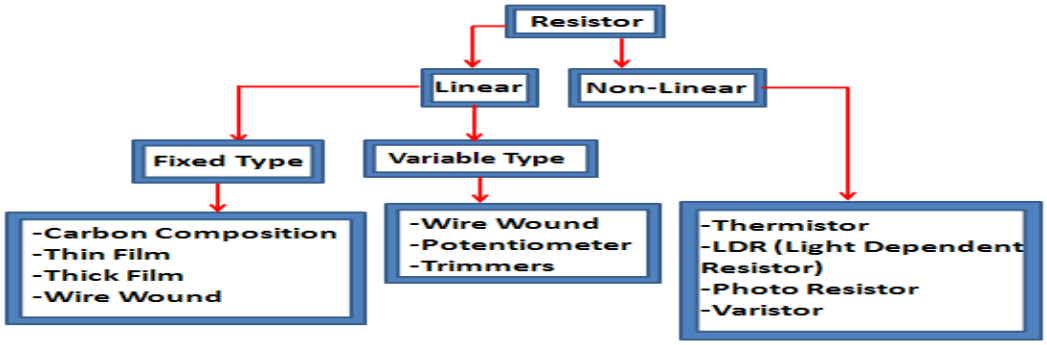
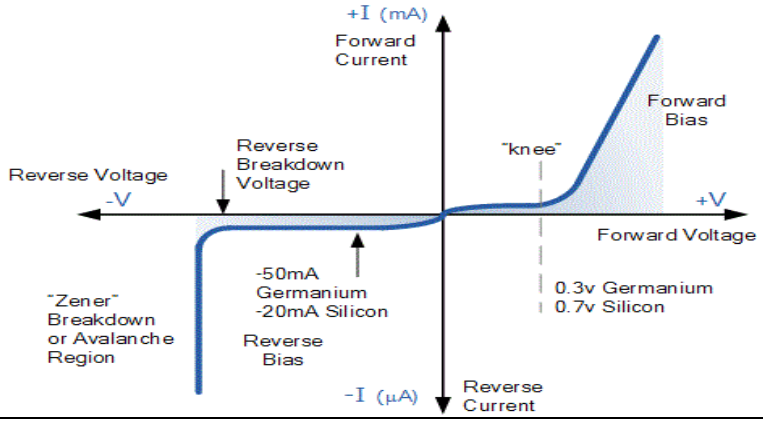
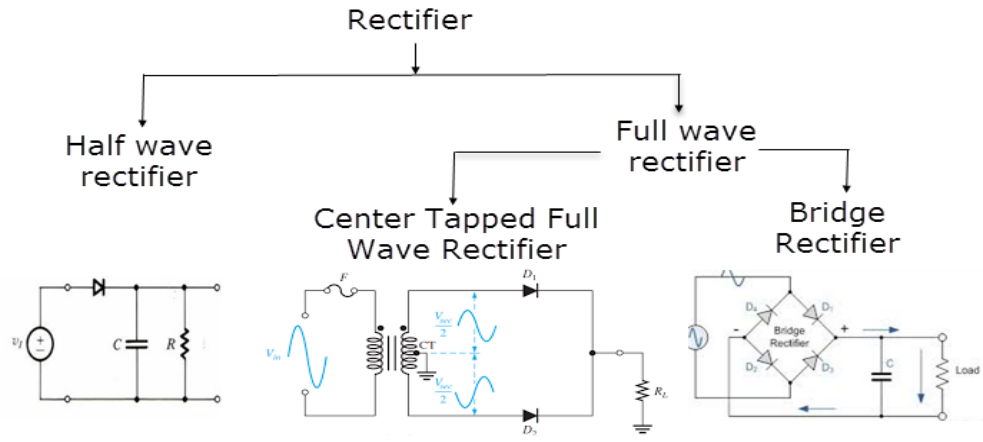
WINTER– 2018 EXAMINATION

