Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electrical Engineering

(Applicable from the academic session 2018-2019)

Semester-VI

Name of the course	**POWER SYSTEM-II**
Course Code: PC-EE-601	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand the method of representation of power system components
2.	To know about loacation and components of a distribution substation.
3.	To understand different methods of load flow studies.
4.	To determine faults in Electrical systems.
5.	To understand the principle of power system stability.
6.	To understand the principle of relays and methods of protection of power system
7.	To solve numerical problems on the topics studied.
Pre-Requisite	
1.	Electric Circuit Theory (PC-EE-301)
2.	Electromagnetic field theory (PC-EE-303)
3.	Power system-I (PC-EE-502)

Unit	Content	Hrs	Marks
1	**Representation of Power system components:** Single-phase representation of balanced three phase networks, the one-line diagram and the impedance or reactance diagram, per unit (PU) system.	02	
2	**Distribution substation:** Types of substations, location of substations, substation equipments and accessories, earthling (system & equipment), feeder and distributors, radial and loop systems.	05	
3	**Load flow studies:** Network model formulation, formation of Ybus, load flow problem, Gauss-Siedel method, Newton-Raphson method, Decoupled load flow studies, comparison of load flow methods.	05	
4	**Faults in Electrical systems:** Transient on a transmission line, short circuit of a synchronous machine under no load & loaded condition. Symmetrical component transformation, sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. Symmetrical component analysis of unsymmetrical faults, single line-to –ground fault, lineto-line fault, double line-to- ground fault	08	
	Power system stability: Steady state stability, transient stability,		

5	equal area criteria, swing equation, multi machine stability concept	04	
6	**Power system protection:** Protective zones, Relaying elements and quantities. Protective relays, basic requirements and type of protection, phase and amplitude comparator, grading (time & current), classification of Electromagnetic relays, Directional relay, Distant relay, Differential relay, basic aspects of static and digital relays, relay protection scheme for transformer, feeder, generators and motors. Circuit breakers, circuit breaking transients, transient recovery voltage, current chopping and resistance switching, circuit breaker rating, arc and arc extinction, circuit breaker types, oil circuit breaker, vacuum circuit breaker, air blast circuit breaker, SF6 circuit breaker and operating mechanism, advantages and disadvantages of different types	12	

Text book:

1. Modern Power System Analysis, D.P. Kothari & I.J. Nagrath, 4th Edition, Tata McGraw Hill.
2. Electrical Power Systems, Subir Ray, PHI
3. Switchgear protection and power systems, Sunil S Rao, Khanna Publications.
4. A text book on Power System Engineering, M.L.Soni, P.V.Gupta, U.S. Bhatnagar & A. Chakrabarti, Dhanpat Rai & CO.

Reference Books:

1. Protection & Switchgear, B. Bhalja, R.P. Maheshwari, N.G.Chothani, Oxford.
2. Power system protection & switchgear, B.Ram & D.N. Vishwakarma, Tata McGraw Hill.
3. Handbook of Electrical Power Distribution, G. Ramamurthy, University Press
4. Electric Power Transmission and Distribution, S. Sivanagaraju, S.Satyanarayana, Pearson Education.
5. Power Systems Stability, Vol. I,II & II, E.W. Kimbark, Wiley.
6. Power Engineering, D.P Kothari & I.J. Nagrath, Tata McGraw Hill.
7. Power Systems Analysis, A. R. Bergen & V. Vittal, Pearson Education. 8. Computer Aided Power systems analysis, Dr. G. Kusic, CEC press.

Course Outcome:

After completion of this course, the learners will be able to

1. Represent power system components in line diagrams.
2. Determine the location of distribution substation.
3. Determine the performance of power system with the help of load flowv studies.
4. Analyse faults in Electrical systems.
5. Determine the stabilty of Power system.
6. Explain principle of operation of different power system protection equipments.
7. Solve numerical problems related to representation, load flow, faults, stabilty and protection of power system.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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Syllabus for B. Tech in Electrical Engineering

(Applicable from the academic session 2018-2019)

