Course code	Course Name	L-T-P - Credits	Year of Introduction
EE402	Special Electrical Machines	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To get an overview of some of the special machines for control and industrial applications

Syllabus

AC Servomotors – construction – operation - DC servomotors – Stepper motor – operation – types-modes of excitation – AC series motor – Universal motor – Hysteresis motor – Reluctance motor – Switched reluctance motor – Permanent magnet DC motor – Brushless DC motor – Linear motors – Linear induction motors.

Expected outcome.

- The students will gain knowledge in the construction and principle of operation of certain special electrical machines having various applications.

Text Book:

E. G. Janardhanan, '*Special Electrical Machines*' PHI Learning Private Limited.

References:

1. Irving L. Kosow.'*Electrical Machinery and Transformers*', Oxford Science Publications.
2. T. J. E. Miller, '*Brushless PM and Reluctance Motor Drives*'.C.Larendon Press, Oxford.
3. Theodore Wildi, '*Electric Machines, Drives and Power Systems*', Prentice Hall India Ltd.
4. Veinott & Martin,'*Fractional & Subfractional hp Electric Motors*'.McGraw Hill International Edn.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	AC Servomotors- Construction-principle of operation – performance characteristics – damped AC servomotors – Drag cup servomotor – applications. DC servomotors – field and armature controlled DC servomotors – permanent magnet armature controlled – series split field DC servomotor.	7	15%
II	Stepper motors – Basic principle – different types – variable reluctance- permanent magnet – hybrid type – comparison – theory of operation – monofilar and bifilar windings – modes of excitation – drive circuits – static and dynamic characteristics – applications	7	15%
	FIRST INTERNAL EXAMINATION		
III	Single phase special electrical machines – AC series motor-construction – principle of working – phasor diagram – universal motor Hysteresis motor- constructional details- principle of operation – torque-slip characteristics – applications.	7	15%
IV	Reluctance motors – principle of operation – torque equation – torque slip characteristics-applications. Switched reluctance motors – principle of operation – power converter circuits – torque equation – different types – comparison – applications.	7	15%

SECOND INTERNAL EXAMINATION			
V	Permanent Magnet DC Motors – construction – principle of working. Brushless dc motor – construction – trapezoidal type-sinusoidal type – comparison – applications.	7	20%
VI	Linear motors – different types – linear reluctance motor – linear synchronous motors – construction – comparison. Linear induction motors – Expression for linear force – equivalent circuit – applications.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE404	INDUSTRIAL INSTRUMENTATION AND AUTOMATION	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To impart knowledge about Industrial instrumentation and automation

Syllabus:

Dynamic characteristic of instrumentation- Transducers: Characteristics, Applications – Nano instrumentation - signal conditioning, MEMS, Virtual instrumentation-Automation system - actuators – sequence control, PLC

Expected Outcome:

After the completion of the course, the students will be able to:

i. Select instruments and transducers for various physical variables.
ii. Get an insight on data acquisition, processing and monitoring system
iii. Design various signal conditioning systems for transducers.
iv. Analyze dynamic responses of various systems.
v. Get the concepts of virtual instrumentation
vi. Understand the programming realization of PLC

Text books:

1. Curtis D Johnson ," *Process Control Instrumentation Technology"*, PHI, 1986
2. Doeblin E.O, 'Measurement Systems: Application and Design, Fourth Edition, McGraw Hill, Newyork, 1992
3. DVS. Murty, 'Transducers and Instrumentation' Second Edition, PHI Learning Pvt Ltd New Delhi ,2013
4. Madhuchhanda Mitra, Samarjit Sengupta, 'Programmable Logic Controllers and Industrial Automation An Introduction', Penram International Publishing (India) Pvt Ltd., 2009
5. Mickell. P. Groover 'Automation, Production and computer integrated manufacturing' Prentice Hall of India, 1992
6. Patranabis, D., 'Principles of Industrial Instrumentation', Second Edition Tata McGraw Hill Publishing Co. Ltd.. New Delhi
7. Robert B. Northrop, 'Introduction to instrumentation and measurements', CRC, Taylor and Francis 2005

References:

1. G.K.McMillan, 'Process/Industrial Instrument and control and hand book' McGraw Hill, New York,1999
2. Michael P .Lucas, 'Distributed Control system', Van Nastrant Reinhold Company, New York

