
Mid Exam Duration: 1Hr 30 Min					End Exam Duration: 3Hrs		

Course Objectives:

- To become familiar with 8086 Microprocessor and 8051 Microcontroller Architecture, Instructions, Operating Modes and Programming.
- To use 8086 microprocessor and 8051 microcontroller for various applications.
- To study various peripherals for microprocessor based systems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Define various components and list out various features of microprocessor, microcontroller and peripherals.
CO 2	Describe the internal block diagram of microprocessor, microcontroller and peripherals, addressing modes, instruction set and data transfer schemes.
CO 3	Develop algorithm and assembly language programs to solve problems.
CO 4	Apply an appropriate algorithm, program and peripheral for the application.
CO 5	Design the microprocessor or microcontroller based system to solve real time problems. (Prepare a case study model to get a first prototype)

UNIT I

Introduction to Microprocessors: 8085 Microprocessor - Architecture, Instruction set, Addressing modes, Basic Timing Diagrams, Interrupts and Simple Programs.

8086 Microprocessor - Architecture, Instruction set, Addressing modes, Interrupt system. Pin diagram, Minimum mode 8086 system and timings, Maximum mode 8086 system and timings.

UNIT II

Assembly Language Programming: Assembler directives, Assembly language programs (8086) with Assembler directives for addition, subtraction, multiplication, division etc., sorting and searching, bit manipulation, look-up tables, string manipulations, Macros and Delay subroutines.

Data transfer schemes and Memory Interfacing: Synchronous, Asynchronous, Interrupt driven and DMA type schemes, Address decoding techniques, Interfacing Static RAM and ROM chips,

UNIT III

Peripheral Interfacing: 8255 PPI and its interfacing, Programmable Communication Interface (8251 USART) and its interfacing, Programmable Interval Timer (8254) and its

interfacing, Programmable interrupt controller (8259) and its interfacing, Programmable DMA controller (8257) and its interfacing, ADC and DAC Interfacing.

UNIT IV

The 8051 microcontroller: Architecture, pin diagram, memory organization, external memory interfacing, stack, addressing modes, instruction set, Assembler directives, Assembly Language programs and Time delay Calculations, 8051 interrupt structure, 8051 counters and Timers, programming 8051 timers.

UNIT V

Introduction to ARM: ARM Design philosophy, Registers, Program Status Register, Instruction pipeline, Interrupts and vector table, Instruction Set- Data Processing Instructions, Branch, Load-Store, Software interrupt, PSR instructions, Conditional instructions, Thumb instruction Set: Register Usage, Other Branch instructions, Data processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions.

Text Books:

1. Ramesh S. Gaonkar, "Microprocessor architecture, programming and its applications with 8085", Penram International Publications, 4th Edition.
2. A. K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and Peripherals", TMH.
3. The 8051Microcontroller and Embedded Systems, Mazidi Muhammad Ali, Mazidi Janice Gillespie & McKinlay Rolin D, 2nd Edition, Pearson Education, 2008.
4. The 8051 microcontroller: Architecture, Programming & Applications, Kenneth J Ayala, penram publications, 2nd edition.
5. ARM System Developer's Guide-Designing and Optimizing system software, Andrew N.Sloss, Dominic Symes, Chris Wright, Elsevier, 2008.

Reference Books:

1. Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, Tata McGraw-Hill.
2. Barry B. Brey, "The Intel Microprocessors-Architecture, Programming and Interfacing", 8th Edition, PHI.
3. Y. Liu and Glenn A. Gibson, "Microcomputer Systems: 8086/8088 Family Architecture, Programming and Design", 2nd Edition, PHI.
4. Microcontrollers Architecture, Programming, Interfacing and System Design – Raj Kamal, Pearson Education, 2005.
5. Steve Furbur, ARM System onchip Architecture, 2nd Edition, Addison Wesley, 2000.

