Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
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Dr. MAHALINGAM
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Accredited by NBA - Tier1 (Mech, Auto, Civil, EEE, ECE, EIE and CSE)
Udumalai Road, Pollachi - 642 003. Tel: 04259-236030/40/50 Fax: 04259-236070 www.mcet.in

Question Bank

Fundamentals of Instrumentation Engineering

DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION

ENGINEERING

19EISN2101 – Fundamentals of Instrumentation Engineering

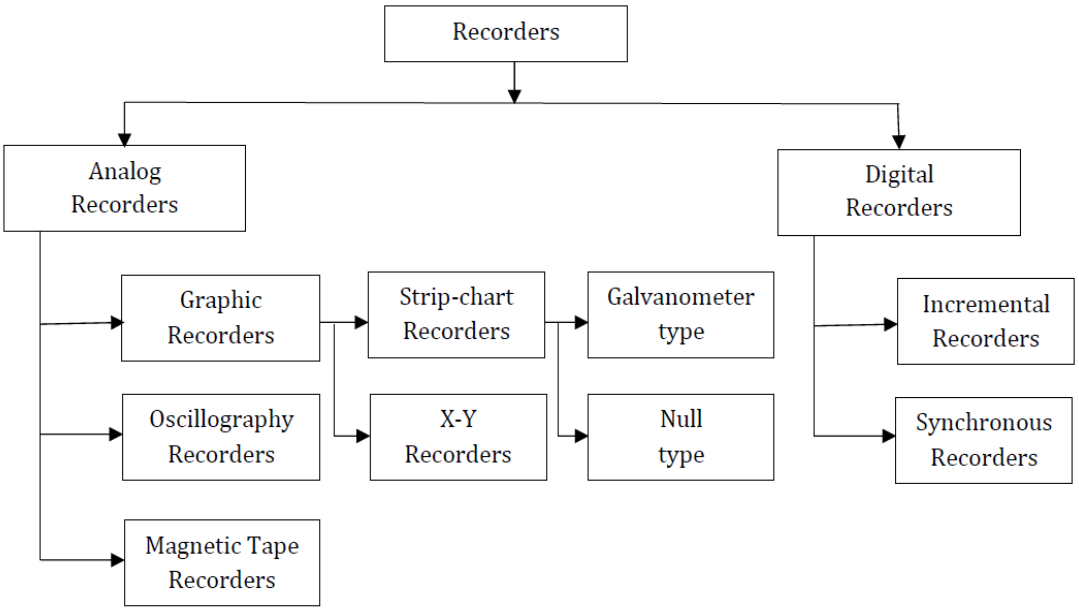
Question Bank

Unit I	
Part A	
1	**Define Current.** The flow of free electrons in metal is called electric current. The unit of current is ampere. I = Q/ t
2	**Define voltage.** The potential difference between two points in an electric circuit is called voltage. The unit of voltage is volts. Voltage = Workdone / charge
3	**Define resistivity.** The ressitivity of the material depends on the nature of material. Resistivity is also called as specific resistance It is measured in Ohm metre.
4	**Define conductance.** Conductance is the ability of the element to conduct the electric current, it is the reciprocal of element material and it is denoted by mho or siements.
5	**Define Conductivity.** Conductivity is defined as the reciprocal of resistivity It is denoted by the letter 'G' and it is measured in siements/ metre.
6	**Define Active and passive elements.** The source of energy are called as passive elements. Ex: Voltage source , Current Source The elements which stores or dissipates energy is called passive elements Ex: Resistor , Inductor, Capacitor.
7	**Define power factor.** The power factor (PF or cosφ) is the ratio between the power that can be used in electric circuit (real power, P) and the power from the result of multiplication between the current and voltage circuit (apparent power, S).
8	**State Kirchoffs law.** ***Kirchhoff's current law*** states that current flowing into a node (or a junction) must be equal to current flowing out of it. ***Kirchhoff's Voltage Law*** (KVL) deals with the conservation of energy around a closed circuit path. Voltage law states that for a closed loop series path the algebraic sum of all the voltages around any closed loop in a circuit is equal to zero.
9	**Write the equivalent resistance for a circuit with 3 equal resistors.** For Series circuit: $R_{eq}=R_1+R_2+R_3$ For Parallel circuit: $1/R_{eq}= (R_2R_3+ R_1R_3+ R_1R_2)/(R_1R_2R_3)$
10	**Define form factor & crest factor.** ***Form factor*** of an alternating current waveform (signal) is the ratio of the RMS (root mean square) value to the average value. ***Crest factor*** is a parameter of a waveform, such as alternating current or sound, showing the ratio of peak values to the effective value.
11	**A 5ohm resistance has a voltage v=150sin377t volts. Find the corresponding current and power.**