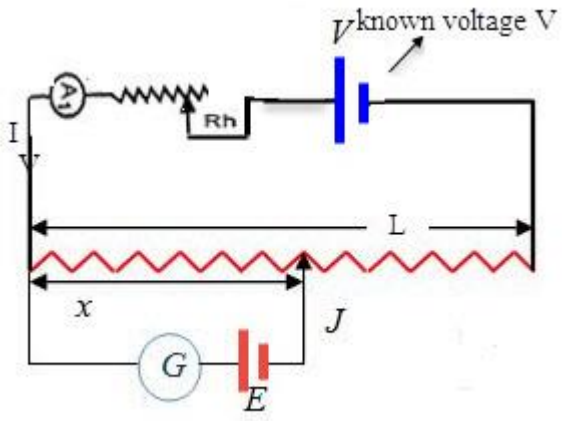
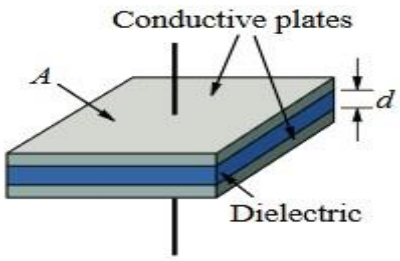
Model Answer **Subject Code:** 22220

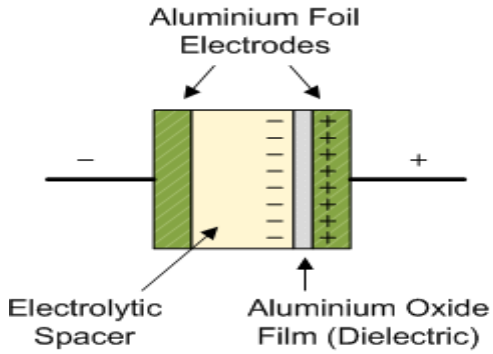
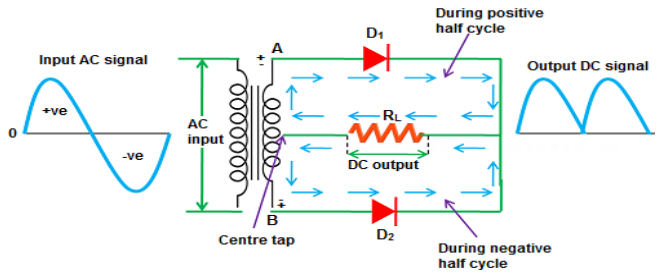
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical spelling errors should not be given more Importance Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.		**Attempt any FIVE of the following:**	10 M
	(a)	**Define passive components.** **Ans:** Passive Components are electronic components that do not require a Source of Energy to perform their intended functions.	2M
	(b)	**Give classification of resistor in brief** **Ans:** 	2M
	(c)	**Write down mathematical formula for capacitance and on which factor capacitance depends.** **Ans:** $C = \frac{\varepsilon A}{d}$ *Where,* C = Capacitance in Farads ε = Permittivity of dielectric (absolute, not relative) A = Area of plate overlap in square meters d = Distance between plates in meters Capacitance depends on A and d	2M

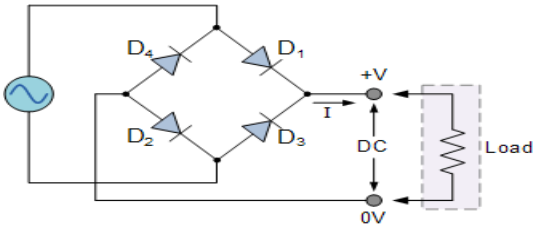
	(d)	**State Faraday's Law of electromagnetic induction** **Ans:** **Faraday's Law of electromagnetic induction:** The emf, Ɛ produced around a loop of conductor is proportional to the rate of change of the magnetic flux, φ, through the area, A, of the loop. This can be stated mathematically as: $\mathcal{E}=-N\,\Delta\phi/\Delta t$ where $\phi=B\cdot A\phi=B\cdot A$ and B is the strength of the magnetic field. NN is the number of circuit loops. A magnetic field is measured in units of teslas (T). The minus sign indicates direction and that the induced emf tends to oppose the change in the magnetic flux. The minus sign can be ignored when calculating magnitudes.	**2M**
	(e)	**Draw the V-I characteristics of P-N junction diode** **Ans:** 	**2M**
	(f)	**Write the type of rectifier in short** **Ans:** 	**2M**
	(g)	**Draw symbols of i) Photo diode ii) Tunnel diode** **Ans:** i) Photo diode  ii) Tunnel diode 	**1 M** **1M**