Linear and Digital IC Applications

Course Objectives:

- To give introduction to Op-Amps
- To study about Timers and PLLs
- To Learn the applications of Op-Amps.
- To introduce **Verilog** and its language elements to design digital systems.
- Make students familiar with design of different combinational and sequential digital circuits.

Learning Outcomes:

CO1: Understand the operation and characteristics of OP-AMPs.
CO2: Analyze multivibrator circuits and 555 timers using OP-AMPs.
CO3: Apply PLL in various Communication applications
CO4: Compare various digital logic families.
CO5: Simulate digital logic circuits using **Verilog** HDL.

UNIT-I

OP-AMP AND ITS CHARACTERISTICS

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 and its features, Inverting and non-inverting amplifier.

UNIT-II

OP-AMP APPLICATIONS

Integrator and differentiator, difference amplifier, instrumentation amplifier, AC amplifier, V-I, I-V converters, comparators, Multivibrators, Triangular and square wave generators, Log and antilog amplifiers, precision rectifiers.

UNIT-III

TIMERS AND PHASE LOCKED LOOPS

Introduction to 555 Timer, functional diagram, Monostable and Astable operations, Schmitt Trigger, PLL-Introduction, Block schematic, principles and description of individual blocks,565 PLL, applications.

UNIT–IV

UNIPOLAR & BIPOLAR LOGIC FAMILIES

Introduction to logic families, CMOS logic, CMOS steady state electrical behavior, CMOS dynamic state electrical behavior, CMOS logic families, Bipolar logic, transistor logic, TTL families, CMOS/TTL interfacing, ECL, Comparison of logic families.

UNIT–V

VERILOG HDL AND DESIGN EXAMPLES

HDL based Design flow, Program Structure, Logic system, Nets, Variables and Constants,Vectors and Operators, Arrays,Logical Operators and Expressions. Structural design elements, data flow design elements, behavioral design elements (procedural code). Design using basic gates, Decoders, Encoders, Multiplexers and Demultiplexers, Adders, Subtractors , SSI Latches and Flip-Flops, Counters, Design of Counters and Shift Registers .**Verilog** Modules for the above ICs.

Text Books:

1. Ramakanth A. Gayakwad, "Op-Amps & Linear ICs", 4th edition, PHI, 1987.

2. John F. Wakerly, "Digital Design Principles & Practices" PHI/Pearson Education Asia, 4th Edition, 2008.
3. J. Bhasker, "A Verilog HDL Primer", Star Galaxy Publishing; 3rd edition (January 31, 2005)

References:

1. D. Roy Chowdhury, "Linear Integrated Circuits", New Age International (P) Ltd, 2nd Edition, 2003.

2. James M.Fiore, "Operational Amplifiers & Linear integrated circuits & applications", Cengage 2009.
3. Fundamentals of Digital Logic with Verilog Design – Stephen Brown, Zvonko Vranesic, TMH, 3rd Edition, 2014

Course Title	Power Electronics					B. Tech. V Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1802503	Professional Core (PCC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	30	70	100
Mid Exam Duration : 2Hrs						End Exam Duration : 3Hrs		
Course Objectives: The objective of the course is to learn the basic concepts of power semiconductor devices, converters, choppers and inverters and their analysis.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand the basic operation of power semiconductor devices and passive components.							
CO 2	Analyze the performance of different power converters subjected to various loads.							
CO 3	Design static and dynamic equalizing circuits, Snubber circuits.							
CO 4	Evaluate number of SCRs required for desired series /parallel operation, Electrical parameters and different variables of various power electronic circuits.							
CO 5								

UNIT - I

Silicon Controlled Rectifier: SCR – static characteristics –turn on and off mechanism – gate characteristics – dynamic characteristics – series and parallel operation of scr's – static and dynamic equalization circuits – design of snubber circuit – line commutation and forced commutation circuits, MOSFET, IGBT, GTO Characteristics.

UNIT - II

Phase controlled Rectifiers: Phase controlled rectifiers – single phase half and fully controlled converters – midpoint and bridge connections with R and RL loads – effect of source inductance- single phase and three phase half and fully controlled converters with R load - single phase and three phase dual converters with R and RL loads-numerical problems.