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Process Control - block diagram of process control loop, definition of elements. Sensor time response - first and second order responses. Review of Transducers: Characteristics and Choice of transducer-	6	15%

	factors influencing choice of transducer		
II	Applications of Transducers Displace measurement: Resistance potentiometer, Capacitive and Inductive. Capacitive differential pressure measurement Torsional, shearing stress and rotating shaft Torque measurement using strain gauge. Flow measurement :Hotwire anemometer, constant resistance Constant current type Eddy current sensors, Variable reluctance tachometers Phase measurement :Analog and digital phase detectors Nano Instrumentation	8	15%
FIRST INTERNAL EXAMINATION			
III	Signal conditioning circuits-Instrumentation amplifiers- Unbalanced bridge. Bridge linearization using op amp Precision rectifiers, Log amplifiers, Charge amplifiers, Isolation amplifier, Switched capacitor circuits, Phase sensitive detectors, Noise problem in instrumentation and its minimisation	7	15%
IV	Micro Electromechanical system (MEMS) Advantages and Applications, MEMS micro sensors and actuators, Manufacturing process: Bulk micro machining and surface micromachining, MEMS accelerometers Virtual instrumentation system: architecture of virtual instruments – Virtual instruments and traditional instruments – concepts of graphical programming	7	15%
SECOND INTERNAL EXAMINATION			
V	Overview of Automation System - Architecture of Industrial Automation Systems, Different devices used in Automation Actuators, definition, types, selection. Pneumatic, Hydraulic, Electrical, Electro-Pneumatic and valves , shape memory alloys	7	20%
VI	Introduction to Sequence Control, PLCs - Working, Specifications of PLC Onboard/Inline/Remote IO's, Comparison of PLC & PC, Relay Ladder Logic- PLC Programming- realization of AND, OR logic, concept of latching, Introduction to Timer/Counters, Exercises based on Timers, Counters. Basic concepts of SCADA, DCS and CNC	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P -Credits	Year of Introduction
EE462	Design of Digital Control Systems	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To introduce the need and concept of digital control system.
- To impart knowledge about different strategies adopted in the design of digital controllers.
- To familiarize with the design of different types of digital controllers.

Syllabus

Basic digital control system-Pulse transfer function-Digital PID controller design- compensator design using frequency response - compensator design using root locus - Direct design-method of Ragazzini - Dead-beat controller design - State space analysis and controller design.

Expected outcome.

On successful completion, the students will have the ability to

i. design digital controllers.
ii. analyse discrete time system using state space methods.
iii. analyse the stability of discrete time system.

Text Books:

1. Benjamin C. Kuo, Digital Control Systems, 2/e, Saunders College Publishing, Philadelphia, 1992.
2. C. L. Philips, H. T. Nagle, Digital Control Systems, Prentice-Hall, Englewood Cliffs, New Jersey, 1995.
3. M. Gopal, Digital Control and State Variable Methods, Tata McGraw-Hill, 1997
4. Ogata K., Discrete-Time Control Systems, Pearson Education, Asia.

References:

1. Constantine H. Houpis and Gary B. Lamont, Digital Control Systems Theory, Hardware Software, McGraw Hill Book Company, 1985.
2. Isermann R., Digital Control Systems, Fundamentals, Deterministic Control, V. I, 2/e, Springer Verlag, 1989.
3. Liegh J. R., Applied Digital Control, Rinchart & Winston Inc., New Delhi.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Basic digital control system- Examples - mathematical model-ZOH and FOH- choice of sampling rate-principles of discretization - Mapping between s-domain and z-domain	7	15%
II	Pulse transfer function- Different configurations for the design- Modified z-transform-Time responses of discrete data systems-Steady state performance.	7	15%
	FIRST INTERNAL EXAMINATION		
III	Digital PID and Compensator Design: Design of digital PID controller, Design of lag, lead compensators - based on frequency response method.	7	15%
IV	Digital Controller Design: Design based on root locus in the z-plane, direct design - method of Ragazzini. Dead-beat response design- Deadbeat controller.	7	15%
	SECOND INTERNAL EXAMINATION		
V	State variable model of discrete data systems -Various canonical form representations-controllable, observable, diagonal and Jordan forms-Conversion from state space to transfer function -Computation of state transition matrix using Cayley-Hamilton theorem and z-transform method	7	20%

VI	Digital state feedback controller design: Complete state and output Controllability, Observability, stabilizability and reachability - Loss of controllability and observability due to sampling.Pole placement design using state feedback for SISO systems.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE464	Flexible AC Transmission Systems	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To introduce various Power Electronics controllers used in the Power Systems for the fast real and reactive power control.