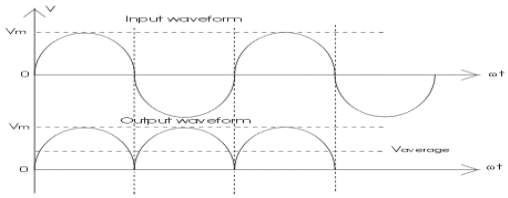
2.		**Attempt any THREE of the following:**	**12 M**
	(a)	**Describe the construction and working of linear potentiometer.** **Ans:** **Construction and Working Principle:** The potentiometer consists of a long resistive wire L made up of magnum or with constantan and a battery of known EMF V. This voltage is called as driver cell voltage. Connect the two ends of the resistive wire L to the battery terminals as shown below; let us assume this is a primary circuit arrangement. One terminal of another cell (whose EMF E is to be measured) is at one end of the primary circuit and another end of the cell terminal is connected to any point on the resistive wire through a galvanometer G. Now let us assume this arrangement is a secondary circuit. The arrangement of the potentiometer as shown below.  The basic working principle of this is based on the fact that the fall of the potential across any portion of the wire is directly proportional to the length of the wire, provided wire has uniform cross-sectional area and the constant current flowing through it.“When there is no potential difference between any two nodes there is electric current will flow”.	**1M** **2M** **1M**
	(b)	**Explain the fixed capacitor on the basis of constructional and applications.** **Ans:** **Fixed Capacitor:** A fixed capacitor is constructed in such manner that it possesses a fixed value of capacitance which cannot be adjusted. A fixed capacitor is classified according to the type of material used as its dielectric, such as paper, oil, mica, or electrolyte. The voltage source connected to the capacitor charges one plate with positive charge, and the other with negative charge. A capacitor is essentially what a battery is, but when the plates touch, the stored electrical energy is dissipated instantaneously, while a battery's energy is dissipated gradually. The change in the capacitance while pressing the key on the keyboard is translated by the computer into letters on the screen.  	**3M**

		Application of fixed capacitor • Filtering devices • Power supply • Reduce losses and avoid overheating • Audio amplifier	**1M (any two)**
	(c)	**Draw and explain constructional diagram of electrolytic capacitor.** Ans:  The plates of an electrolytic capacitor are constructed from conducting aluminium foil. As a result they can be made very thin and they are also flexible so that they can be packaged easily at the end of the production process. The two plates or foils are slightly different. One is coated with an insulating oxide layer, and a paper spacer soaked in electrolyte is placed between them. The foil insulated by the oxide layer is the anodes while the liquid electrolyte. The thickness of the anode oxide thin film in an aluminium electrolytic capacitor is selected by the required working withstands voltage. The second foil acts as the cathode and although this does have a naturally occurring oxide layer, this is very much thinner.	**2M** **2M**
	(d)	**Explain the working of full wave rectifier with neat sketch.** Ans: **Centre Tap Full Wave Rectifier:**  The primary winding of the centre tap transformer is applied with the Ac voltage. Thus the two diodes connected to the secondary of the transformer conducts alternatively. For the positive half cycle of the input diode D1 is connected to the positive terminal and D2 is connected to the negative terminal. Thus diode D1 is in forward bias and the diode D2 is reverse biased. Only diode D1 starts conducting and thus current flows from diode and it appears across the load RL. So positive cycle of the input is appeared at the load. During the negative half cycle the diode D2 is applied with the positive cycle. D2 starts conducting as it is in forward bias. The diode D1 is in reverse bias and this does not conduct. Thus current flows from diode D2 and hence negative cycle is also rectified, it appears at the load resistor RL. **OR**	**2M** **2M**

Bridge full wave rectifier:

A bridge rectifier is a type of full wave rectifier which uses four or more diodes in a bridge circuit configuration to efficiently convert the Alternating Current (AC) into Direct Current (DC).The four diodes labeled D_1 to D_4 are arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load as shown below. During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch "OFF" as they are now reverse biased. The current flowing through the load is the same direction as before.