Name of the course		**MICROPROCESSOR & MICRO CONTROLLER**	
Course Code: PC-EE-602		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the architecture of 8086 microprocessor.		
2.	To understand the design aspects of I/O and Memory Interfacing circuits.		
3.	To interface microprocessors with supporting chips.		
4.	To understand the architecture of 8051 microcontroller.		
5.	To design a microcontroller based system		
Pre-Requisite			
1.	Analog Electronics (PC-EE-302)		
2.	Digital Electronics (PC-EE-402)		
Unit	Content	Hrs	Marks
1	**The 8086 Microprocessor:** Introduction to 8086- Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.	08	
2	**8086 System bus structure:** 8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.	08	
3	**I/O INTERFACING**: Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller –DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.	08	
4	**Microcontroller:** Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.	08	
5	**Interfacing Microcontroller:** Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation – Comparison	06	

	of Microprocessor, Microcontroller, PIC and ARM processors		

Text books:

1. Advanced Microprocessors and Peripheral, Koshor M Bhurchandi, Ajay Kumar Ray, 3rd Edition, MC Graw hill education.
2. Microprocessor & Interfacing, D.V. Hall, Mc Graw Hill.
3. The 8051 microcontroller, Ayala, Thomson.

Ref erence books:

1. Advanced Microprocessors, Y. Rajasree, New Age international Publishers.
2. An introduction to the Intel family of Microprocessors, James L. Antonakos, Pearson Education,
3. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.
4. The 8086 Microprocessors: Programming & Interfacing the PC, K.J.Ayala, Thomson.
5. Microprocessor & Peripherals, S.P. Chowdhury & S. Chowdhury, Scitech.
6. Microchip technology data sheet, www.microchip.comerence books

Course Outcome:

After completion of this course, the learners will be able to

1. explain the architecture of 8086 and 8051.
2. do assembly language programming of 8086, 8051
3. interface different peripheral with 8086 and 8051
4. develop micro processor/ microcontroller based systems.
5. compare microprocessor, microcontroller, PIC and ARM processors

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course		**DIGITAL CONTROL SYSTEM**	
Course Code: PE-EE-601A		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the principle of sampling and reconstruction of signals.		
2.	To find Z-tranaform and inverse Z-transform of systems.		
3.	To carry out the analysis and design of digital control systems		
4.	To design compensators for digital control system to achieve desired specifications.		
5.	To represent digital control systems using state space models.		
6.	To analyze the effect sampling on stability, controllability and observability.		
7.	To design digital controllers for industrial applications.		
8.	To solve numerical problems on the topics studied.		
Pre-Requisite			
1.	Control system (PC-EE-503)		
Unit	Content	Hrs	Marks
1	**Sampling and reconstruction:** Introduction, Examples of Data control systems – Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.	03	
2	**Z-transform:** Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms	05	
3	**Z- Plane analysis of discrete-time control system:** Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane.	05	
4	**State space analysis:** State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations.	06	
5	**Controllability and observability:** Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function	04	
6	**Stabilty analysis:** Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci, Constant damping ratio loci, Stability Analysis of	05	

	closed loop systems in the Z-Plane. Jury stablility test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.		
7.	**Design of discrete time control system by conventional methods:** Transient and steady – State response Analysis – Design based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.	06	
8.	**State feedback controllers and observers:** Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula. State Observers – Full order and Reduced order observers.	05	

Text book:

1. Digital Control and State Variable Methods , M. Gopal, TMH Publishers
2. Discrete-time Control Systems, K. Ogata, Pearson Education,
3. Digital Control Systems, B.C. Kuo, Wiley Publications.
4. Control System Engineering, I.J. Nagrath, M. Gopal, New age International.

Reference books

1. Digital control of dynamic systems, Gene F. Franklin, J. David Powell, and Michael Workman 3rd ed, 1998, Addison-Wesley.
2. Digital Control Systems, design, identification and implementation, Landau**,** Ioan Doré**,** Zito**,** Gianluca, Springer-Verlag London.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the principle of sampling and reconstrction of analog signal.
2. perform Z-transformation and inverse Z-tranaformation of systems.
3. analyse and design digital control systems.
4. design compensators for digital control system to achieve desired specifications.
5. represent digital control systems using state space models.
6. analyze the effect sampling on stability, controllability and observability.