UNIT - III

AC Voltage Controllers: AC voltage controllers- single phase ac voltage controllers with SCR and triac for R and RL load –cyclo converters – single phase cyclo converters (mid-point and bridge configuration) with R and RL loads.

UNIT - IV

Choppers: Choppers – principle of operation – control strategies- types of chopper circuits – type A, type B, type C, type D and type E chopper circuits - multiphase chopper circuits – buck converter, boost converter, buck -boost converter, problems.

UNIT - V

Inverters: Inverters – single phase inverter – basic series inverter – basic parallel capacitor inverter – bridge inverter– current source inverter - forced commutation circuits for bridge inverters – output voltage control techniques- PWM techniques- space vector modulation - harmonic reduction techniques.

Text Books

1. Power Electronics – By M.D Singh & K.B. Kanchandhani, Tata McGrawHill Publishing Company, 1998.
2. Power Electronics - Circuits, Devices and Applications – by M.H. Rashid, Prentice Hall of India, 2nd Edition 1998.
3. Power Electronics- by PS Bimbhra, Khanna Publications.

Reference Books

1. Power Electronics – By Vedam Subramanyam, New Age Information Limited, 3rd Edition.
2. Power Electronics – By V.R. Murthy, Oxford University Press, 1st Edition – 2005
3. Power Electronics – By P.C Sen, Tata Mc Graw Hill Publishing.
4. Thyristorised Power Controllers – By G.K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, New Age Informational(p) Limited Publishing 1996.

Course Title	**Power System Operation & Control**				**B. Tech. V Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
1802504	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		

Course Objectives: The objective of the course is to learn steady state and transient stability analysis, economic operation of power systems, hydrothermal scheduling, modeling of governor, generator, single area and two area load frequency control.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Analyze the stability of the power system under different operating conditions
CO 2	Understand optimal operation of thermal unit, hydrothermal scheduling and modeling of power system components for LFC studies.
CO 3	Analyze economic operation criteria of thermal unit, hydrothermal units, modeling of turbine and governor.
CO 4	Analyze load frequency control parameters in single and two area systems.
CO 5	Design suitable controllers to improve LFC dynamics in single and two area power systems.

UNIT I

Stability Studies: Classification of stability studies – the power flow equations of wound rotor and salient pole synchronous machine connected to infinite bus through a transmission system – power angle diagrams – steady state stability and limits.

Transient Stability Analysis: General considerations and assumptions –inertia constant, derivation of swing equations, equal area criterion – application of equal area criterion to a) sudden increase in input b) sudden three phase fault on one of the lines of a transmission system – determination of critical clearing angle – clearing time- – limitations of equal area criterion, methods for improving power system stability.

UNIT II

Economic Operation: Optimal operation of thermal power units, - heat rate curve – cost curve–incremental fuel and production costs, input-output characteristics, optimum generation allocation with line losses neglected. Optimum generation allocation including the effect of transmission line losses – loss coefficients, general transmission line loss formula.

UNIT III

Hydrothermal Scheduling: optimal scheduling of hydrothermal system: hydroelectric power plant models, scheduling problems- short term hydrothermal scheduling problem.

Modeling of Turbine: First order turbine model, block diagram representation of steam turbines and approximate linear models.

Modeling of Governor: Mathematical modeling of speed governing system , derivation of small signal transfer function – block diagram.

UNIT IV

Load Frequency Control: Necessity of keeping frequency constant, definitions of control area, single area control, block diagram representation of an isolated power system, steady state analysis dynamic response, uncontrolled case.

UNIT V

Load Frequency Control-II: Load frequency control of two -area system – uncontrolled case and controlled case, tie-line bias control, proportional plus integral control of two area and its block diagram representation, steady state response, load frequency control and economic dispatch control.