Syllabus

Power flow control - Benefits of FACTS -Transmission line compensation. Uncompensated line - shunt and series compensation .Reactive power compensation . Static shunt and series compensators - Static Voltage and Phase Angle Regulators (TCVR &TCPAR). Switching Converter type shunt and series Compensators - principle of operation, configuration and control. Unified Power Flow Controller

Expected outcome .

The students will be able to:

- Understand various power electronics based FACTS devices for the control of active and reactive power in the system
- Understand the control schemes of various FACTS devices.

References:

1. Hingorani and L Gyugyi, “Understanding FACTS”, IEEE Press, 2000
2. J Arriliga and N R Watson, "Computer modeling of Electrical Power Systems”, Wiley, 2001 T J E Miller, "Reactive Power Control in Power Systems'', John Wiley, 1982
3. K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers, 2007
4. Ned Mohan et. al "Power Electronics”, John Wiley and Sons.
5. Y.H. Song and A.T. Johns, “Flexible ac Transmission Systems (FACTS)”, IEE Press, 1999

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Power flow in Power Systems – Steady-state and dynamic problems in AC systems – Voltage regulation and reactive power flow control in Power Systems – control of dynamic power unbalances in Power System Power flow control -Constraints of maximum transmission line loading - Benefits of FACTS - Transmission line compensation: Compensation by a series capacitor connected at the midpoint of the line, Shunt Compensation connected at the midpoint of the line -Phase angle control	7	15%
II	Reactive power compensation – shunt and series compensation principles – reactive compensation at transmission and distribution level – Static versus passive VAr Compensators	6	15%
	FIRST INTERNAL EXAMINATION		
III	Static shunt Compensator - Objectives of shunt compensations, Methods of controllable VAR generation -		15%

	Variable impedance type VAR Generators -TCR , TSR, TSC, FC-TCR Principle of operation, configuration and control Static Series compensator - Objectives of series compensations, Variable impedance type series compensators - TCSC - Principle of operation, configuration and control.	8	
IV	Static Voltage and Phase Angle Regulators (TCVR & TCPAR): Objectives of Voltage and Phase angle regulators Thyristor controlled Voltage and Phase angle Regulators	7	15%
SECOND INTERNAL EXAMINATION			
V	Switching converter type shunt Compensators.- Principle of operation, configuration and control , Comparison between SVC and STATCOM- Applications Switching converter type Series Compensators-(SSSC)- Principle of operation, configuration and control	7	20%
VI	Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPFC General Equivalent Circuit for Facts Controllers (Shunt+series) Introduction to interline power flow controller.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI. Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE466	Digital Image Processing	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To impart the image enhancement, image restoration and image compression procedures
- To know about morphological image processing.
- To study the image segmentation and representation techniques.

Syllabus

Elements of visual perception, Basic geometric transformations, Separable Image Transforms, Spatial Domain methods, Frequency domain filters, Model of Image Degradation/restoration process, Compression Techniques, Morphological Processing, Segmentation, Representation and Description

Expected Outcomes.

The students will be able to

i. Demonstrate understanding of the basic concepts of two-dimensional signal acquisition, sampling, and quantization.
ii. Demonstrate understanding of spatial filtering techniques, including linear and nonlinear methods.
iii. Demonstrate understanding of 2D Fourier transform concepts, including the 2D DFT and FFT, and their use in frequency domain filtering.
iv. Apply programming skills in digital image processing related problems

Text Book:

Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education

References:

1. K. Jain, Fundamentals of Digital Image Processing, PHI
2. Chanda Dutta Magundar, Digital Image Processing and Applications, PHI
3. MilanSonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis and Machine Vision, CL Engineering, 2007
4. William K. Pratt, Digital Image Processing, John Wiley & Sons

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh –Hadamard – Discrete Cosine Transform, Haar transforms	7	15%
II	Spatial Domain methods: Basic grey level transformation – Histogram equalization –Image subtraction – Image averaging Spatial filtering: Smoothing, sharpening filters – Laplacian filters Frequency domain filters : Smoothing – Sharpening filters – Homomorphic filtering.	7	15%
FIRST INTERNAL EXAMINATION			

