| Course No. | Course Name | L-T-P -Credits | Year of Introduction |
|---|---|---|---|
| EE 402 | Special Electrical Machines | 3-0-0-3 | 2015 |

**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**.

Upon successful completion of this course, students will be able to know the construction and principle of operation of certain special electrical machines having various applications.

**Text Book**:

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

**References:**

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

**Course Plan**

| Module | Contents | Hours | Sem.Exam Marks |
|---|---|---|---|
| I | AC Servomotors- Construction-principle of operation – performance characteristics – damped AC servomotors – Drag cup servomotor – applications.<br>DC servomotors – field and armature controlled DC servomotors – permanent magnet armature controlled – series split field DC servomotor. | 7 hrs | 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 hrs | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| III | Single phase special electrical machines – AC series motor-construction – principle of working – phasor diagram – universal motor<br>Hysteresis motor- constructional details- principle of operation – torque-slip characteristics – applications. | 7 hrs | 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 hrs | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |

| | | | |
|---|---|---|---|
| **V** | Permanent Magnet DC Motors – construction – principle of working. Brushless dc motor – construction – trapezoidal type- sinusoidal type – comparison – applications. | 7 hrs | 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 hrs | 20% |
| **END SEMESTER EXAM** | | | |

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

**QUESTION PAPER PATTERN:**

**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**: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

| Course No. | Course Name | L-T-P -Credits | Year of Introduction |
|---|---|---|---|
| EE 404 | INDUSTRIAL INSTRUMENTATION AND AUTOMATION | 2-1-0 | 2015 |

**Course Objectives**

To impart knowledge about the Industrial instrumentation and automation

**Syllabus:** Dynamic characteristic of instrumentation, signal conditioning, MEMS, Virtual instrumentation, actuators and PLC

**Expected Outcome:**

After the completion of the course student will be able to:

1. Select and describe the operation of instruments and transducers for various physical variables.
2. get an insight on data acquisition, processing and monitoring system
3. Design various signal conditioning systems for transducers.
4. Analyze dynamic responses of various systems.
5. Get the concepts of virtual instrumentaion
6. Understand the programming realization of PLC

**Text books:**


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


**References:**


1. Jain R.K. 'Mechanical and Industrial Measurements', Khanna Publishers
2. Michael P .Lucas, 'Distributed Control system', Van Nastrant Reinhold Company, New York,
3. G.K.Mc-Millan, 'Process/Industrial Instrument and control and hand book'Mc- GrawHill, New York,1999


**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | | 6 | 15% |

| | | | |
|---|---|---|---|
| | Introduction to Process Control - block diagram of process control loop, definition of elements. Sensor time response - first and second order responses.<br>Review of Transducers:<br>Characteristics and Choice of transducer-factors influencing choice of transducer | | |
| **II** | Applications of Transducers<br>Displace measurement: Resistance potentiometer, Capacitive and Inductive. Capacitive differential pressure measurement<br>Torsional, shearing stress and rotating shaft Torque measurement using strain gauge. Flow measurement :Hotwire anemometer, constant resistance Constant current type<br>Eddy current sensors, Variable reluctance tachometers<br>Phase measurement :Analog and digital phase detectors<br>Nano Instrumentation | 8 | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | Signal conditioning circuits-Instrumentation amplifiers-<br>Unbalanced bridge. Bridge linearization using opamp<br>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)<br>Advantages and Applications, MEMS micro sensors and actuators, Manufacturing process: Bulk micro machining and surface micromachining, MEMS accelerometers<br><br>Virtual instrumentation system<br>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<br><br>Actuators, definition, types, selection.<br>Pneumatic, Hydraulic, Electrical, Electo-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** | | | |

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

**QUESTION PAPER PATTERN:**

**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**: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

| Course No. | Course Name | L-T-P -Credits | Year of Introduction |
|---|---|---|---|
| EE462 | Design of Digital Control Systems | 3-0-0-3 | 2015 |

**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, students will have the

1. Ability to design digital controllers.
2. Ability to analyse discrete time system using state space methods.
3. Ability to analyse the stability of discrete time system.

