6. Arrange the Visit to industries/firms of your product/service stream to study their business model.
7. Visit the banks and other financial Institutions to enquire about various funding scheme for set up the new business.
8. Compile the information of government agencies and financial agencies which provide loan/financial support to establish the business.
9. Prepare a report of technological and financial feasibility of chosen product/service.
10. Prepare a marketing strategy for chosen product/service.
11. Prepare a short term & long-term goal of your business.
12. Prepare a business plan for your chosen product/services.
13. Arrange a discussion session with successful entrepreneur to discuss on your business plan.
14. Study the stories of successful entrepreneur.
15. Prepare a DPR (Detail Project Report) of chosen product /services.

7EE09 PROJECT & SEMINAR

Seminar:
Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for 50 marks.

Project:
The objective of the project is to enable the students to work in groups of not more than six members in each group on a project involving analytical, experimental, design or combination of these in the area of Electrical Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. On completion of the work, a project report should be prepared and submitted to the department. The evaluation is based on continuous internal assessment by an internal assessment committee for 75 marks. The university examination, which carries a total of 75 marks, will be a Viva Voce examination at the end of VIII Semester, conducted by a committee of one external examiner appointed by the University and one internal examiner/Guide.

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EIGHTH SEMESTER

8EE01 EMBEDED SYSTEMS

Course Outcomes:
After completing this course, the students will be able to:

6. Acquire a basic knowledge about fundamentals of microcontrollers
7. Acquire a basic knowledge about programming and system control to perform a specific task.
8. Acquire knowledge about devices and buses used in embedded networking.
9. Develop programming skills in embedded systems for various applications.
10. Acquire knowledge about Life cycle of embedded design and its testing.

Unit-I : Introduction: Embedded systems design, embedded system architecture, embedded systems model, An Overview of Programming Languages and Examples of Their Standards, Standards and Networking, Multiple Standards-Based Device Example: Digital Television (DTV).

Unit-II: Embedded Hardware Building Blocks and the Embedded Board:
Powering the hardware, Instruction Set Architecture (ISA) architecture model, internal processor design and its performance.

Unit-III: Memory: ROM, RAM and auxiliary memory, Memory Management of External Memory, Performance of memory .I/ O: Managing Data: Serial vs. Parallel I/O, Interfacing the I/O Components, I/O performance.Buses: arbitration, timing and performance.

Unit-IV: Device Drivers: Device Drivers for Interrupt-Handling, Memory Device Drivers, On-board Bus Device Drivers, Board I/O Driver. Embedded OS: Multitasking and Process Management, Memory Management.

Unit-V: Embedded OS: I/O and File System Management, OS Standards: POSIX, OS Performance Guidelines. Middleware: meaning and examples. Application layer software: meanings and examples.

Unit-VI: Embedded system design & implementation:
Defining the System-Creating the Architecture and Documenting the Design, Stages in creating an Embedded System Architecture. Implementing the Design. Quality Assurance and Testing of the Design.

Text Book: Tammy Noergaard ñEmbedded Systems Architectureò Elsevier Newnes Publication.
Reference Books:
1. Rajkamal , ñEmbedded Systems, Architecture, Programming & Designò TMH.
2. Jane W. S. Liu óReal Time Systemsò, Pearson Education
3. Vahid&Givargis ñEmbedded System Designò John Wiley & Sons P Ltd.
4. Peter Marwedel ñEmbedded Systems Designò Springer, Netherland.

8EE02 POWER SYSTEM PROTECTION

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

1. Explain the need, desirable features & main components of protection system.
2. Design the various protection scheme for transmission line
3. Develop the protection scheme for Alternator, Transformer, Motors &Busbar
4. Demonstrate the knowledge of static relays & Numerical relays
5. Select the proper type & rating of circuit breaker and fuses for various applications.

Unit I: Circuit Interruption, Circuit breaker control circuit, Fault clearing process, Autoreclosure, Arc phenomenon-maintenance, properties and interruption theories; AC circuit breakers- current interruption, transient recovery voltage (TRV), rate of rise of TRV, factors affecting TRV, ratings; Inductive and Capacitive current interruptions, current chopping.

Unit II: A. Fuses Types, Constructional features, operation, Characteristics and Applications B. Circuit Breaker (Part ï I) Air break, Air blast, Bulk oil and minimum oil-types, constructional features, operation and application.