Special Remarks (if any)

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(Applicable from the academic session 2018-2019)

Name of the course	**HVDC TRANSMISSION**
Course Code: PE-EE-601B	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Practical: hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand the basics of DC power transmssion system
2.	To analyse HVDC converters.
3.	To understand methods of control of HVDC system
4.	To understand causes of fault and protection against fault of converters.
5.	To understand function of smooting reactor and transient over voltage of DC line
6.	To understand methods of reactive power control.
7.	To solve numerical problems on the topics studied.
Pre-Requisite	
1.	Electric Circuit Theory (PC-EE-301)
2.	Power system-1 (PC-EE-502)
3.	Control system (PC-EE-503)
4.	Power Electronics (PC-EE-504)

Unit	Content	Hrs	Marks
1	**DC power transmission technology:** Introduction, Comparison of HVAC and HVDC transmission system, Applications of DC transmission, Description of DC transmission system, Configurations, Modern trends in DC transmission.	04	
2	**Analysis of HVDC converters:** Pulse number, Choice of converter configuration, Simplified analysis of Graetz circuit, Converter bridge characteristics, Characteristics of a twelve-pulse converter, Detailed analysis of converters with and without overlap	06	
3	**Converter and HVDC system control:** General, Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control, Higher level controllers.	06	
4	**Converter faults and protection:** Converter faults, Protection against over-currents, Overvoltages in a converter station, Surge arresters, Protection against over-voltages.	05	
5	**Smoothing reactor and DC line:** Introduction, Smoothing reactors, DC line, Transient over voltages in DC line, Protection of DC line, DC breakers, Monopolar operation, Effects of proximity of AC and DC transmission lines.	06	
6	**Reactive power control:** Reactive power requirements in steady state, Sources of reactive power, Static VAR systems, Reactive	06	

	power control during transients, Harmonics and filters, Generation of harmonics, Design of AC filters and DC filters.		
7.	**Component models for the analysis of ac/dc systems:** General, Converter model, Converter control, Modelling of DC network, Modelling of AC networks. **Power flow analysis in AC/DC systems:** General, Modelling of DC links, Solution of DC load flow, Discussion, Per unit system for DC quantities.	06	

Text book:

1. HVDC Power transmission systems , K.R. Padiyar , Third Edition, New Age International Publishers

Reference books

1. Power Transmission by Direct Current, Erich Uhlmann, Fourth Indian Reprint, Springer International Edition, 2012.
2. HVDC Transmission, S Kamakshaiah, V Kamaraju , 2nd Edition, Mcgraw Hill Education, 2020.
3. Direct Current Transmission, E.W.Kimbark, Wiley–Blackwell; Volume 1 edition (1 January 1971)
4. H.V.D.C Transmission , J Arrillaga , 1st Edition, The Institution of Engineering and Technology, 1998

Course Outcome:

After completion of this course, the learners will be able to

1. choose intelligently AC and DC transmission systems for the dedicated application(s).
2. identify the suitable two-level/multilevel configuration for high power converters.
3. select the suitable protection method for various converter faults.
4. identify suitable reactive power compensation method.
5. decide the configuration for harmonic mitigation on both AC and DC sides..
6. solve numerical problems related to converters, power flow analysis, reactive power control.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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Name of the course		**ELECTRICAL MACHINE DESIGN**	
Course Code: PE-EE-601C		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the baisc principle of design of Electric machines.		
2.	To understand basics of design of Transformer, Induction machine and Synchronous machines.		
3.	To understand different factors that influence design of Electric machines.		
4.	To undertand the need and use software tools for design of Electric machines		
5.	To solve numerical problems on the topics studied		
Pre-Requisite			
1.	Electric Machine-I (PC-EE-401)		
2.	Electric Machine-II (PC-EE-501)		
Unit	Content	Hrs	Marks
1	**Introduction:** Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise and Insulating Materials - Rating of machines – Standard specifications.	04	
2	**Transformer:** Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.	10	
3	**Induction motors:** Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency.	10	
4	**Synchronous machines:** Output equations – choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.	10	
	Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid	05	

	methods, design optimization methods, variables, constraints and objective function, problem formulation.		

Text book:

1. A Course in Electrical Machine Design, A.K. Sawhney, Dhanpat rai and sons.
2. Electrical machine design, V. rajini, V.S. Nagarajan, Pearson India education services Pvt. Ltd.
3. Computer Aided Design of Electrical Machine, K. M. V. Murthy, B.S. Publications.

Reference books

1. Design and Testing of Electrical Machines, M.V.Deshpande, PHI
2. Principles of Electrical Machine Design, 3rd Edition, S.K. sen, Oxf-Ibh
3. Computer Aided Design of Electrical Equipment, M. Ramamoorthy, East-West Press.