**Text Book**:


**1)** M. Gopal, Digital Control and State Variable Methods, Tata McGraw-Hill, 1997

**2)** Ogata K., Discrete-Time Control Systems, Pearson Education, Asia.

**3)** C. L. Philips, H. T. Nagle, Digital Control Systems, Prentice-Hall, Englewood Cliffs, New Jersey, 1995.

**4)** Benjamin C. Kuo, Digital Control Systems, 2/e, Saunders College Publishing, Philadelphia, 1992.


**Data Book ( Approved for use in the examination):**

**References:**


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


**Course Plan**

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| 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 hrs | 15% |
| II | Pulse transfer function- Different configurations for the design- Modified z-transform-Time responses of discrete data systems-Steady state performance. | 7 hrs | 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 hrs | 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 hrs | 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 hrs | 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 hrs | 20% |
| **END SEMESTER EXAM** | | | |

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

**QUESTION PAPER PATTERN:**

**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**: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

| Course No. | Course Name | L-T-P | Year of Introduction |
|---|---|---|---|
| EE 464 | **Flexible AC Transmission Systems** | **3-0-0-3** | **2015** |

**Course Objectives:**
The objective of the course is 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**

After studying this subject , students are 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.

**Textbooks and References**


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


**COURSE PLAN**

| Module | Contents | Hours Allotted | % of Marks in End-Semester Examination |
|---|---|---|---|
| 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<br>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 EXAM** | | |
| III | Static shunt Compensator - Objectives of shunt compensations, Methods of controllable VAR generation - Variable impedance type VAR Generators -TCR , TSR, TSC, FC-TCR Principle of operation, configuration and control<br>Static Series compensator - Objectives of series compensations, Variable impedance type series compensators - TCSC - Principle of operation, configuration and control. | 8 | 15 |
| IV | Static Voltage and Phase Angle Regulators (TCVR &TCPAR): Objectives of Voltage and Phase angle regulators<br>Thyristor controlled Voltage and Phase angle Regulators | 7 | 15 |
| | **SECOND INTERNAL EXAM** | | |
| V | Switching converter type shunt Compensators.- Principle of operation, configuration and control , Comparison between SVC and STATCOM- Applications<br>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<br>General Equivalent Circuit for Facts Controllers (Shunt+series)<br>Introduction to interline power flow controller. | 7 | 20 |
| **END SEMESTER EXAM** | | | |

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

**QUESTION PAPER PATTERN:**

**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**: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

| Course No. | Course Name | L-T-P -Credits | Year of Introduction |
|---|---|---|---|
| EE 466 | **Digital Image Processing** | **3-0-0** | **2015** |

**Course Objectives**

• To study the image fundamentals and mathematical transforms necessary for image processing.

• To study the image enhancement techniques

• To study image restoration procedures.

• To study the image compression procedures

• To study 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**.

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

**Text Book:**

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

**Data Book ( Approved for use in the examination):**

**References:**

1. Chandra Dutta MAgundar, Digital Image Processing and Applications, PHI

2. MillmanSonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniv, Image Processing Analysis and Machine Vision

3. A. K. Jain, Fundamentals of Digital Image Processing, PHI

4. William K. Pratt, Digital Image Processing, John Wiley & Sons

## Course Plan

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| 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. | 7 | 15% |

| | | | |
|---|---|---|---|
| | Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG | | |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Morphological Image Processing-Dilation, Erosion, Morphological Reconstruction- Gray Scale Morphology<br><br>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** | | | |

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

**QUESTION PAPER PATTERN:**

**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**: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

| Course No. | Course Name | L-T-P -Credits | Year of Introduction |
|---|---|---|---|
| EE 468 | **Computer Networks** | **3-0-0** | **2015** |

**Course Objectives**

To teach 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**.