Unit III: Circuit Breaker (Part ï II) SF6,Vacuum, Miniature, Earth leakage and Moulded Case ï types, Constructional features, operation and application; Testing, Installation and Maintenance.

Unit IV: A. Relaying Principle Components, Essential features, Characteristics, Terminology, CTôs and PTôs, Relay classification. B. Electromagnetic Relays, Overcurrent, Directional, Distance and Differential ï types, constructional features, operation, characteristics and application.

Unit V: Protection of Transmission Lines Relaying schemes ï overcurrent, earth fault, directional, distance and differential; Parallel feeders and ring mains protection, three stepped protection ,Carrier current relaying, Overload and Power swing.

Unit VI: A. Other Power System Elements Protection Transformers, Motors, Generators and Buses.
B. Static Relaying Basic concepts, equipmentôs, comparators, Characteristics realization ï overcurrent, directional, differential and distance relay. Microprocessor based relay introduction.

Text Book: Sunil S. Rao ï ñSwitchgear and Protectionò Khanna Publications New Delhi.

Reference Books:

1. R. T. Lythall ï ñSwitchgear Handbookò J and P Newness Butterworth, London.
2. C. R. Mason ï ñThe Art and Science of Protective Relayingò
3. A. R. Van and C Warringtan ï ñProtective Relaying ,Vol 1 and 2,ò Chapman Hall, London.
4. Geosonoviz ï ñHigh Voltage Circuit Breakersò
5. V. A. Slabikov ï ñGeneration Protection and Switchgearò CIT, Coimbatore.
6. Badri Ram and B. N. Vishwkarma ï ñPower System Protection and Switchgearò Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
7. B. Ravindranath and M Chander ï ñPower System Protection and Switchgearò Wiley Eastern Ltd, New Delhi.

8EE03 PROFESSIONAL ELECTIVE - V
(i) BIOMEDICAL ELECTRONICS

Course Outcomes:
After completing this course, the students will be able to:

1. Understand the electronic devices and theory of operation in the medical area.
2. Learn to design, test, and analyze electronic circuits using oscilloscopes and other electronic test equipment.
3. Apply knowledge of engineering and science to interpret data.
4. Apply knowledge of engineering and science to understand the principle of biomedical electronic circuits.
5. Understand how to apply, measure circuit performance, and solve problems in the areas of biomedical signals.

UNIT-I: introduction to biomedical engineering:

Physiological system of heart, Man instrument system, Sources of bioelectric potentials, Different bioelectric signals like ECG, EMG and EEG, Bio-potential Electrode theory, Basic electrode, Electrodes for EEG, ECG, EMG, Biochemical electrodes. Skin contact Theory : skin contact impedance measurement of skin con tact impedance, motion artefacts, nearest equation Nearest Equation.

UNIT-II: Biomedical Recorder And Measurement:
Biomedical recorders for EEG, ECG, EMG, Blood pressure variation as a function of time, relationship of heart soundsto a function of the cardio vascular system, Measurement of Blood Pressure (Direct & Indirect), Blood flow, Heart sound.

UNIT-III: Medical Imaging System:
Instrumentation for diagnostics X-ray , X- ray basics properties , X-ray machine , Special imaging technique. Ultrasonic imaging system : Physics of Ultrasound, Biological effect of ultrasound. Ultrasonic A-scan, M-scan, B-scan, Real-time ultrasonic imaging systems.

UNIT-IV: Therapeutic Equipments:
Need of Physiological and electro therapy equipment. Cardiac pacemaker machine, Cardiac Defibrillators, Nerve and Muscle stimulators. Diathermy : short wave, microwave, ultrasonic.

UNIT-V: Patient Care and Monitoring and Safety:
System concepts, Bedside patient monitors, central monitors, Average reading heart monitor, Intensive care monitoring, Ambulatory monitoring. Biotelemetry: Single channel and Multichannel biotelemetry, telephonic data transmission. PATIENT SAFETY : Electric shock hazards, leakage current. Types of Leakage current, measurement of leakage current, methods of reducing leakage current, precautions to minimize electric shock hazards. Telemedicine.

UNIT-VI: Computers In Biomedical Engineering:
Computerized Axial Tomography (CAT), Computerized Aided ECG analysis, Computerized patient monitoring system. Computerized Catheterization.