	V_{rms}=1.414 V I_{rms}=0.28 A P=V_{rms}*I_{rms}=1.414*0.28=0.399W
12	**Define Reactive power.** **Reactive power** is given by Q = V I Sinθ which can be positive (+ve) for inductive, negative (-Ve) for capacitive load. The unit of **reactive power** is Volt-Ampere **reactive**.
13	**Define true power.** In an AC circuit, **true power** is the **actual power** consumed by the equipment to do useful work. It is distinguished from **apparent power** by eliminating the **reactive power** component that may be present. The **true power** is measured in watts and signifies the **power** drawn by the circuit's resistance to do useful work.
14	**Define Apparent power.** The combination of **reactive power** and true **power** is called **apparent power**, and it is the product of a circuit's voltage and current, without reference to phase angle. **Apparent power** is measured in the unit of Volt-Amps (VA) and is symbolized by the capital letter S.
15	**State ohm's law.** At constant temperature current flows through the conductor is directly proportional to the potential difference across the conductor and inversely proportional to the resistance of the conductor. I =V/R Amps
	Part B
1	**A voltage of v(t)=50sin(wt+30) is applied to a RL circuit with resistance 10ohm & reactance j30 ohm. Determine the true power, reactive power and the power factor.**
2	**Explain the working of Solenoid with neat sketch.**
3	**List the types of relay & explain the working principle of any two relay circuit.**
4	**Explain the working of contactor with neat sketch.**
	Unit II
1	**Define electron volt.** **Ans:** A unit of energy equal to the work done on an electron in accelerating it through a potential difference of one volt.
2	**Write the equation of diffusion current.** **Ans:** $J = -qD\frac{dp}{dx}$
3	**Write down the function of transistor as a switch.** The areas of operation for a transistor switch are known as the ***Saturation Region and the Cut-off Region.***
4	**List the features of LED.** a) Energy Efficient. b) Maintenance & Safety. c) Durable Quality.

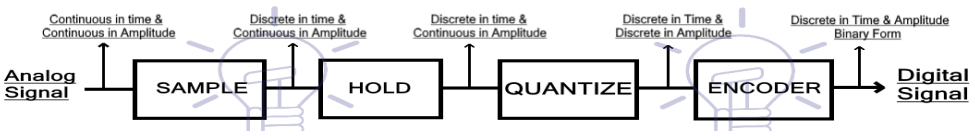
	d) Design Flexibility.
5	**State the effect of temperature of PN junction diode.** When temperature is high, the electrons of the outermost shell take the thermal energy and become free. So conductivity increases with temperature.
6	**Define Intrinsic Semiconductor.** Pure form of semiconductors are said to be intrinsic semiconductor Ex: germanium, silicon.
7	**Define Extrinsic Semiconductor.** If certain amount of impurity atom is added to intrinsic semiconductor the resulting semiconductor is Extrinsic or impure Semiconductor.
8	**Define drift current?** When an electric field is applied across the semiconductor, the holes move towards the negative terminal of the battery and electron move towards the positive terminal of the battery. This drift movement of charge carriers will result in a current termed as drift current.
9	**Define zener breakdown?** Zener break down takes place when both sides of the junction are very heavily doped and Consequently the depletion layer is thin and consequently the depletion layer is tin. When a small value of reverse bias voltage is applied , a very strong electric field is set up across the thin depletion layer. This electric field is enough to break the covalent bonds. Now extremely large number of free charge carriers are produced which constitute the zener current. This process is known as zener break down.
10	**Define avalanche break down?** When bias is applied , thermally generated carriers which are already present in the diode acquire sufficient energy from the applied potential to produce new carriers by removing valence electron from their bonds. These newly generated additional carriers acquire more energy from the potential and they strike the lattice and create more number of free electrons and holes. This process goes on as long as bias is increased and the number of free carriers get multiplied. This process is termed as avalanche multiplication. Thus the break down which occur in the junction resulting in heavy flow of current is termed as avalanche break down.
11	**Define transistor (BJT)?** Transistor is a three terminal device whose output current, voltage and /or power is controlled by input current.
12	**List are the terminals present in a transistor?** Three terminals: emitter, base, collector
	Part B
1	**Describe the principle and operation of PN junction diode with VI characteristics.**
2	**Explain Avalanche breakdown and Zener breakdown.**
3	**Elucidate the following with neat sketch:** **1) LED** **2) Solar Cell**