At the end of this subject, students should be able to:

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

**Text Book:**

1. ``Computer Networking: A Top-Down Approach,'' by Jim Kurose and Keith Ross, 5th Edition.
2. ``Computer Networks: A Systems Approach,'' by Larry L. Peterson and Bruce S. Davie

**Data Book ( Approved for use in the examination): Nil**

**References:**

1. Computer Networks by Tanenbaum, Andrew S, Prentice Hall of India, New Delhi

2. Data Communications and Networking by Foronzan, Tata McGraw Hill, New Delhi

3. Local area Networks by Peter Hudson , Thomson Learning

4. Understanding Local area Network by Neil Jenkins , SAMS Publishers

**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** | | | |

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

**QUESTION PAPER PATTERN:**

**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**: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

| Course No. | Course Name | L-T-P -Credits | Year of Introduction |
|---|---|---|---|
| EE 492 | Instrumentation Systems | 3-0-0-3 | 2015 |

**Course Objectives**

- To introduce the measurement techniques of force, torque and speed.
- To introduce the pressure measurement techniques.
- To introduce the flow measurement techniques.
- To introduce the temperature measurement techniques.
- To introduce different types of electronic circuits for measurements and their applications.

**Syllabus**

General Concepts ,Generalised Configurations and Functional Description of Measuring Instruments, Measuring Devices, Force and Torque Measurements, Shaft Power Measurements,

Pressure and Sound Measurements, Dynamic Testing of Pressure-Measuring Systems, Flow Measurement, Temperature Measurement, Bridge Circuits ,Amplifiers ,Filters, Integration and Differentiation, Voltage-Indicating and Recording Devices,Electromechanical Servo type XT and XY Recorders.

**Expected outcome**.

- Ability to understand and analyze Instrumentation systems.
- Ability to select proper measurement system for various applications.

**Text Book:**

1. **Ernest O Doebelin and Dhanesh N Manik, Measurement Systems, Mc Graw Hill, 6e.**

**Data Book ( Approved for use in the examination):**

**References:**

1. Turner and Hill, Instrumentation for Engineers and Scientists, Oxford University Press
2. Neubert, Instrument Transducers, Oxford University Press.

**Course Plan**

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| I | General Concepts : Need for Measurement Systems, Classification of Types of Measurements Applications | | 15% |

| | | | |
|---|---|---|---|
| | Generalised Configurations and Functional Description of Measuring Instruments : Functional Elements of an Instrument , Active and Passive Transducers , Analog and Digital Modes of Operation ,Null and Deflection Methods, Input-Output Configurations of Instruments and Measurement Systems | | |
| **II** | Measuring Devices :<br><br>Motion Measurements : Fundamental Standards, Relative Displacements : Translational and Rotational , Relative Velocity : Translational and Rotational, Relative-Acceleration Measurements<br><br>Force and Torque Measurements : Standards and calibration , Basic Methods of Force Measurements , Characteristics of Elastic Force Transducers ,Torque Measurement on Rotating Shafts | | 15% |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | Shaft Power Measurements : Shaft Power Measurements (Dynamometers ), Vibrating-Wire Force Transducers<br><br>Pressure and Sound Measurements: Standards and Calibration , Basic Methods of Pressure Measurements, Deadweight Gages and Manometers , Elastic Transducers, Vibrating-Cylinder and Other Resonant Transducers | | 15% |
| **IV** | Dynamic Testing of Pressure-Measuring Systems, High Pressure Measurement, Low Pressure(Vacuum) Measurement, Sound Measurements<br><br>Flow Measurement : Local Flow Velocity , Magnitude and Direction , Gross Volume Flow Rate | | 15% |

| | | | |
|---|---|---|---|
| | | | |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Temperature Measurement : Standards and Calibration ,<br>Thermal-Expansion Methods ,Thermoelectric Sensors (Thermocouples ),Electric-Resistance Sensors, Junction Semiconductor Sensors ,Digital Thermometers ,Radiation Methods | | 20% |
| **VI** | Bridge Circuits ,Amplifiers ,Filters, Integration and Differentiation<br>Voltage-Indicating and Recording Devices :<br>Standards and Calibration , Analog Voltmeters and Potentiometers<br>Electrical Instruments : RMS Voltmeter , Ohm Meter , Phase Meter , Q Meter<br>Digital Voltmeters and Multimeters ,Signal Generation :====Square Wave Generation , Electromechanical Servo type XT and XY Recorders | | 20% |
| **END SEMESTER EXAM** | | | |

