8^{th} Semester EE

Semester	Course Code	Paper Title	L	T	P	Credits	GROUP
8	1038xx	Open Elective- III	3	0	0	3	1
8	1038xx	Open Elective-IV	3	0	0	3	1
8	1038xx	Program Elective- V	3	0	0	3	1
8	1038xx	Program Elective- VI	3	0	0	3	1
8	100801	Project-II	0	0	12	6	2

Open Electives								
Semester	Course Code	Paper Title	L	T	P	Credits	Elective	Group
103	100813	Digital Image Processing	3	0	0	3	Open Elective - III	1
103	103807	Strength of Materials	3	0	0	3	Open Elective - III	1
103	103808	Fluid Machinery	3	0	0	3	Open Elective - IV	1
103	100808	Internet of Things	3	0	0	3	Open Elective - IV	1

Program Electives								
Semester	Course Code	Paper Title	L	T	P	Credits	Elective	Group
103	100802	Control Systems Design	3	0	0	3	Prog Elective - V	1
103	103801	Electrical and Hybrid Vehicles	3	0	0	3	Prog Elective - V	1
103	100803	HVDC Transmission Systems	3	0	0	3	Prog Elective - V	1
103	100804	Power Quality and FACTS	3	0	0	3	Prog Elective - VI	1
103	100805	Power System Dynamics and Control	3	0	0	3	Prog Elective - VI	1
103	103802	Advanced Electric Drives	3	0	0	3	Prog Elective - VI	1

Electrical Engineering

100802	Control Systems Design	3L:0T:0P	3 credits

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand various design specifications.
- Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
- Design controllers using the state-space approach.

Module 1: Design Specifications (6 hours)
Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

Module 2: Design of Classical Control System in the time domain (8 hours)

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

Module 3: Design of Classical Control System in frequency domain (8 hours)

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Module 4: Design of PID controllers (6 hours)

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Module 5: Control System Design in state space (8 hours)

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feed back gain design. Design of Observer. Reduced order observer. Separation Principle.

Module 6: Nonlinearities and its effect on system performance (3 hours)

Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Text and Reference Books:

1. N. Nise, "Control system Engineering", John Wiley,2000.
2. J. Nagrath and M. Gopal, "Control system engineering", Wiley,2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern,1988.
4. K. Ogata, "Modern Control Engineering", Prentice Hall,2010.
5. B. C. Kuo, "Automatic Control system", Prentice Hall,1995.
6. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventionaland modern)", McGraw Hill,1995.
7. R.T.StefaniandG.H.Hostetter,"DesignoffeedbackControlSystems",SaundersCollegePub,1994.

103801	Electrical and Hybrid Vehicles	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

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

Module 1: Introduction (10 hours)

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.

Module 3: Electric Trains (10 hours)

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.

Module 4: Energy Storage (10 hours)

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

Module 5: Energy Management Strategies (9 hours)

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.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. C. Mi, M. A. Masrur and D. W.Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and FuelCell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge,2016.

103802	Advanced Electric Drives	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the operation of power electronic converters and their control strategies.
- Understand the vector control strategies for ac motor drives
- Understand the implementation of the control strategies using digital signal processors.

Module 1: Power Converters for AC drives (10 hours)

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

Module 2: Induction motor drives (10 hours)

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).

Module 3: Synchronous motor drives (6 hours)

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Module 4: Permanent magnet motor drives (6 hours)

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Module 5: Switched reluctance motor drives (6 hours)

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

Module 6: DSP based motion control (6 hours)

Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

Text / References:

1. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
2. P.C. Krause, O. Wasynczuk and S.D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRC press, 2003.
4. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press,2009.

100803	HVDC Transmission Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the advantages of dc transmission over ac transmission.
- Understand the operation of Line Commutated Converters and Voltage Source Converters.
- Understand the control strategies used in HV dc transmission system.
- Understand the improvement of power system stability using an HV dc system.

Module 1: dc Transmission Technology (4 hours)

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HV dc Systems. Components of a HV dc system. Line Commutated Converter and Voltage Source Converter based systems.

Module 2: Analysis of Line Commutated and Voltage Source Converters (10 hours)

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap.

Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

Module 3: Control of HV dc Converters: (10 hours)

Principles of Link Control in a LCCHV dc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HV dc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Module 3: Components of HV dc systems: (8 hours)

Smoothing Reactors, Reactive Power Sources and Filters in LCC HV dc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Monopolar Operation. Ground Electrodes.

Module 4: Stability Enhancement using HV dc Control (4 hours)

Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

Module 5: MT dc Links (4 hours)

Multi-Terminal and Multi-Infeed Systems. Series and Parallel MT dc systems using LCCs. MT dc systems using VSCs. Modern Trends in HV dc Technology. Introduction to Modular Multi-level Converters.

Text/References:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.

100804	Power Quality and FACTS	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
- Understand the working principles of FACTS devices and their operating characteristics.
- Understand the basic concepts of power quality.
- Understand the working principles of devices to improve power quality.

Module 1: Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours)

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.

Module 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)

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.

Module 3: Voltage Source Converter based (FACTS) controllers (8 hours)

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.