Text Books:
1. Khandpur R.S. : ñHandbook of Biomedical Instrumentationò, TMH, New Delhi.
2. Cromwell L. &Weibell F.J.: ñBiomedical Instrumentation and Measurementò, Prentice Hall of India.

Reference Books:
1. Dr.Lele R.D. : ñComputer Applications of Medicineò, Tata Mc-Graw Hill, New Delhi.
2. Webstar J.G. : ñMedical Instrumentationò, IIIed., John Wiley & Sons.
3. Carr and Brown : Biomedical Equipment Technology.

8EE03/6EP04 PROFESSIONAL ELECTIVE-V
(ii) PROCESS CONTROL SYSTEMS

Course Outcomes: After Completing this course student will be able to:

1. Explain the various Electronic Instruments for measurement of electrical parameters.
2. Analyse the different signals
3. Demonstrate the signal counting, recording and working of digital readout devices.
4. Demonstrate the Various techniques of A/D and D/A conversions.
5. Apply various signal processing tools as per requirement
6. Develop ladder diagrams &programmes for PLC

Unit I: Electronics Instruments for Measurement of Electrical Parameters Advantages of Electronic Instruments, Electronic Voltmeters Electronic Multi-meter, differential volt meter, Digital voltmeter, Q meter,vector impedance meter, vector voltmeter.

Unit II: Signal Generation and Analysis Signal generators, Function generators. Wave analyzer HarmonicDistortion Analysers, Spectrum Analysis.

Unit III: Signal Counting and Recording Decade counting Assembly, Binary counter, Decimal counter, Decade counter with digital display, universal counter, Digital readout devices, storage type CRO, Servo type X-Y recorder.

Unit IV: Signal conditioning and Conversions. Frequency characteristics of various types of signals, active filters bandpass, low pass and high pass filters using op Amps. Various techniques of A/D and D/A conversions. Modulation and demodulation PCM techniques, phase locked loop.

Unit V: Signal Processing Pulse times, triggered delayed sweeps, discrete pulse delay circuits, pulses sequencing, analog multiplexers and de-multiplexers, digital multiplexing sample and hold circuits, serial and parallel digital data conversion. Signal transmission, Analog and digital telemetry techniques, MODEM and UART, keyboard and character generators, tape recorder

Unit VI: Introduction to Processor and Processor based Techniques. Introduction to PLC, PLC architecture, programming; ladder diagram and examples, micro controller based instrumentation

Text Books:
1. H.S. Kalsiï Electronic Instrumentation, - Tata Mc-Graw Hill Publishing Company, New Delhi.
2. Cooper, Helfrickï Electronic Instrumentation and Measurement Techniques, A Prentice Hall of India, New Delhi.

Reference Books: -
1. B.R.Gupta -Electronics and Instrumentation ï Wheeler Publishing.
2. Rangan, Sharma & Mani ï ñInstrumentation ï devices & Systemsò Tata Mc-Graw Hill Publishing Company, New Delhi.
3. R.P. Jain-Digital Electronics, Tata Mc-Graw Hill Publishing Company, New Delhi.
4. Microprocessors and Digital Systems, by:D.V.Hall, TMH Publishing Company, New Delhi.
5. Shoen Beck- Electronic Communication, Prentice Hall of India Pvt. Ltd. New Delhi.
6. B. Ram- fundamental of Microprocessors, Dhanpat Rai & Sons, New Delhi.
7. A.K. Sawhneyï A Course in Electrical & Electronics Instrumentation, Dhanpat Rai& Sons, New Delhi

8EE03 PROFESSIONAL ELECTIVE-V
(iii) DIGITAL IMAGE PROCESSING

Course Outcomes:
After completing this course, the students will be able to:

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques.
5. Interpret Image compression standards.
6. Interpret image segmentation and representation techniques.

UNIT-I : Introduction to digital image processing :
Digital Image Fundamental, Elements of Visual Perception, Simple Image Model, Sampling and Quantization, Basic Relationships between Pixel Imaging Geometry, Gray scale image representation.

UNIT-II: Image Transforms:
Introduction to the Fourier Transform, DFT, Properties of Two Dimensional Fourier Transform, FFT, Hadamard, Harr DCT, Slant Transform.

UNIT-III: Image Enhancement:
Basic Techniques, Enhancement by point processing, Spatial Filtering, Enhancement in Frequency domain, histogram based processing, homo-morphic filtering.