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

**QUESTION PAPER PATTERN:**

**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**: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

| Course No. | Course Name | L-T-P -Credits | Year of Introduction |
|---|---|---|---|
| EE 492 | Instrumentation Systems | 3-0-0-3 | 2015 |

**Course Objectives**

**Syllabus**

**Expected outcome**.

**Text Book:**

**2. Ernest O Doebelin and Dhanesh N Manik, Measurement Systems, Mc Graw Hill, 6e.**

**Data Book ( Approved for use in the examination):**

**References:**

3. Turner and Hill, Instrumentation for Engineers and Scientists, Oxford University Press
4. Neubert, Instrument Transducers, Oxford University Press.

**Course Plan**

| Module | Contents | Hours | Sem.ExamMarks |
|---|---|---|---|
| I | General Concepts : Need for Measurement Systems, Classification of Types of Measurements Applications<br><br>Generalised Configurations and Functional Description of Measuring Instruments : Functional Elements of an Instrument , Active and Passive Transducers , Analog and Digital Modes of Operation ,Null and Deflection Methods, Input-Output Configurations of Instruments and Measurement Systems | | 15% |
| II | Measuring Devices : | | 15% |

| | | | |
|---|---|---|---|
| | Motion Measurements : Fundamental Standards, Relative Displacements : Translational and Rotational , Relative Velocity : Translational and Rotational, Relative-Acceleration Measurements<br><br>Force and Torque Measurements : Standards and calibration , Basic Methods of Force Measurements , Characteristics of Elastic Force Transducers ,Torque Measurement on Rotating Shafts | | |
| **FIRST INTERNAL EXAMINATION** | | | |
| **III** | Shaft Power Measurements : Shaft Power Measurements (Dynamometers ), Vibrating-Wire Force Transducers<br><br>Pressure and Sound Measurements: Standards and Calibration , Basic Methods of Pressure Measurements, Deadweight Gages and Manometers , Elastic Transducers, Vibrating-Cylinder and Other Resonant Transducers | | 15% |
| **IV** | Dynamic Testing of Pressure-Measuring Systems, High Pressure Measurement, Low Pressure(Vacuum) Measurement, Sound Measurements<br><br>Flow Measurement : Local Flow Velocity , Magnitude and Direction , Gross Volume Flow Rate | | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| **V** | Temperature Measurement : Standards and Calibration , | | 20% |

| | | | |
|---|---|---|---|
| | Thermal-Expansion Methods ,Thermoelectric Sensors (Thermocouples ),Electric-Resistance Sensors, Junction Semiconductor Sensors ,Digital Thermometers ,Radiation Methods | | |
| **VI** | Bridge Circuits ,Amplifiers ,Filters, Integration and Differentiation<br><br>Voltage-Indicating and Recording Devices :<br><br>Standards and Calibration , Analog Voltmeters and Potentiometers<br><br>Electrical Instruments : RMS Voltmeter , Ohm Meter , Phase Meter , Q Meter<br><br>Digital Voltmeters and Multimeters ,Signal Generation :====Square Wave Generation , Electromechanical Servo type XT and XY Recorders | | 20% |
| **END SEMESTER EXAM** | | | |

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

**QUESTION PAPER PATTERN:**

**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**: 8 questions

3 questions from each 2 module set; at least one question from each module.

Student has to answer any 2 from 3 questions: (2 x 10) x 3=60