Course Outcome:

After completion of this course, the learners will be able to

1. specify the rating of electrical machines with standard specifications.
2. explain the principles of electrical machine design and carry out basic design of an ac machine
3. determine the various factors which influence the design of electrical, magnetic and thermal loading of electrical machines
4. explain the construction and performance characteristics of electrical machines.
5. use software tools to do design calculations.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**ELECTRICAL AND HYBRID VEHICLE**
Course Code: PE-EE-602A	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand the basic difference between conventional and Hybrid vehicles.
2.	To understand different configuration and control of Electric drives.
3.	To understand energy storage system in Hybrid vehicles.
4.	To understand different energy management strategies of Hybrid vehicles.
5.	To solve numerical problems on the topics studied
Pre-Requisite	
1.	Electric Machine-I (PC-EE-401)
2.	Electric Machine-II (PC-EE-501)

Unit	Content	Hrs	Marks
1	**Introduction:** Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	09	
2	**Electric Trains:** Electric Drive-trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	10	
3	**Energy Storage:** Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching	09	

	the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems		
4	**Energy Management Strategies:** Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	06	
5	**Case Studies:** Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).	05	

Text book:

1. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press.
2. Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons.
3. Electric and Hybrid Vehicles: Khanna Publishing House.
4. Hybrid Electric Vehicles: Energy Management Strategies, Onori Simona, Serrao Lorenzo and Rizzoni Giorgio, Springer.
5. Electric and Hybrid Vehicles, T. Denton, Routledge.

Reference books

1. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley.
2. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi CRC Press, 2004.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the principle of Electric traction.
2. choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources.
3. design and develop basic schemes of electric vehicles and hybrid electric vehicles.
4. choose proper energy storage systems for vehicle applications
5. implement different energy management strategies for hybrid vehicle.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**POWER QUALITY AND FACTS**
Course Code: PE-EE-602B	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2.	To understand the working principles of FACTS devices and their operating characteristics.
3.	To understand the basic concepts of power quality.
4.	To understand the working principles of devices to improve power quality.
5.	To solve numerical problems on the topics studied

Pre-Requisite	
1.	Power system-I (PC-EE-502)
2.	Control system (PC-EE-503)
3.	Power Electronics (PC-EE-504)

Unit	Content	Hrs	Marks
1	**Transmission Lines and Series/Shunt Reactive Power Compensation:** Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.	04	
2	**Thyristor-based Flexible AC Transmission Controllers (FACTS):** Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.	06	
3	**Voltage Source Converter based (FACTS) controllers:** Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.	08	

4	**Application of FACTS** : Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.	04	
5	**Power Quality Problems in Distribution Systems** : Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.	04	
6.	**DSTATCOM**: Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques for DSTATCOM.	06	
7.	**Dynamic Voltage Restorer and Unified Power Quality Conditioner:** Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.	06	

Text book:

1. FACTS Controllers in Power Transmission and Distribution, N K. R. Padiyar, New Age International (P) Ltd. 2007.

Reference books

1. Understanding FACTS: Concepts and Technology of FACTS Systems, N. G. Hingorani and L. Gyugyi Wiley-IEEE Press, 1999.
2. Reactive Power Control in Electric Systems, T. J. E. Miller, John Wiley and Sons, New York, 1983.
3. Electrical Power Systems Quality", R. C. Dugan, McGraw Hill Education, 2012.
4. Electric Power Quality, G. T. Heydt , Stars in a Circle Publications, 1991

Course Outcome:

After completion of this course, the learners will be able to

1. analyse uncompensated AC transmission line.
2. explain the working principles of FACTS devices and their operating characteristics.
3. apply FACTS devices for power flow control and stabilty.
4. identify different issues of power quality in distribution system.
5. apply different compensation and control techniques for DSTATCOM
6. explain working principle of dynamic voltage restorer and UPQC

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course		**INDUSTRIAL ELECTRICAL SYSTEMS**	
Course Code: PE-EE-602C		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the electrical wiring systems with standard symbols , drawings and SLD for residential, commercial and industrial consumers		
2.	To understand various components of industrial electrical systems		
3.	To analyze and selec tthe proper size of various electrical system components		
4.	To understand methods of automation of Industrial Electrical Systems		
5.	To solve numerical problems on the topics studied		
Pre-Requisite			
1.	Power system-I (PC-EE-502)		
2.	Control system (PC-EE-503)		
3.	Power Electronics (PC-EE-504)		
Unit	Content	Hrs	Marks
1	**Electrical System Components:** LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices	06	
2	**Residential and Commercial Electrical Systems** :Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.	08	
3	**Illumination Systems** : Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.	06	
	Industrial Electrical Systems I: HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting		

4	of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.	06	
5	**Industrial Electrical Systems II:** DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.	06	
6.	**Industrial Electrical System Automation**: Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.	06	

Text book:

1. Electrical Wiring, Estimating & Costing, S. L. Uppal and G. C. Garg, Khanna publishers, 2008.
2. Electrical Design, Estimating & Costing, K. B. Raina, New age International, 2007.

