Course Objectives

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


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:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem.Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>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.</td>
<td>7 hrs</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>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.</td>
<td>7 hrs</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION

SECOND INTERNAL EXAMINATION


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:

#### References:

#### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
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<tbody>
<tr>
<td>I</td>
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<td>6</td>
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<tr>
<td><strong>Applications of Transducers</strong></td>
<td>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</td>
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<tr>
<td><strong>Signal conditioning circuits</strong></td>
<td>Instrumentation amplifiers- Unbalanced bridge. Bridge linearization using opamp Precision rectifiers, Log amplifiers, Charge amplifiers, Isolation amplifier, Switched capacitor circuits, Phase sensitive detectors, Noise problem in instrumentation and its minimisation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Micro Electromechanical system (MEMS)</strong></td>
<td>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</td>
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<td></td>
</tr>
<tr>
<td><strong>Introduction to Sequence Control, PLCs - Working</strong></td>
<td>Specifications of PLC Onboard/Inline/Remote IO’s, Comparison of PLC &amp; 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</td>
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</tr>
</tbody>
</table>
EVALUATION SCHEME

- **INTERNAL EVALUATION:**
  - MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20
  - MARKS FOR TESTS: 30

- **EXTERNAL EVALUATION:**
  - Maximum Marks: 100
  - Exam Duration: 3Hrs.

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<th>Course No.</th>
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<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE462</td>
<td>Design of Digital Control Systems</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

**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:**

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

**References:**

**Course Plan**

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<tbody>
<tr>
<td>I</td>
<td>Basic digital control system- Examples - mathematical model-ZOH and FOH- choice of sampling rate-principles of discretization - Mapping between s-domain and z-domain</td>
<td>7 hrs</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Pulse transfer function- Different configurations for the design- Modified z-transform-Time responses of discrete data systems-Steady state performance.</td>
<td>7 hrs</td>
<td>15%</td>
</tr>
</tbody>
</table>

**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%             |
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.

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:

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One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x 5) = 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 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.


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

COURSE PLAN
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Allotted % of Marks in End-Semester Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>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&lt;br&gt;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.</td>
<td>7</td>
<td>15</td>
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<tr>
<td>II</td>
<td>Reactive power compensation – shunt and series compensation principles – reactive compensation at transmission and distribution level – Static versus passive VAr Compensators</td>
<td>6</td>
<td>15</td>
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<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
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<tr>
<td>III</td>
<td>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&lt;br&gt;Static Series compensator - Objectives of series compensations, Variable impedance type series compensators - TCSC - Principle of operation, configuration and control.</td>
<td>8</td>
<td>15</td>
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<tr>
<td>IV</td>
<td>Static Voltage and Phase Angle Regulators (TCVR &amp; TCPAR): Objectives of Voltage and Phase angle regulators&lt;br&gt;Thyristor controlled Voltage and Phase angle Regulators</td>
<td>7</td>
<td>15</td>
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<td><strong>SECOND INTERNAL EXAM</strong></td>
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<tr>
<td>V</td>
<td>Switching converter type shunt Compensators.- Principle of operation, configuration and control , Comparison between SVC and STATCOM- Applications&lt;br&gt;Switching converter type Series Compensators-(SSSC)- Principle of operation, configuration and control</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>
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:

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**Part B:** 8 questions

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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 | 3-0 | 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:**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>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</td>
<td>7</td>
<td>15%</td>
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<tr>
<td>III</td>
<td>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</td>
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<td>IV</td>
<td>Lossless compression: Variable length coding – LZW coding – Bit plane coding, predictive coding-DPCM.</td>
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<tr>
<td>-modules</td>
<td>topics</td>
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<tr>
<td>V</td>
<td>Morphological Image Processing-Dilation, Erosion, Morphological</td>
<td>7</td>
<td>20</td>
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<tr>
<td></td>
<td>Reconstruction-Gray Scale Morphology Edge detection – Thresholding</td>
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<td></td>
<td>- Region Based segmentation</td>
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<tr>
<td>VI</td>
<td>Boundary representation: chair codes-Polygonal</td>
<td>7</td>
<td>20</td>
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<td>approximation – Boundary segments – boundary descriptors: Simple</td>
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<td>descriptors Fourier descriptors-Regional descriptors – Simple</td>
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<td>descriptors</td>
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</table>