UNIT-IV: Image Restoration:
Degradation model, Diagonalisation concept, Algebraic approach to Restoration. Inverse filtering, Weiner (CNS) filtering Restoration in Spatial domain, Basic morphological concept, morphological principles, binary morphology, Basic concepts of erosion and dilation.

UNIT-V: Image Compression:
Fundamentals, Image compression models, Elements of Information theory, Lossy and predictive methods, vectorquantization, runlength coding, Hauff coding, and lossless compression, compression standards.

UNIT-VI: Image Segmentation:
Detection of discontinuities, Edge Linking and boundary detection, Thresholding, Regional oriented Segmentation.

Text Books :
1) Gonzaler and Woods: ñDigital Image Processingò, Addison / Wesley.
2) Milan Sonka, Vaclav Hlavac, Roger Boyle: ñImage processing Analysis and Machine Visionò , Book / Cole 2nd Edition.

Reference Books:
1) A. K. Jain: ñDigital Image Processingò, PHI
2) William K. Pratt : ñDigital Image Processingò, 3rd ed. , John Wiley and Sons Publi.

8EE04 PROFESSIONAL ELECTIVE-VI
(i) ROBOTICS

Course Outcomes: After completing this course, the students will be able to:

1. Learn about knowledge for the design of robotics.
2. Understand robot kinematics and robot programming.
3. Understand application of Robots.
4. Learn about force and torque sensing.

UNIT I: Introduction:
Brief History, Types of robots, Degrees of freedom of robots, Robot configurations and concept of workspace, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

UNIT II: Rigid Motion and Homogeneous transformation:
Position definitions. Coordinate frames. Different orientation descriptions.Free vectors. Translations rotations and relative motion, Composition of rotation, rotation with respect to fixed frame and current frame, parameterisation of rotation, Euler Angele, roll, pitch, yaw, axis/angle representation, Homogeneous transformation

UNIT III: Forward Kinematics:
Link coordinate frames, Denavit-Hartenberg convention. Assignment, of coordinate frame, Joint and end effector Cartesian space. Calculation of DH parameters and forward kinematic equation of different configuration of manipulator, Planner elbow manipulator, Cylindrical three link, SCARA, Spherical Wrist and other configuration.

UNIT IV: Velocity Kinematics:
Forward kinematics transformations of position Translational and rotational velocities.Velocity Transformations. Singularity, The Manipulator Jacobian.

UNIT V: Robot Dynamics:
Lagrangian formulation, general expression for kinetic and potential energy of n-link manipulator, Newton-Euler equations of motion. Derivation of equations of motion for simple cases: two-link.

UNITVI: Trajectory Planning& Programming: Trajectory planning and avoidance of obstacles. Trajectory for point to point motion, Cubic polynomial trajectory, Quintic polynomial, LSPB(Linear segment with parabolic blend)Minimum time trajectory, Trajectories for Paths Specified by Via Points. Robot languages, computer control and Robot software.

Text Books:

1. M.W. Spong, S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley, .2nd revise edition, 2012
2. J.J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Education, 4th Edition, 2017
3. M.P. Groover, et.al., Industrial Robots: Technology, Programming and applications, McGraw Hill, 2nd Indian edition, 2012.

Reference Books:
1. Robot Manipulators: Modeling, Performance Analysis and Control. by Etienne Dombre; Wisama Khalil, Somerset : Wiley, 2013.
2. M O Tokhi, A K M Azad, Flexible robot manipulator :modelling, simulation and control 2nd edition, 2017.
3. Ashitava Ghosal. ôRobotic fundamental Concept and Analysisô, Oxford University Press, 11th impression 2015.

8EE04/8EP04 PROFESSIONAL ELECTIVE – VI

(ii) ELECTRICAL ENERGY CONSERVATION AND AUDITING

Course Outcomes:

After successful completion of this course, students will be able to:

1. Summarize Indian and global energy scenario.
2. Explain types of energy Audit and its procedure.
3. Discuss economics of energy conservation
4. Elaborate the concepts of energy conservation and management.
5. Choose Appropriate energy efficient techniques for energy conservation
6. Apply the understanding of energy conservation and management for industrial applications.

Unit I: Energy Scenario: Various forms of energy: Primary and secondary energy, commercial and non-commercial energy, renewable and non-renewable. Indian and global energy scenario, energy needs of growing economy, energy pricing, electricity billing and tariff. Energy sector reforms: In coal, oil, natural gas and electricity. Functions and Responsibilities of CERC& SERC. Energy Conservation Act-2001, Indian electricity Act 2003 and its features.Electricity (Amendment) Bill, 2020 ï Key Highlights. Energy and environmental Impacts.