Text Books

1. Electrical Power Systems by C.L. Wadhwa, New Age Internationa Publishers, 6th Edition,
2. Power System Analysis Operation and Control by A. Chakravarthy and S. Halder, 3rd Edition, PHI, 2012.
3. Modern Power System Analysis by I. J. Nagrath & D. P. Kothari, Tata Mc Graw – Hill Publishing Company Ltd, 2nd Edition, 2003.
4. Power Systems Analysis and Stability by S.S.Vadhera, Khanna Publications.

Reference Books

1. Power System Analysis and Design by J. Duncan Glover and M.S. Sharma., THOMSON, 3rd Edition, 2008.
2. Electric Power Systems by S. A. Nasar, Schaum Outline Series, Revised 1st Edition, TMH, 2005.

Course Title	Energy Auditing & Demand Side Management (PE - I)				B. Tech. V Semester		
Course Code	Category	Hours / Week		Credits	Maximum Marks		
1802505	Professional Elective Core (PEC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	1	0	3	30	70	100
Mid Exam Duration: 2Hrs					End Exam Duration : 3Hrs		
Course Objectives: The objective of the course is to learn about energy auditing practices , conservation schemes, different methods to improve power factor, lighting and energy instruments, load and demand side management.							
Course Outcomes: On successful completion of this course, the students will be able to							
CO 1	Understand energy auditing practices, energy conservation schemes, energy economics and management						
CO 2	Analyze energy conservation measures, energy auditing practices, energy economics and management						
CO 3	Design an appropriate energy conservation scheme for commercial and industrial applications						
CO 4	Choose appropriate technique for energy auditing and conservation.						

UNIT – I

Energy Auditing: Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, sankey diagrams, load profiles, energy conservation schemes. measurements in energy audits, presentation of energy audit results.

UNIT - II

Energy Efficient Motors: Energy efficient motors, constructional details, loss distribution, factors affecting efficiency, characteristics - variable speed, variable duty cycle systems, rms hp- voltage variation-voltage unbalance- over motoring- motor energy audit.

UNIT – III

Power Factor Improvement: Power Factor – methods of improvement, location of capacitors, pf with non linear loads, effect of harmonics on pf, pf motor controllers.

UNIT – IV

Lighting and Energy Instruments: Good lighting system design and practice, lighting control ,lighting energy audit - energy instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

UNIT – V

Demand Side Management: Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning.

Load Management: Load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. management and organization of energy conservation awareness programs.

Text Books

1. Electrical Power distribution by A. S. Pabla, TMH, 5th edition, 2004.
2. Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
3. Energy management hand book by W. C. Turner, John Wiley and Sons.

References

1. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998.
2. Energy efficient electric motors by John. C. Andreas, Marcel Dekker Inc Ltd., 2nd Edition, 1995.
3. Energy management and good lighting practice: Fuel Efficiency- Booklet12 – EEO.
4. Recent Advances in Control and Management of Energy Systems by D. P. Sen, K. R. Padiyar, Indrane Sen, M. A. Pai, Interline Publisher, Bangalore, 1993.
5. Energy Demand – Analysis, Management and Conservation, Ashok V. Desai, Wiley Eastern, 2005.

Course Title	**Electrical Machine Design (PE – I)**				**B. Tech. V Semester**		
Course Code	**Category**	**Hours / Week**		**Credits**	**Maximum Marks**		
1802506	**Professional Elective Core (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**1**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2Hrs					**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn the design specifications of electrical machines, basic design considerations of transformers, rotating machines, three phase induction motors, synchronous machines and cooling of machines.							
Course Outcomes: On successful completion of this course, the students will be able to							
CO 1	Understand various design specifications of Electrical Machines.						
CO 2	Estimate the design specifications of DC machines, Transformers, Induction machines and synchronous machines.						
CO 3	Analyze the choice between various parameters like type of windings, no.poles, no.of slots etc						
CO 4	Analyze the heating and cooling of electrical machines						

UNIT I

The Design problem: Basic considerations, design specifications, ISI specifications, design constraints, specification of transformers, rotating machines.