4	**Explain Zener diode as a voltage regulator.**
5	**Illustrate transistor as a switch.**
6	**Enlighten NPN and PNP transistor.**
7	**Explain HWR and FWR with suitable derivations.**
	Unit III
1	**Define SI units.** When a particular instrument indicated a reading, to specify the reading and use it for further calculations, it is necessary to specify type and magnitude for that reading. The magnitude is the reading obtained and the type of the reading is the unit of the physical quantity which is measured by the instrument.
2	**List any two ISA & IEEE standards.** ***IEEE Standards:*** ➢ IEEE 802.11 wireless LAN standards ➢ IEEE 1901 is a standard for high speed communication devices via electric power lines. ➢ IEEE 754 was an industry standard for representing floating-point numbers in computers ***ISA Standards;*** ➢ ISA5.1, Instrumentation Symbols and Identification ➢ ISA5.7, Process and Instrumentation Diagrams ➢ ISA67, Nuclear Power Plant Standards
3	**Classify the types of errors in instruments.** ➢ Gross error ➢ Systematic error ➢ Random error
4	**Write down the various signal levels in instrumentation.** ➢ Current - 4 to 20mA ➢ Voltage – 1 to 5 V ➢ Pressure – 3 to 15psi ➢ Internal Resistance - 250ohm
5	**State the need of damping torque & list the various techniques by which damping torque is produced.** Damping torque is very much important in measuring instruments; they are used for avoiding unwanted oscillations. Damping torque techniques are: ➢ Air friction damping ➢ Fluid friction damping ➢ Eddy current damping
6	**Mention the various torques needed in measuring instruments.** ➢ Deflecting torque ➢ Controlling torque ➢ Damping torque
7	**Classify the types of electrical measuring instruments.** ➢ Indicating instruments

	➢ Recording instruments ➢ Integrating instruments
8	**Define the principle used in PMMC instruments.** When a current carrying coil is placed across a magnetic field, the coil experience a force and moves. Or the amount of force experienced by the coil is proportional to the current passing through the coil.
10	**Define Calibration** Calibration in its simplest terms, is a process in which an instrument or piece of equipment's accuracy is compared with a known and proven standard.
11	**Classify the different types of recorders.** 
	Part B
1	**List the types of measuring instruments and Explain the working principle of Moving coil instruments.**
2	**Explain the working principle of Moving Iron Instruments.**
3	**Derive the torque equation of MI instruments.**
4	**Elucidate the following with neat sketch:** **1. Damping torque** **2. Controlling torque**
5	**Explain the following** 1. **X-Y Recorders** 2. **Magnetic Tape Recorders**
	Unit IV
1	**Define Transducer.** A transducer is defined as a sensing device used to convert a physical phenomenon or a non electrical quantity into electrical output signal.
2	**Classify the type of transducer.** The transducers can be classified based on three ways. They are listed as follows.