III	Model of Image Degradation/restoration process – Noise models – Inverse filtering –Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse – Singular value decomposition	7	15%
IV	Lossless compression: Variable length coding – LZW coding – Bit plane coding, predictive coding-DPCM. Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG	7	15%
SECOND INTERNAL EXAMINATION			
V	Morphological Image Processing-Dilation, Erosion, Morphological Reconstruction- Gray Scale Morphology Edge detection – Thresholding - Region Based segmentation	7	20%
VI	Boundary representation: chair codes- Polygonal approximation –Boundary segments – boundary descriptors: Simple descriptors Fourier descriptors - Regional descriptors –Simple descriptors	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P -Credits	Year of Introduction
EE468	Computer Networks	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To impart the mode of operation of different types of computer networks that are used to interconnect a distributed community of computers and various interfacing standards and protocols

Syllabus

Introduction on Computer Networks, Network Hardware, Protocol architecture, functionalities, MAC protocols, Network layer, Transport layer, Application Layer

Expected Outcome.

The students will be able to:

i. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
ii. Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols.
iii. Analyze, specify and design the topological and routing strategies for an IP based networking infrastructure.

Text Book:

1. Jim Kurose and Keith Ross, ``Computer Networking: A Top-Down Approach," 5th Edition, Pearson Education, 2012
2. Larry L. Peterson and Bruce S. Davie , ``Computer Networks: A Systems Approach," Morgan Kaufmann, 5/e, 2011

References:

1. Andrew S, Computer Networks by Tanenbaum, Prentice Hall of India, New Delhi
2. Foronzan, Data Communications and Networking, Tata McGraw Hill, New Delhi
3. Neil Jenkins, Understanding Local area Network, SAMS Publishers
4. Peter Hudson, Local area Networks by, Thomson Learning

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Introduction-Uses of Computer Networks, Network Hardware, Network Software, Reference Models, Example Networks,	6	15%
II	Network Standardization. The Medium Access Control Sublayer- The Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANs, Broadband Wireless, Bluetooth.	7	15%
	FIRST INTERNAL EXAMINATION		
III	The Network Layer- Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, Internetworking, The Network Layer in the Internet	7	15%

IV	The Transport Layer- The Transport Service, Elements of Transport Protocols, A Simple Transport Protocol,	7	15%
SECOND INTERNAL EXAMINATION			
V	The Internet Transport Protocols: UDP, The Internet Transport Protocols: TCP, Performance Issues.	7	20%
VI	The Application Layer- DNS-The Domain Name System, Electronic Mail, The World Wide Web, Multimedia	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	L-T-P -Credits	Year of Introduction
EE 472	Internet of Things	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- Vision and Introduction to IoT.
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Understand Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Syllabus

Internet in general and Internet of Things,IoTTechnology Fundamentals, Communication Technology for IoT, Data Management, Sensors and security of IoT, Standardisation and Protocol, IoT architectures, Embedded design for IoT, Case Studies and smart applications

Expected outcome.

i. Explain in a concise manner how the general Internet as well as Internet of Things work.
ii. Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
iii. Use basic sensing and measurement and tools to determine the real-time performance of network of devices
iv. Develop prototype models for various applications using IoT technology

Text Books:

1. Rajkamal, "Internet of Things : Architecture and Design Principles", McGraw Hill (India) Private Limited.
2. Vijay Madisetti and Arshdeep Bahga, **"**Internet of Things (A Hands-on-Approach)"**,** 1st Edition, VPT, 2014

References:

1. The Internet of Things (The MIT Press Essential Knowledge series)Paperback – March 20, 2015 by Samuel Greengard
2. The Internet of Things : Converging Technologies for Smart Environments and Integrated Ecosystems, OviduVermesan and Peter Friess, River Publishers.
3. Internet of Things - From Research and Innovation to Market Deployment -RIVER PUBLISHERS , PETER FRIESS , OVIDIU VERMESAN (Editors)

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction : Definition , Internet of Things IoT Architectural view, IoT Technology M2M Communication, Success Factors of Internet of Things, IoT Application Areas , IoT Functional View, Design Principles for connected Devices, Communication Technologies	6	15%
II	IoT Data Management, Device Management Gateways, Design Principles for Web Connectivity, Web communication protocols for connected devices, Web connectivity for connected devices using Gateways- Internet connectivity Principles – Internet based communication, IP addressing in the IoT	8	15%