Design of transformers: Types of transformer – core construction, output equation, principle of design of core, windings, yoke main dimensions (H & W) for single phase: core type, shell type. 3-phase – core type transformers estimation of no load current of transformer.

UNIT II

General concepts of rotating machines: Output equation of dc machines, ac machines, separation of D & L, choice of specific loadings.

Design of D.C machines: Choice of no. of poles, selection of no. of armature slots, choice of winding, estimation of conductor cross section of armature, design of field systems: tentative design of field winding of dc machines.

UNIT III

Design of 3-phase induction motor: Separation of D & L, ranges of Ampere conductors and Bav.

Stator design – Selection of no of stator slots, turns per phase, design of conductor cross section.

Rotor design - Selection of no of rotor slots, principles of design of squirrel cage rotor, design of slip ring rotor.

UNIT IV

Design of synchronous machines: Separation of D & L, choice of Ampere conductors & Bav - Short Circuit Ratio (SCR) and its significance.

Armature design – choice of no. of stator (Armature) slots, turns/phase, conductor cross section for both salient pole and cylindrical pole machines.

UNIT V

Heating & Cooling of electrical machines: Theory of Solid body heating, heating time constant- cooling time constant, elementary treatment of cooling and heating time curves.

Cooling of machines: Volume of coolant required, types of coolants, cooling methods of transformer- hydrogen cooling, transformer tank design.

Text Books:

1. Electrical machine design by A. K. Sawhney, Dhanpatrai & Sons.
2. Electrical System Design by M. K. Giridharan, I. K. International Publishing House Pvt. Ltd., 2011.
3. Design of Electrical Machines by V. N. Mittle and A. Mittal, Standard Publishers Distributors, 4th Edition, 1998.

Reference Books:

1. Principles of Electrical machine design by M. G. Say & Parker Smith.
2. Electrical machine design by Balbir Singh by Khanna Publishers.

Course Title	Advanced Control Systems (PE-I)					B. Tech. V Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1802507	Professional Elective Core (PEC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	1	0	3	30	70	100
Mid Exam Duration: 2 Hrs						End Exam Duration : 3Hrs		
Course Objectives: Student is able to learn the State Space, Describing function, phase plane and stability analysis including controllability and observability.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand the concept of state State techniques							
CO 2	Analyse the stability of linear and nonlinear Systems describing functions for different nonlinearities							
CO 3	Construct the state model of linear time invariant systems and lyapunov functions for nonlinear systems							
CO 4	Determine Eigen values state transition matrix examine the controllability and observability of linear time invariant systems							
CO 5	Design compensators controllers state feedback controller and observer							

UNIT – I

Linear System Design: Introduction of compensating networks – Lead, Lag, lead – lag cascade compensation in time domain –P, PI and PID controllers design using bode plot and root locus techniques.

UNIT – II

State variable descriptions: Concepts of state, state variables, state vector, state space model, representation in state variable form, phase variable representation – solution of state equations – state transition matrix.

UNIT – III

Controllability and Observability: Definition of controllability – controllability tests for continuous linear time invariant systems – Definition of observability – observability tests for continuous linear time invariant systems, diagonalization – canonical variable representation.

UNIT – IV

Design of Control Systems: Introduction, Pole placement by state feedback, Full order and reduced order observers,

UNIT – V

Stability: Introduction, equilibrium points – stability concepts and definitions – stability in the sense of liapunov stability of linear system – methods of constructing liapunov functions for non – linear system – krasovskii's method – variable gradient method.

Text Books

1. Modern Control System Theory by M. Gopal, New Age International Publishers, 2nd edition, 1996.
2. Control System Engineering by I. J. Nagarath and M. Gopal, New Age International (P) Ltd.

Reference Books

1. Modern Control Engineering by K. Ogata, Prentice Hall of India, 3rd Edition, 1998.
2. Systems and Control by Stainslaw, H. Zak, Oxford Press, 2003.
3. Digital Control and State Variable Methods by M. Gopal, TMH, 1997.