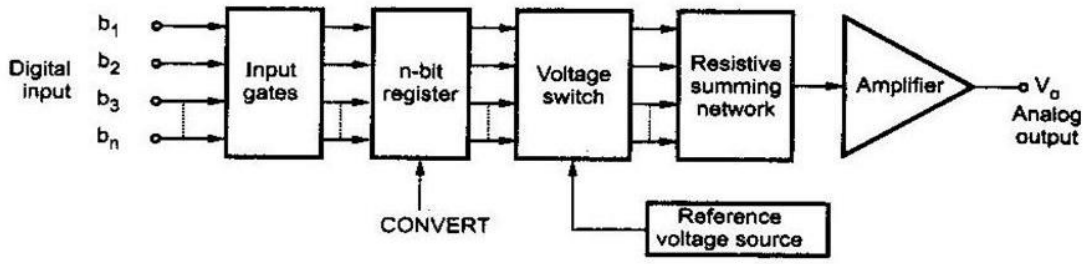
<table>
<tr><td></td><td>

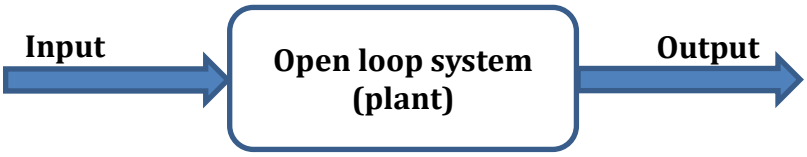
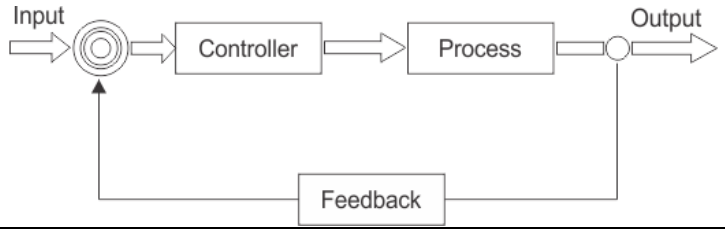
Based on the physical effect employed
Based on the physical quantity they convert and
Based on source of energy for their output

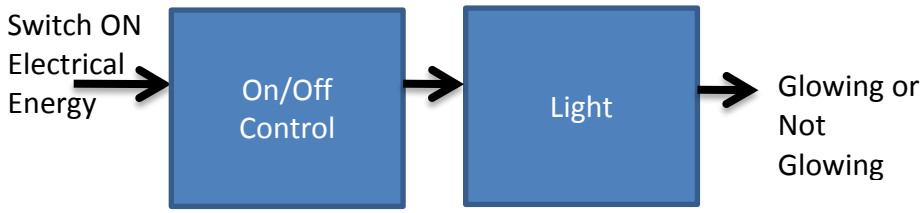
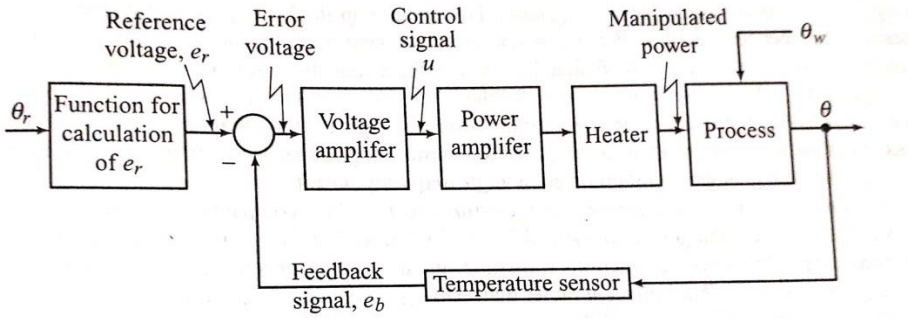
</td></tr>
<tr><td>3</td><td>Differentiate Analog and Digital Signal.
<table>
<tr><th>Analog</th><th>Digital</th></tr>
<tr><td>Analog signals are continuous signals</td><td>Digital signals are discrete time signals</td></tr>
<tr><td>They are subjected to deterioration by noise during transmission and write / read cycle.</td><td>Can be noise-immune without deterioration during transmission and write / read cycle.</td></tr>
<tr><td>Stored in form of wave signals.</td><td>Stored in the form of binary data.</td></tr>
<tr><td>Ex: Human voice in air, analog electronic devices.</td><td>Ex: Computers, CDs, DVDs, digital electronic devices.</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>Write down the process of Signal Conditioning Unit.
A signal conditioner is a device that converts one type of electronic signal into another type of signal. Its primary use is to convert a signal that may be difficult to read by conventional instrumentation into a more easily read format. In performing this conversion a number of functions may take place.</td></tr>
<tr><td>5</td><td>Compare Active and Passive transducer
<table>
<tr><th>Active</th><th>Passive</th></tr>
<tr><td>Active transducer are those which do not require an auxiliary power source to produce their output.</td><td>Passive transducer derives the power required for transduction from auxiliary power source.</td></tr>
<tr><td>They are also known as Self generating type</td><td>They are known as externally powered transducers.</td></tr>
<tr><td>The energy required for production of output signal is obtained from the physical quantity being measured.</td><td>The energy required for production of output signal is obtained from auxillary power source they also derive part of the power required for conversion from the physical quantity under measurement.</td></tr>
</table>
</td></tr>
<tr><td>6</td><td>Define Sensor
An element that senses a variation in input energy to produce a variation in another or same form of energy is called a SENSOR.</td></tr>
<tr><td>7</td><td>Draw the general block diagram of ADC.
 
</td></tr>
<tr><td>8</td><td>List the applications of ADC.