Reference books

1. Electrical estimating and costing, S. Singh and R. D. Singh, Dhanpat Rai and Co., 1997.
2. Web site for IS Standards.
3. Residential Commercial and Industrial Systems, H. Joshi, McGraw Hill Education, 2008.

Course Outcome:

After completion of this course, the learners will be able to

1. Represent electrical wiring system for residential, commercial and industrial consumers.
2. Determine the rating of components of residential and commercial electrical systems.
3. Design lighting scheme for a residential and commercial premises.
4. Select transformer, switchgear, protection equipments for industrial electrical systems.
5. explain methods of automation of Industrial Electrical Systems
6. Solve numerical problems related to earthing system, lighting scheme, power factor correction.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course		**DIGITAL SIGNAL PROCESSING**	
Course Code: OE-EE-601A		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand sampling and reconstruction of signal		
2.	To understand the method of Z-transform and inverse Z- transform of signal and its properties		
3.	To understand Discrete Fourier Transform		
4.	To understand methods of design of Digital filters		
5.	To understand applications of Digital signal processing		
6.	To solve numerical problems on the topics studied		
Pre-Requisite			
1.	Electric circuit theory (PC-EE-301)		
2.	Control system (PC-EE-503)		
Unit	Content	Hrs	Marks
1	**Discrete-time signals and systems:** Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.	06	
2	**Z-transform:** z-Transform, Region of convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z- transforms.	06	
3	**Discrete Fourier Transform :** Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.	08	
4	**Design of Digital filters:** Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Bandstop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing	12	
	Applications of Digital Signal Processing: Correlation		

5	Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.	06	

Text book:

1. Digital Signal Processing-A computer based approach, S. Mitra, TMH
2. Digital Signal Processing: Principles, Algorithms & Application, J.C. Proakis & M.G. Manslakis, PHI
3. Fundamental of Digital Signal Processing using MATLAB , Robert J. Schilling, S.L. Harris, Cengage Learning.

Reference books

1. Digital Signal Processing-implementation using DSP microprocessors with examples from TMS320C54XX, Avtar Singh & S. Srinivasan, Cengage Learning
2. Digital Signal Processing, Chen, OUP
3. Digital Signal Processing, Johnson, PHI
4. Digital Signal Processing using MATLAB, Ingle, Vikas.
5. Digital Signal Processing, Ifeachor, Pearson Education.
6. Digital Signal Processing, A.V. Oppenhein & R.W. Shaffer, PHI
7. Theory and application of Digital Signal Processing, L.R. Rabiner & B. Gold, PHI
8. Digital Signal Processing, Ashok Ambarder, Cengage Learning.
9. Digital Signal Processing, S. Salivahanan, A. Vallavaris & C. Gnanpruja, TMH.
10. Xilinx FPGA user manual and application notes.

Course Outcome:

After completion of this course, the learners will be able to

1. represent signals mathematically in continuous and discrete-time and in the frequency domain.
2. analyse discrete-time systems using z-transform.
3. explain the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. design digital filters for various applications.
5. apply digital signal processing for the analysis of real-life signals.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**COMMUNICATION ENGINEERING**
Course Code: OE-EE-601B	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand the AM, FM and PM schemes with reference to SNR
2.	To understand the performance of ASK, FSK, PSK, BPSK, QPSK in a digital communication system
3.	To understand the source coding and channel coding schemes for a given communication link
4.	To understand the band width requirement and probability of error in various digital modulation systems
5.	To understand various digital modulation methods
6.	To solve numerical problems on the topics studied
Pre-Requisite	
1.	Analog Electronics (PC-EE 302)
2.	Digital Electronics (PC-EE 402)

Unit	Content	Hrs	Marks
1	**Elements of communication system:** The elements of a communication system, origin of noise and its effect, importance of SNR in system design. Basic principle of linear (AM) modulation, Generation of AM waves, Demodulation of AM wave. Basic principle of nonlinear (FM, PM) modulation. Generation of FM waves. Demodulation of FM waves. Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, Aliasing. Analog pulse modulation-PAM (natural & flat topped sampling), PWM, PPM. Basic concept of Pulse code modulation, Block diagram of PCM, Multiplexing-TDM, FDM.	12	
2	**Digital transmission:** Concept of Quantization & Quantization error, Uniform quantizer, Non-uniform quantizer, A-law and μ -law. Encoding, coding efficiency. Line coding & properties, NRZ & RZ, AMI, Manchester coding, PCM, DPCM. Base band pulse transmission, Matched filter, error rate due to noise, ISI, Raised cosine function, Nyquist criterion for distortion-less base band binary transmission, Eye pattern, Signal power in binary digital signal.	08	
3	**Digital carrier modulation & demodulation technique:** Bit rate, Baud rate, Information capacity, Shanon's limit, M-ary encoding, Introduction to the different digital modulation techniques-ASK.FSK, PSK, BPSK, QPSK, mention of 8 BPSK, 16 BPSK.	10	