Module 4: Application of FACTS (4 hours)

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.

Module 5: Power Quality Problems in Distribution Systems (4hours)

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.

Module 6: DSTATCOM (8 hours)

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 in for DSTATCOM.

Module 6: Dynamic Voltage Restorer and Unified Power Quality Conditioner (6 hours)

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.

Text/References

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press,1999.
2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd.2007.
3. T. J. E.Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education,2012.
5. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications,1991

100805	Power System Dynamics and Control	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the problem of power system stability and its impact on the system.
- Analyze linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.
- Understand the methods to improve stability.

Module 1: Introduction to Power System Operations (3hours)

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Module 2: Analysis of Linear Dynamical System and Numerical Methods (5 hours)

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

Module3: Modeling of Synchronous Machines and Associated Controllers (12hours) Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Module 4: Modeling of other Power System Components (10 hours)

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

Module 5: Stability Analysis (11 hours)

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi-machine systems–Intra-plant, Local and Inter-are a modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

Module 6: Enhancing System Stability (4 hours)

Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures-Preventive Control. Emergency Control.

Text/Reference Books

1. K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2. P. Kundur, "Power System Stability and Control", McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.

	Computer Networks	3L:0T: 0P	3 Credits

Objectives of the course

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Detailed contents

Module 1 **Lecture 8 hrs.**

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Module 2 **Lecture 8 hrs.**

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Module 3 **Lecture 8 hrs.**

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping - ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Module 4 **Lecture 8 hrs.**

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Module 5 **Lecture 8 hrs.**

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Suggested books

1 Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill.

2 Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Suggested reference books

1 Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

2 Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.

3 TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course Outcomes

After the completion of course, students can able to able to:

1 Explain the functions of the different layer of the OSI Protocol.

2 Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) and can able to describe the function of each block.

3 Program for a given problem related TCP/IP protocol.

4 Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

100813 Common Paper (EE/CSE)	Digital Image Processing	3L:0T:0P	3 Credits

Detailed contents

Module 1 **Lecture 8 hrs.**

Introduction: Background, Digital Image Representation, Fundamental Steps in Image Processing, Elements of a Digital Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, a Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels, Imagining Geometry.

Module 2 **Lecture 8 hrs.**

Image Transforms: Introduction to the Fourier Transform, The Discrete Fourier Transform, Some Properties of the Two-Dimensional Fourier Transform, Other Separable Image Transforms.

Module 3 **Lecture 8 hrs.**

Image Enhancement: Spatial Domain Methods, Frequency Domain Methods, Some Simple Intensity Transformations, Histogram Processing, Image Subtraction, Image Averaging, Background, Smoothing Filters, Sharpening Filters, Lowpass Filtering, Highpass Filtering, Generation of Spatial Masks from Frequency Domain Specifications.

Module 4 **Lecture 8 hrs.**

Image Restoring: Degradations Model - Definitions, Degradation Model for Continuous Functions, Diagonalization of Circulant and Block-Circulant Matrices, Circulant Matrices, Block Circulant Matrices, Effects of Diagonalization on the Degradation Model, Algebraic Approach to Restoration, Unconstrained Restoration, Constrained Restoration, Inverse Filtering – Formulation, Removal of Blur Caused by Uniform Linear Motion, Restoration in the Spatial Domain, Geometric Transformation.

Module 5 **Lecture 8 hrs.**

Image Compression: Fundamentals – Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Fidelity Criteria. Image Compression Models – The Source Encoder and Decoder, The Channel Encoder and Decoder. Elements of Information Theory – Measuring Information, The Information Channel, Fundamental Coding Theorems, Using Information Theory. Error-Free Compression – Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding. Lossy Compression – Lossy Predictive Coding, Transform Coding.

Text Book:

1. Rafael. C. Gonzalez & Richard E.Woods.- Digital Image Processing, 2/e Pearson Education, New Delhi - 2006

Reference Books:

1. W.K.Pratt.-Digital Image Processing, 3/e Edn., John Wiley & sons, Inc. 2006

103807	Strength of Materials	3L:0T:0P	3 credits

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Contents:

Module:1 (8 lectures)

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle, theories of failure,

Module:2 (8 lectures)

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Module:3 (8 lectures)

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Module:4 (8 lectures)

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Module:5 (8 lectures)

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi,2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr. and John J. Dewole, Mechanics of Materials, Tata GrawHill Publishing Co. Ltd., New Delhi2005.