FIRST INTERNAL EXAMINATION			
III	Data acquiring and storage for IoT devices, Organization of Data, Big data, Acquiring methods, management techniques, Analytics, Storage technologies. Cloud computing for Data storage (concept only)	8	15%
IV	Sensor Technologies for IoT Devices, Industrial IoT and Automotive IoT, Actuators for various devices, Sensor data communication protocols, Wireless Sensor network Topology	8	15%
SECOND INTERNAL EXAMINATION			
V	Prototyping concepts, Basics of Embedded computing, Embedded platforms for prototyping, Iot Connected devices through Cloud Designing software for IoT, Prototyping embedded device software	8	20%
VI	Case Study& Advanced IoT Applications: Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / ARM Cortex/ Arduino)- Block diagram, specifications. Internet of Things SMART Applications : Energy management and Smart grid, IoT for Home ,Cities , Environment monitoring, Agriculture, Supply chain and customer monitoring	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End Sem Exam)

Maximum Marks: 100 Exam Duration: 3Hrs.

Part A: 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions from modules I & II with at least one question from each module. Student has to answer any 2 from the 3 questions: (2 x 10)=20

Part C: 3 questions from modules III & IV with at least one question from each module. Student has to answer any 2 from the 3 questions: (2 x 10) =20

Part D: 3 questions from modules V & VI with at least one question from each module. Student has to answer any 2 from the 3 questions: (2 x 10) =20

Course code	Course Name	L-T-P - Credits	Year of Introduction
EE474	ENERGY MANAGEMENT AND AUDITING	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To enable the students to understand the concept of energy management and energy management opportunities
- To understand the different methods used to control peak demand
- To know energy auditing procedure
- To understand the different methods used for the economic analysis of energy projects.

Syllabus

General principles of Energy management and Energy management planning - Peak Demand controls - Energy management opportunities in electrical systems and HVAC systems – Reactive power management – Energy audit – cogeneration system – Economic analysis of energy projects

Expected outcome .

- The students will be able to understand the different methods used to reduce energy consumption

Data Book (Approved for use in the examination):

References:

1. Albert Thumann, William J. Younger, Handbook of Energy Audits, CRC Press, 2003.
2. Charles M. Gottschalk, Industrial energy conservation, John Wiley & Sons, 1996.
3. Craig B. Smith, Energy management principles, Pergamon Press.
4. D. Yogi Goswami, Frank Kreith, Energy Management and Conservation Handbook, CRC Press, 2007
5. G.G. Rajan, Optimizing energy efficiencies in industry -, Tata McGraw Hill, Pub. Co., 2001.
6. IEEE recommended practice for energy management in industrial and commercial facilities,
7. IEEE std 739 - 1995 (Bronze book).
8. M Jayaraju and Premlet, Introduction to Energy Conservation And Management, Phasor Books, 2008
9. Paul O'Callaghan, Energy management, McGraw Hill Book Co.
10. Wayne C. Turner, Energy management Hand Book - - The Fairmount Press, Inc., 1997.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	General principles of Energy management and Energy management planning. Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal Load scheduling-Case studies.	6	15%
II	Energy management opportunities in Lighting and Motors. Electrolytic Process and Electric heating, Case studies.	8	15%
	FIRST INTERNAL EXAMINATION		
III	Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler.		

	Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery.	8	15%
IV	HVAC system: Coefficient of performance, Capacity, Factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Classification and Advantages of Waste Heat Recovery system, analysis of waste heat recovery for Energy saving opportunities	7	15%
SECOND INTERNAL EXAMINATION			
V	Energy audit -Definition, Need, Types of energy audit, Energy audit Instruments. Cogeneration-Types and Schemes, Optimal operation of cogeneration plants- Case study. Computer aided energy management.	7	20%
VI	Economic analysis methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.	6	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Course code	Course Name	Credits	Year of Introduction
**492	PROJECT	6	2016

Prerequisite : Nil

Course Objectives

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

Course Plan

In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester
Review and finalization of the approach to the problem relating to the assigned topic
Preparing a detailed action plan for conducting the investigation, including team work
Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed
Final development of product/process, testing, results, conclusions and future directions
Preparing a paper for Conference presentation/Publication in Journals, if possible
Preparing a report in the standard format for being evaluated by the dept. assessment board
Final project presentation and viva voce by the assessment board including external expert

Expected outcome

The students will be able to

iii. Think innovatively on the development of components, products, processes or technologies in the engineering field
iv. Apply knowledge gained in solving real life engineering problems

Evaluation

Maximum Marks : 100

(i) Two progress assessments	20% by the faculty supervisor(s)
(ii) Final project report	30% by the assessment board
(iii) Project presentation and viva voce	50% by the assessment board

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.