	Introduction to QAM, basic of 8 QAM, 16 QAM. Basic concept of Delta modulating, Adaptive delta modulation. Introduction to the concept DPCM. Basic concept of spread spectrum modulation.		
4	**Introduction to coding theory:** Introduction, News value & Information content, Entropy, Mutual information, Information rate, Shanon-Fano algorithm for encoding, Shanon's theorem-source coding theorem, Channel coding theorem, Information capacity theorem. Basic principle of Error control & coding.	08	

Text book:

1. An Introduction to Analog and Digital communication, Simon Haykin, Wiely India.
2. Analog communication system, P. Chakrabarti, Dhanpat Rai & Co.
3. Principle of digital communication, P. Chakrabarti, Dhanpat Rai & Co.
4. Modern Digital and Analog Communication systems, B.P. Lathi, Oxford university press

Reference books

1. Digital and Analog communication Systems, Leon W Couch II, Pearson Education Asia.
2. Communication Systems, A.B. Calson, Mc Graw Hill.
3. Communication Systems, R. Anand, Khanna Publications.

Course Outcome:

After completion of this course, the learners will be able to

1. compare the performance of AM, FM and PM schemes with reference to SNR
2. explain noise as a random process and its effect on communication receivers
3. evaluate the performance of ASK, FSK, PSK, BPSK, QPSK in a digital communication system
4. identify source coding and channel coding schemes for a given communication link
5. analyze various digital modulation methods
6. compute band width requirement and probability of error in various digital modulation systems

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**VLSI AND MICRO ELECTRONICS**
Course Code: OE-EE-603C	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:	
1.	To understand the concept of VLSI design
2.	To understand the basics of MOS structure
3.	To understand the process of VLSI fabrication
4.	To understand the principle of logic circuit design with hardware description language

Pre-Requisite	
1.	Analog Electronics (PC-EE 302)
2.	Digital Electronics (PC-EE 402)

Unit	Content	Hrs	Marks
1	**Introduction to VLSI Design**: VLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioral, Structural, Physical), Y-Chart, Digital VLSI Design Steps.	08	
2	**MOS structure**: E-MOS & D-MOS, Charge inversion in E-MOS, Threshold voltage, Flat band voltage, Potential balance & Charge balance, Inversion, MOS capacitances. **Three Terminal MOS Structure:** Body effect **Four Terminal MOS Transistor**: Drain current, I-V characteristics. Current-voltage equations (simple derivation) **Scaling in MOSFET**: Short Channel Effects, General scaling, Constant Voltage & Field scaling **CMOS**: CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS.	12	
3	**Micro-electronic Processes for VLSI Fabrication**: Silicon Semiconductor Technology- An Overview, Wafer processing, Oxidation, Epitaxial deposition, Ion-implantation & Diffusion, Cleaning, Etching, Photo-lithography – Positive & Negative photo-resist. **Basic CMOS Technology** – (Steps in fabricating CMOS), Basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator **Layout Design Rule**: Stick diagram with examples, Layout rules.	10	

4	**Hardware Description Language** – VHDL or Verilog Combinational & Sequential Logic circuit Design.	08	

Text book:

1. Digital Integrated Circuit, J.M.Rabaey, Chandrasan, Nicolic, Pearson Education.
2. CMOS Digital Integrated Circuit, S.M.Kang & Y.Leblebici, TMH.
3. Modern VLSI Design, Wayne Wolf, Pearson Education.
4. VHDL, Bhaskar, PHI.
5. Advance Digital Design Using Verilog , Michel D. Celliti, PHI