Practical:

1. Hooke's Law
2. Hardness Test: Rockwell, Brinell, Vicker
3. Izod & Charpy Impact Test
4. Bending Test
5. Torsion Test
6. Shear test
7. Compressive strength test
8. Fatigue Test
9. Verification of Maxwell's reciprocal theorem

10. Continuous beam deflection test
11. Strain Measurement

****Atleast 8 experiments should be performed from above list***

Course Outcomes:

1. After completing this course, the students should be able to recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

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103808	Fluid Machinery	3L:0T:0P	3 Credits

Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Contents:

Module: 1

Introduction – Classification of fluid machinery. **(Lectures: 2)**

Module: 2

Dynamic action of fluid jet – Impact of fluid jet on fixed and moving flat places, impact of jet on fixed and moving curved vanes, flow over radial vanes, jet propulsions. **(Lectures: 4)**

Module: 3

Euler's fundamental equation, degree of reaction. **(Lectures:2)**

Module: 4

Hydraulic turbines, introduction, classification, impulse turbine, construction details, velocity triangles, power and efficiency calculations, reaction turbines; constructional details, working principle, velocity triangles, power and efficiency calculations, draft tube, cavitation, governing. **(Lectures: 10)**

Module: 5

Principle of similarity in fluid machinery; unit and specific quantities, testing models and selection of hydraulic turbines. **(Lectures: 3)**

Module: 6

Positive displacement pumps: Reciprocating pump; working principle, classification, slip, indicator diagram, effect of friction and acceleration, theory of air vessel, performance characteristics gas gear oil pump and screw pump. **(Lectures: 4)**

Module: 7

Rotodynamic pumps: Introduction, classification, centrifugal pump; main components, working principle velocity triangle, effect of shape of blade specific speed, heats, power and efficiency, calculations minimum steering speed, multi stage pumps, performance characteristic, comparison with reciprocating pump. **(Lectures: 7)**

Course Outcomes:

Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

Text Books:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press,2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International,1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international,1969.
4. Hydrantic Machine by Jagdish Lal
5. Hydraulics & Hydraulic Machines by Vasandari
6. Hydrantic Machine by RD Purohit

Practical:

1. Performance on hydraulic turbines:
    a. Pelton wheel
    b. Francis turbine
    c. Kaplan turbine.
2. Performance on hydraulic pumps:
    a. Single stage and multi stage centrifugal pumps
    b. Reciprocating pump.
3. Performance test of a two stage reciprocating air compressor
4. Performance test on an air blower

OPTIONAL

1. Visit to hydraulic power station/Municipal water pump house and case studies.
2. Demonstration of cut section models of hydraulic turbines and pumps.

100808 Common Paper (EE/ECE)

Internet of Things 3L:0T:0P 3 Credits

1. Introduction: Internet of Things Promises Definition Scope Sensors for IoT Applications Structure of IoT IoT Map Device 9

2. SEVEN GENERATIONS OF IOT SENSORS TO APPEAR: Industrial sensors Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics–Polytronics Systems – Description & Characteristics–Sensors Swarm – Description &Characteristics–Printed Electronics – Description & Characteristics–IoT Generation Roadmap 9

3 TECHNOLOGICAL ANALYSIS: Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module 9

4 IOT DEVELOPMENT EXAMPLES: ACOEM Eagle – En Ocean Push Button – NEST Sensor – Ninja Blocks -Focus on Wearable Electronics 9

5 PREPARING IOT PROJECTS: Creating the sensor project: Preparing Raspberry Pi- Claystar libraries - Hardware- Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data - Creating the actuator project- Hardware - Interfacing the hardware - Creating a controller - Representing sensor values - Parsing sensor data - Calculating control states - Creating a camera - Hardware -Accessing the serial port on Raspberry Pi - Interfacing the hardware - Creating persistent default settings Adding configurable properties - Persisting the settings - Working with the current settings Initializing the camera 9

Sl. No. Name of Authors / Books /Publishers

1 Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 - 2024',Yole Development Copyrights, 2014

2 Peter Waher, 'Learning Internet of Things',Packt Publishing, 2015

3 Editors OvidiuVermesan Peter Friess,'Internet of Things – From Research and Innovation to Market

4 Deployment', River Publishers, 2014

5 N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014

104810 Power Electronics 3L:0T:0P 3 Credits

1. Semiconductor Switching Devices: Review of Thyristor, two transistor Model of SCR, classification and V-I characteristics, junction temperature, gate circuit ratings, triggering process, UJT and characteristics, UJT as a relaxation oscillator, triggering UJT using SCR, turn off methods, fast recovery diodes, schottky diodes, Series and parallel connections of SCR, DIAC, TRIAC, Power MOSFETS, application of SCR. 7

2. Power Rectification: Classification of rectifiers, half, full, three-phase rectifier, semi converters, full converters, freewheeling diodes, circuits using SCR, voltage multiplying rectifier circuits, transformer utility factor 5

3. Regulated Power Supplies: Classification of voltage regulators, short period and long period accuracy of voltage regulator, D.C. voltage regulators, complete series voltage regulator circuit with ICs, SMPS basic principles, step up and step down circuits, UPS. 5

4. Inverters: Introduction, simple Inverters and Power Inverter using SCR, output voltage control in inverter waveform control, PWM inverters, reduction of harmonies with the help of PWM inverters. 5

5. Induction and Dielectric Heating: Induction heating effect of frequency power requirements, merits and application of induction heating, Dielectric heating, dielectric properties of a few typical materials, thermal losses, appli- cation of dielectric heating, skin effect, high frequency sources for induction and dielectric heaters. 6

6. Electronic Control of D.C. Motors: Introduction, control of D.C. shunt motor, full wave D.C. shunt motor control overload projection, universal motor control, electronic control for reversing motor control using SCR, choppers, their classifications and applications. 6

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