Cell phones operate on the digital voice signal. Originally the voice is in analog form, which is converted through ADC before feeding to the cell phone transmitter.
Images and videos captured using camera is stored in any digital device, is also

</td></tr>
</table>

	converted into digital form using ADC. ➢ Medical Imaging like **x-ray** & **MRI** also uses **ADC** to convert images into Digital form before modification. They are then modified for better understanding. ➢ Music from the **cassette** is also converted into the digital form such as **CDs** and **thumb drives** using **ADC** converters. ➢ **Digital Oscilloscope** also contains **ADC** for converting Analog signal into a digital signal for display purposes & different other features. ➢ **Air conditioner** contains **temperature sensors** for maintaining the room temperature. This temperature is converted into digital form using ADC so that onboard controller can read & adjust the cooling effect.
9	**Write down the function of SOC and EOC.** SOC informs the converter when to start the conversion. EOC informs when conversion is complete
10	**Draw the general block diagram of DAC.** 
11	**Write down the advantages of R/2R ladder over Binary weighted resistor DAC.** Binary weighted DAC needs N binary-weighted resistor values for N inputs, due to which drop will be high and accuracy will be less.
	Part B
1	**Describe the various stages of instrumentation system and its working.**
2	**Explain the process involved in analog to digital conversion technique**
3	**Explain the process involved in digital to analog conversion technique**
4	**Enlighten the classification of transducers based on physical effect applied.**
5	**Illuminate the classification of transducers based on physical quantity and sources of energy.**
	Unit V
1	**Define system.** When a number of elements or components are connected in a sequence to perform a specific function, the group thus formed is called as system.
2	**Define Control system.** In a system when the output quantity is controlled by varying the input quantity, the system is called control system.
3	**List two major types of control system.** 1. Open loop system 2. Closed loop system

4	**Define open loop system.** ➢ Any physical systems in which the ***output quantity has no effect upon the input*** to the control process are called open-loop control systems or control systems in which the output quantity has no effect upon the input quantity are called open-loop control system. ➢ This means that the output is not feedback to the input for correction. 
5	**Define Closed loop system.** ➢ Control system in which the *output has an effect upon the input quantity* in such a manner as to maintain the desired output value are called closed loop system. ➢ The open loop system can be modified as closed loop system by providing a feedback. ➢ The provision of feedback *automatically corrects the changes in output due to disturbances*. Hence the closed loop system is also called *Automatic Control System.* 
6	**Define feedback and list the types of feedback employed in control system.** Feedback is a control action in which the output is sampled and a proportional signal is given to the input for automatic correction of any changes in desired output. 1. *Negative feedback* 2. *Positive feedback*
7	**Define Manipulated variable** Manipulated variable is the quantity of the condition that is varied by the controller so as to affect the value of controlled variable.
8	**Define Controlled variable** Controlled Variable is the quantity or condition that is measured and Controlled. Normally controlled variable is the output of the control system.
9	**Write down the components of feedback control system.** A feedback **control system** consists of five basic **components**: 1. Input 2. Process being controlled 3. Output 4. Sensing elements 5. Controller and actuating devices.
10	**Distinguish between open loop and closed loop system.**

	Open Loop Control Systems	**Closed Loop Control Systems**
	Control action is independent of the	Control action is dependent of the
	Feedback path is not present.	Feedback path is present.
	These are also called as **non-feedback**	These are also called as **feedback**
	Easy to design.	Difficult to design.
	These are economical.	These are costlier.
	Inaccurate.	Accurate.
11	**List the function of error detector in a control system.** The error detector produces an error signal, which is the difference between the input and the feedback signal. This feedback signal is obtained from the block (feedback elements) by considering the output of the overall system as an input to this block. Instead of the direct input, the error signal is applied as an input to a controller. So, the controller produces an actuating signal which controls the plant	
12	Draw the open loop system block diagram for domestic lighting system. 	
13	**Mention the role of controller in a system.** The primary role of the controller is to manage the manipulated variable so as to counteract the effect of disturbance.	
14	**Sketch the blocks used in home heating control system.** 	
15	**List the requirements of good control system.** 1. Accuracy 2. Sensitivity 3. A good control system should be able to reduce the noise effect for better	

	performance. 4. Stability 5. Speed 6. Oscillation
Part B	
1	**With a neat sketch explain temperature control system.**
2	**Explain the basic terminologies of control system**
3	**Describe traffic light control using open loop and closed loop system.**
4	**Explicate vehicle driving control system with neat sketch.**
5	**Illustrate electronic weighing scale**
6	**Explain open loop drying system**