Reference books

1. Digital Integrated Circuits, Demassa & Ciccone, John Willey & Sons .
2. Modern VLSI Design: system on silicon, Wayne Wolf; Addison Wesley Longman Publisher
3. Basic VLSI Design, Douglas A. Pucknell & Kamran Eshranghian, PHI
4. CMOS Circuit Design, Layout & Simulation, R.J.Baker, H.W.Lee, D.E. Boyee, PHI
5. Digital System Design using VHDL, R. Anand, Khanna Publications.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the principle of design of VLSI circuits
2. explain different MOS structure with characteristics
3. apply different processes for VLSI fabrication
4. use programming language for the design of logic circuits
5. draw the stick diagram and layout for simple MOS circuits

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course		**ECONOMICS FOR ENGINEERS**	
Course Code: HM-EE-601		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the process of economic decision making		
2.	To understand th basic financial management aspects		
3.	To develop the skills to analyze financial statements		
4.	To understand the basic of accounting		
Pre-Requisite			
1.	Basic understanding of Engineering processes		
Unit	Content	Hrs	Marks
1	Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - PerUnit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	06	
2	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value Of Money, Debt repayment, Nominal & Effective Interest. Present Worth Analysis : End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Cash Flow & Rate Of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate Of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.	10	
3	Uncertainty In Future Events - Estimates And Their Use In Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation	10	

	Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.		
4	Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life Of A New Asset, Marginal Cost, Minimum Cost Life Problems. Inflation And Price Change – Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.	08	
5	Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	06	

Text book:

1. Sociology & Economics for Engineers, Premvir Kapoor, Khanna Publishing House.
2. Engineering Economics, James L.Riggs, David D. Bedworth, Sabah U. Randhawa 4e , McGraw-Hill Education.
3. Engineering Economics Analysis, Donald Newnan, Ted Eschembach, Jerome Lavelle , OUP
4. Principle of Engineering Economic Analysis, John A. White, Kenneth E.Case,David B.Pratt , Wiley

Reference books

1. Engineering Economy, Sullivan and Wicks, Koelling, Pearson
2. Engineering Economics, R.Paneer Seelvan, PHI
3. Engineering Economics Analysis, Michael R Lindeburg, ,Professional Pub

Course Outcome:

After completion of this course, the learners will be able to

1. evaluate the economic theories, cost concepts and pricing policies
2. explain the market structures and integration concepts
3. apply the concepts of financial management for project appraisal
4. explain accounting systems , the impact of inflation, taxation, depreciation
5. analyze financial statements using ratio analysis
6. explain financial planning, economic basis for replacement, project scheduling, legal and regulatory issues applied to economic investment and project-management problems

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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Name of the course	**POWER SYSTEM-II LABORATORY**
Course Code: PC-EE 691	**Semester: 6th**
Duration: 6 months	**Maximum marks:100**
Teaching Scheme	**Examination scheme:**
Theory: 0 hr/week	**Continuous Internal Assessment:40**
Tutorial: 0 hr/week	**External Assessment: 60**
Practical: 2 hrs/week	
Credit Points:1	

	Laboratory Experiments:
1.	Study on the characteristics of on load time delay relay and off load time delay relay.
2.	Test to find out polarity, ratio and magnetization characteristics of CT and PT.
3.	Test to find out characteristics of (a) under voltage relay (b) earth fault relay.
4.	Study on DC load flow
5.	Study on AC load flow using Gauss-seidel method
6.	Study on AC load flow using Newton Raphson method.
7.	Study on Economic load dispatch.
8.	Study of different transformer protection schemes by simulation
9.	Study of different generator protection schemes by simulation
10.	Study of different motor protection schemes by simulation

11.	Study of different characteristics of over current relay.
12.	Study of different protection scheme for feeder.

Institute may develop experiments based on the theory taught in addition to experiments mentioned.

Course outcome: After completion of this course, the learners will be able to

1. Identify appropriate equipment and instruments for the experiment.
2. Test the instrument for application to the experiment.
3. Construct circuits with appropriate instruments and safety precautions.
4. Validate the characteristics of under voltage relay, over current relay, earth fault relay, on load time delay relay, off load time delay relay, CT and PT.
5. Validate protection schemes of transformer, generator, motor and feeder.
6. Apply software tools to find bus voltage, currents and power flows throughout the electrical system.
7. work effectively in a team

Special Remarks: The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**MICRO PROCESSOR AND MICRO CONTROLLER LABORATORY**
Course Code: PC-EE 692	**Semester: 6th**
Duration: 6 months	**Maximum marks:100**
Teaching Scheme	**Examination scheme:**
Theory: 0 hr/week	**Continuous Internal Assessment:40**
Tutorial: 0 hr/week	**External Assessment: 60**
Practical: 2 hrs/week	
Credit Points:1	

	Laboratory Experiments:
1.	Programs for 16 bit arithmetic operations for 8086 (using various addressing modes)
2.	Program for sorting an array for 8086
3.	Program for searching for a number or character in a string for 8086
4.	Program for String manipulations for 8086
5.	Program for digital clock design using 8086.
6.	Interfacing ADC and DAC to 8086.
7.	Parallel communication between two microprocessors using 8255.
8.	Serial communication between two microprocessor kits using 8251.
9.	Interfacing to 8086 and programming to control stepper motor.
10.	Programming using arithmetic, logical and bit manipulation instructions of 8051
11.	Program and verify Timer/Counter in 8051.