Unit II: Energy Audit: Definition, energy audit, need, types of energy audit: Preliminary and detailed energy audit. Energy audit instruments. Procedure for carrying out energy audit.Data Analysis-Energy production relationship, specific energy consumption, Sankey (energy flow) diagram, CUSUM Technique, Bench marking, energy performance.

Unit III: Economics of Energy conservation: Cost factors, Budgeting, Standard costing and Sources of capital, Cash flow diagram and activity chart, Simple Payback period analysis, Time value of money, Net present value method, and internal rate of return method. Profitability index for benefit cost ratio.

Unit IV: Energy Conservation & Management: Definition and necessity of energy conservation. Review of electric motors, types, losses, motor efficiency, factors affecting motor Performance, transformer types & its losses. Rewinding and motor replacement issues. Definition and Objective of Energy Management, concept of Supply Side Management (SSM) and Demand Side Management (DSM), methods of implementing demand side management and advantages to consumer, utility and society. Energy strategy for the future.

Unit V: Energy Efficient Techniques in Electrical Systems: Review of power factor improvement and its benefit, selection and location of capacitors. Power factor penalties and incentives in tariff for demand control. Recommendations for energy conservation: Maximum demand controllers, automatic power factor controllers, Variable Speed Drives, Energy efficient transformers. Soft starting of motors.

Unit VI: Energy Conservation in Industrial Applications: Energy conservation opportunities in motive power (Motors and drive system)- Energy efficient motors, Heating Ventilation and Air Conditioning (HVAC), Illumination system, Pumps and Pumping systems, thermal power stations, Utility Industries: Transmission & Distribution Sector. Cogeneration & Waste heat recovery systems. Energy Audit Case Study of energy intensive industry.
BOOKS RECOMMENDED:
Text Books:

1. ñEnergy Audit and Conservationò, TERI.
2. S. C. Tripathy, ñUtilization of Electrical Energy and Conservationò, Mc. Graw Hill, 1991.

Reference Books:

1. ñSuccess stories of Energy Conservationò, BEE, New Delhi. (www.beeindia.gov.in)
2. Thumman, ñEnergy Conservation and Auditò, Fairmont Press.
3. Sonal Desai, ñHandbook of Energy Auditò, Mc. Graw Hill.
4. Guide books for National Certification Examination for Energy Manager/Energy.
5. Auditors Books, General Aspects (available online).

8EE04/8EP04 PROFESSIONAL ELECTIVE – VI
(iii) ELECTRIC AND HYBRID VEHICLES

Course Outcomes:

After successful completion of this course, students will be able to:

1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energy storage.
3. Understand the different strategies related to energy storage systems.

Unit I: Introduction: Conventional Vehicles: Basics of vehicle performance, vehicle power sourceCharacterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit II: 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.

Unit III: **Hybrid Electric Drive**: 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.

Unit IV: Electric Trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train 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.

Unit V: 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 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.

Unit VI: Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison ofdifferent energy management strategies, implementation issues of energy managementstrategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

BOOKS RECOMMENDED:

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, ñHybrid Electric Vehicles: Principles and Applications with Practical Perspectivesò, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, ñHybrid Electric Vehicles: Energy Management Strategiesò, Springer, 2015.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, ñModern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Designò, CRC Press, 2004.
2. T. Denton, ñElectric and Hybrid Vehiclesò, Routledge, 2016.

8EE05 EMBEDDED SYSTEMS LAB

- Student should perform minimum eight practical based on syllabus.

8EE06 POWER SYSTEM PROTECTION LAB

- Student should perform minimum eight practical based on syllabus.

8EE07 PROJECT & SEMINAR

Seminar:

Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for 50 marks.

Project:

The objective of the project is to enable the students to work in groups of not more than six members in each group on a project involving analytical, experimental, design or combination of these in the area of Electrical Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. On completion of the work, a project report should be prepared and submitted to the department. The evaluation is based on continuous internal assessment by an internal assessment committee for 75 marks. The university examination, which carries a total of 75 marks, will be a Viva Voce examination at the end of VIII Semester, conducted by a committee of one external examiner appointed by the University and one internal examiner/Guide.

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