Course Title	**Instrumentation (PE-I)**				**B. Tech. V Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
1802508	**Professional Elective Core (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to know errors that occur in measurement systems, their classification, characteristics of signals, their representation, and signal modulation techniques, methods of data transmission, telemetry, and data acquisition, working principles of different signal analyzers and digital meters, several types of transducers and their use for measurement of non-electrical quantities.							
Course Outcomes: On successful completion of this course, the students will be able to							
CO 1	Understand the types of errors occurring in measurement systems.						
CO 2	Differentiate types of data transmission and modulation technique						
CO 3	Apply digital techniques to measure voltage, frequency and speed.						
CO 4	Choose suitable transducers for measurement of non-electrical quantities.						

UNIT-I

Characteristics of Signals and their Representation: Measuring systems, performance characteristics, - static characteristics, dynamic characteristics; errors in measurement – gross errors, systematic errors, statistical analysis of random errors. signals and their representation: standard test, periodic, aperiodic, modulated signal, sampled data, pulse modulation and pulse code modulation.

UNIT-II

Data Transmission, Telemetry and DAS: Methods of data transmission – general telemetry system, frequency modulation (FM), pulse modulation (PM), pulse amplitude modulation (PAM), pulse code modulation (PCM) telemetry. Comparison of FM, PM, PAM & PCM. analog and digital data acquisition systems – components of analog DAS – types of multiplexing systems: time division and frequency division multiplexing – modern digital DAS– block diagram.

UNIT-III

Signal Analyzers, Digital Meters: Wave analysers- frequency selective analyzers, heterodyne, application of wave analyzers- harmonic analyzers, total harmonic distortion, spectrum analyzers, basic spectrum analyzers, spectral displays, vector impedance meter, q meter.

Peak reading and RMS voltmeters, digital voltmeters - successive approximation, ramp and integrating type-digital frequency meter-digital multimeter-digital tachometer.

UNIT-IV

Transducers: Definition of transducers, classification of transducers, advantages of electrical transducers, characteristics and choice of transducers; principle of operation of resistive, inductive, capacitive transducers, LVDT, strain gauge and its principle of operation, gauge factor, thermistors, thermocouples, synchros, piezoelectric transducers, photovoltaic, photoconductive cells, photo diodes.

UNIT-V

Measurement of Non-Electrical Quantities: Measurement of strain, gauge sensitivity, measurement of displacement, velocity, angular velocity, acceleration, force, torque, temperature, pressure, flow, liquid level.

Text Books

1. A course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, Dhanpat Rai & Co., 2012.
2. Transducers and Instrumentation, D.V.S Murty, Prentice Hall of India, 2nd Edition, 2004.

Reference Books

1. Modern Electronic Instrumentation and Measurement technique, A.D Helfrick and W.D.Cooper, Pearson/Prentice Hall of India., 1990.
2. Electronic Instrumentation, H.S.Kalsi Tata MCGraw-Hill Edition, 2010.
3. Industrial Instrumentation – Principles and Design, T. R. Padmanabhan, Springer, 3rd re print, 2009.

Course Title	**Energy Conversion Systems (PE – I)**				**B. Tech. V Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
1802509	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn about energy conversion techniques, sources of electrical energy production and impact of energy conversion systems on environment.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand the principles and applications of various non-conventional energy systems and energy storage.							

CO 2	Analyze the properties and characteristics of wind, turbines and generators usedn in tidal power
CO 3	Analyze the solar cell operation and its test specifications
CO 4	Analyze the impact of energy conversion systems on environment and remedial measures.

UNIT I

Photo Voltaic Power Generation: Spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, test specifications for PV systems.

UNIT II

Wind Energy Conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

UNIT III

Tidal Power Station: Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation.

Ocean Energy Conversion: Types of ocean thermal energy conversion systems, Application of OTEC systems examples.

UNIT IV

Miscellaneous Energy Conversion Systems: biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, description of fuel cells**.** Types of fuel cells, H_2-O_2 Fuel cells, Application of fuel cells – Batteries, Description of batteries, Battery application for large power.