12.	Program and verify interrupt handling in 8051.
13.	UART operation in 8051.
14.	Interfacing LCD to 8051.
15.	Interfacing matrix or keyboard to 8051.
16.	Data transfer from peripheral to memory through DMA controller 8237/8257

Institute may develop experiments based on the theory taught in addition to experiments mentioned.

Course outcome: After completion of this course, the learners will be able to

1. identify appropriate equipment and instruments for the experiment
2. test the instrument for application to the experiment
3. construct circuits with appropriate instruments and safety precautions
4. program 8086 for arithmatic operation, sorting of array, searching for a number in a string and string manipulation
5. interface ADC/DAC, 8255, 8251 to 8086 and LCD, keyboard to 8051
6. program 8051 using arithmatic, logical and bit manipulation instructions of 8051
7. work effectively in a team

Special Remarks: The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

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(Applicable from the academic session 2018-2019)

Name of the course	**ELECTRICAL AND ELECTRONICS DESIGN LABORATORY**
Course Code: PC-EE 681	**Semester: 6th**
Duration: 6 months	**Maximum marks:100**
Teaching Scheme	**Examination scheme:**
Theory: 1hr/week	**Continuous Internal Assessment:40**
Tutorial: 0 hr/week	**External Assessment: 60**
Practical: 4 hrs/week	
Credit Points:3	

	GROUP A
1.	Designing a heating element with specified wattage, voltage and ambient temperature.
2.	Designing an aircore grounding reactor with specified operating voltage, nominal current and fault current
3.	Designing the power distribution system for a small township
4.	Designing a double circuit transmission line for a given voltage level and power (MVA) transfer.
5.	Wiring and installation design of a multistoried residential building (G+4,not less than 16 dwelling flats with a lift and common pump)
	GROUP B
6.	Designing an ONAN distribution transformer.
7.	Designing a three phase squirrel cage induction motor.
8.	Designing a three phase wound rotor induction motor.
9.	Designing a split phase squirrel cage induction motor for a ceiling fan or a domestic pump.
10.	Designing a permanent magnet fractional hp servo motor .
	GROUP C

11.	Design the control circuit of a Lift mechanism
12.	Design a controller for speed control of DC machine.
13.	Design a controller for speed control of AC machine.
14.	Electronic system design employing electronic hardware (Analog, Digital, Mixed signal), microcontrollers, CPLDs, and FPGAs, PCB design and layout leading to implementation of an application

Topics to be covered in the Lecture class:

1.	Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems,; System assembly considerations..	01

Evaluation Method:

1. The students would INDIVIDUALLY design the equipment and systems as per specifications provided by the class teacher following established procedures.
2. For each student, one item from each of the three groups would be chosen.
3. For unspecified items of specification and or specifications of wires, cables etc., data should be taken by students from handbooks and Indian standard.
4. Students should spend the allotted periods for carrying out design computations.
5. Their attendance shall be recorded.
6. Students should maintain a dedicated bound notebook for recording design activities like calculations, formulae used, sketches, flowcharts etc. The notebook should be regularly submitted to the class teacher for review and signature.
7. Evaluation would be based on (i) Class attendance (20%), (ii) Design Note Book (30%) (iii) Design Report (30%) (iv) End of semester viva (20%,)

Institute may develop experiments based on the theory taught in addition to experiments mentioned.

Course outcome: After completion of this course, the learners will be able to

1. explain basic concept of measurement, noise in electronic system, sensor and signal conditioning circuits
2. implement PC based data acquisition systems
3. construct circuits with appropriate instruments and safety precautions
4. design heating elements, air core grounding reactor, power distribution system for small township, double circuit transmission line and Electric machines
5. do wiring and installation design of a multistoried residential building with lift and pump
6. design electronic hardware for controller of lift, speed of AC/DC motor, and for an application with analog, digital, mixed signal, microcontroller and PCB

Special Remarks: The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.