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**
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  - 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 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:


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

<table>
<thead>
<tr>
<th>Module</th>
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<tbody>
<tr>
<td>I</td>
<td>Introduction-Uses of Computer Networks, Network Hardware, Network Software, Reference Models, Example Networks,</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Network Standardization. The Medium Access Control Sublayer- The Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANs, Broadband Wireless, Bluetooth.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>The Transport Layer- The Transport Service, Elements of Transport Protocols, A Simple Transport Protocol,</td>
<td>7</td>
<td>15%</td>
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<tr>
<td>V</td>
<td>The Internet Transport Protocols: UDP, The Internet Transport Protocols: TCP, Performance Issues.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>The Application Layer- DNS-The Domain Name System, Electronic Mail, The World Wide Web, Multimedia</td>
<td>8</td>
<td>20%</td>
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</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAM**

**EVALUATION SCHEME**

- **INTERNAL EVALUATION:**
  
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  MARKS FOR TESTS: 30

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  Maximum Marks: 100
  Exam Duration: 3Hrs.

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**Part A:** 8 questions.

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**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: \((2 \times 10) \times 3 = 60\)
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


Expected outcome.

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

Text Book:


Data Book (Approved for use in the examination):

References:

1. Turner and Hill, Instrumentation for Engineers and Scientists, Oxford University Press

Course Plan

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<tbody>
<tr>
<td>I</td>
<td>General Concepts: Need for Measurement Systems, Classification of Types of Measurements Applications</td>
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<td>15%</td>
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<tr>
<td>II</td>
<td>Force and Torque Measurements: Standards and calibration, Basic Methods of Force Measurements, Characteristics of Elastic Force Transducers, Torque Measurement on Rotating Shafts</td>
<td></td>
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<tr>
<td>III</td>
<td>Shaft Power Measurements: Shaft Power Measurements (Dynamometers), Vibrating-Wire Force Transducers</td>
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<tr>
<td>III</td>
<td>Pressure and Sound Measurements: Standards and Calibration, Basic Methods of Pressure Measurements, Deadweight Gages and Manometers, Elastic Transducers, Vibrating-Cylinder and Other Resonant Transducers</td>
<td></td>
<td></td>
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<tr>
<td>IV</td>
<td>Flow Measurement: Local Flow Velocity, Magnitude and Direction, Gross Volume Flow Rate</td>
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</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III | Shaft Power Measurements: Shaft Power Measurements (Dynamometers), Vibrating-Wire Force Transducers |
| III | Pressure and Sound Measurements: Standards and Calibration, Basic Methods of Pressure Measurements, Deadweight Gages and Manometers, Elastic Transducers, Vibrating-Cylinder and Other Resonant Transducers |
| IV | Flow Measurement: Local Flow Velocity, Magnitude and Direction, Gross Volume Flow Rate |
| VI | Bridge Circuits, Amplifiers, Filters, Integration and Differentiation, Voltage-Indicating and Recording Devices: Standards and Calibration, Analog Voltmeters and Potentiometers, Electrical Instruments: RMS Voltmeter, Ohm Meter, Phase Meter, Q Meter, Digital Voltmeters and Multimeters, Signal Generation: Square Wave Generation, Electromechanical Servo type XT and XY Recorders | 20% |

END SEMESTER EXAM

EVALUATION SCHEME

- **INTERNAL EVALUATION:**
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<tbody>
<tr>
<td>EE 492</td>
<td>Instrumentation Systems</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

Course Objectives

Syllabus

Expected outcome.

Text Book:


Data Book (Approved for use in the examination):

References:

3. Turner and Hill, Instrumentation for Engineers and Scientists, Oxford University Press

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<td>I</td>
<td>General Concepts : Need for Measurement Systems, Classification of Types of Measurements Applications</td>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Measuring Devices :</td>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>First Internal Examination</td>
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<tr>
<td>Pressure and Sound Measurements: Standards and Calibration, Basic Methods of Pressure Measurements, Deadweight Gages and Manometers, Elastic Transducers, Vibrating-Cylinder and Other Resonant Transducers</td>
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</tbody>
</table>

| IV | 15% |
| Flow Measurement: Local Flow Velocity, Magnitude and Direction, Gross Volume Flow Rate |

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

END SEMESTER EXAM

EVALUATION SCHEME

- INTERNAL EVALUATION:
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