UNIT V

Environmental Effects: Environmental Effects of energy conversion systems, pollution from coal and preventive measures steam stations and pollution, acid rain, pollution free energy systems and nuclear power station pollution.

Text Books

1. "Energy conversion systems" by Rakosh das Begamudre, New age international Private Ltd., publishers, 1st Edition, 2000.
2. "Renewable Energy Resources" by John Twidell and Tony Weir, CRC Press (Taylor & Francis).

Course Title	Electrical Machines - II Lab				B. Tech. V Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
1802510	Professional Core (PCC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		0	0	3	1.5	50	50	100
						End Exam Duration : 3Hrs		
Course Objectives: The objective of the course is to analyze the performance of various AC machines like induction motors and synchronous machines.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Identify parts of transformers and AC machines							
CO 2	Determine the performance of AC machines							
CO 3	Choose the apparatus in experimental circuit based on loading and rating of the AC machines							

List of experiments

1. Brake test on Three Phase Induction Motor
2. No-load & Blocked rotor Tests on Three Phase Induction Motor
3. Speed Control of three phase Induction Motor
4. Equivalent Circuit of a Single Phase Induction Motor
5. Determination of X_d and X_q of a Salient Pole Synchronous Machine
6. Load test of a three phase alternator by Resistive, Inductive and Capacitive Loading
7. Regulation of a Three –Phase Alternator by Synchronous Impedance & M.M.F. Methods.
8. Regulation of Three Phase Alternator by Z.P.F. Method.
9. V and Inverted V Curves of a 3 Phase Synchronous Motor.
10. Determination of transient, sub-transient and steady state reactance of an alternator.

Course Title	Control Systems & Simulation Lab				B. Tech. V Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
1802511	Professional Core (PCC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	30	70	100
Mid Exam Duration : 2Hrs						End Exam Duration : 3Hrs		

Course Objectives: The objective of the course is to learn the performance of second order system, PID controller, synchros and characteristics of servo motor. Stability analysis in time and frequency domain, state space analysis in MATLAB.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the performance of second order system, PID controller, synchros and armature voltage controlled DC motor
CO 2	Analyze the characteristics of magnetic amplifier and servo motor
CO 3	Evaluate stability of linear systems in time and frequency domain using MATLAB
CO 4	Convert transfer function to state space and vice versa using MATLAB

List of the experiments (Any Ten - 8 from Conventional, 2 from MATLAB)

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC Machine
6. Effect of P, PD, PI, PID Controller on a second order systems
7. Microprocessor based stepper motor controller
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Lag and lead compensator design in the frequency domain using MATLAB.
12. Linear system analysis (Time domain analysis) using MATLAB.
13. Stability analysis (Bode, Root Locus) of Linear Time Invariant system using MATLAB
14. State space model for classical transfer function using MATLAB – Verification.

Course Title	Mini Project					B. Tech. V Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1802513	PROJ	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		--	--	-	2	100	--	100
Course Objective: The objective of the project is to enable the student to take up investigative study for social relevance.								
On successful completion of this course, the students will be able to								
CO 1	Understand core concepts and research findings relative to human development, socialization, group dynamics and life course processes.							
CO 2	Identify and transfer existing ideas into new contexts and applications							
CO 3	Apply and transfer academic knowledge into the real-world.							
CO 4	Design a component or a product applying all the relevant standards and with realistic constraints							

The following are the rules and regulation for **Socially Relevant Projects:**

1. The student has to spend 50 to 60 Hrs in the semester on any project (Social Relevance) and submit a report for evaluation.
2. The project is evaluated for 100 marks in the semester by a committee consisting of head of the department, project mentor and one senior faculty member of the department.
3. A student shall acquire 2 credits assigned, when he/she secures 50% or more marks from the total of 100 marks.
4. In case, if a student fails, he/she shall resubmit the report.
5. There is no external evaluation for the socially relevant project.