3. **Attempt any <u>THREE</u> of the following:** **12 M**

(a) **State any two properties of ferromagnetic materials in details and write down any two applications of ferromagnetic materials.**

Ans:

Ferromagnetic materials have following properties:

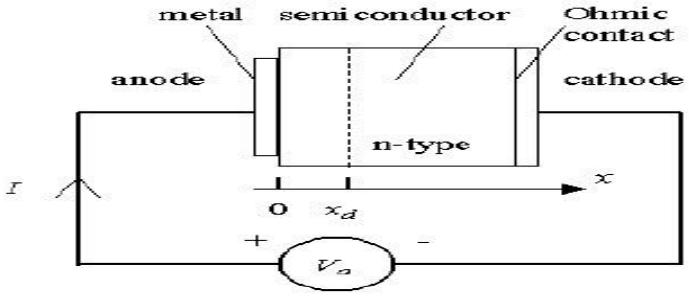
- In ferromagnetic materials, the magnetic lines of forces due to the applied magnetic field are strongly attracted towards the material.
- All ferromagnetic materials become paramagnetic above a temperature called Curie temperature T_c
- Permeability is greater than 1.
- Magnetic susceptibility is large and positive.
- Magnetic susceptibility decreases with the rise in temperature according to Curie-Weiss law.
- Ferromagnetism is the property of a material to be strongly attracted to a magnetic field and to become a powerful magnet.
- The source of ferromagnetism is the spin of the electrons.

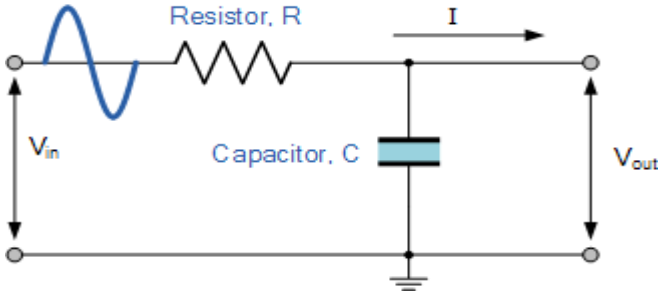
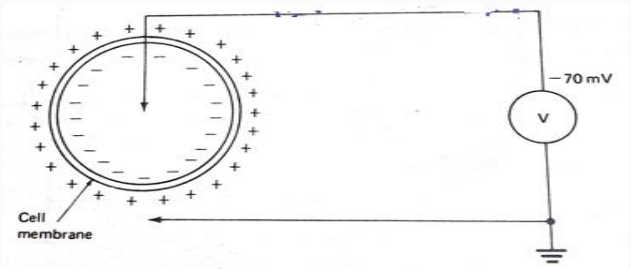
2M

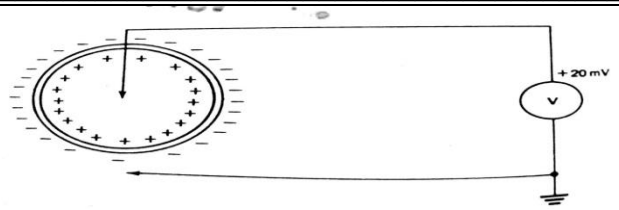
Applications of Ferromagnetic materials:

- Medical use
- Separation
- Catalyst
- Sealing
- Heat transfer
- Damper

2M

	(b)	**Describe air core inductor with neat diagram** **Ans:** **<u>Air Core Inductor</u>** Ceramic core inductors are referred as "Air core inductors". Ceramic is the most commonly used material for inductor cores. Ceramic has very low thermal co-efficient of expansion, so even for a range of operating temperatures the stability of the inductor's inductance is high. Since ceramic has no magnetic properties, there is no increase in the permeability value due to the core material. Its main aim is to give a form for the coil. In some cases it will also provide the structure to hold the terminals in place. The main advantages of these inductors are very low core losses, high Quality factor. These are mainly used in high frequency applications where low inductance values are required.  Air Core inductor	**2M** **2M**
	(c)	**Explain the construction of Schottky diode.** **Ans:** **Schottky Diode Construction** A Schottky diode is also known as a hot carrier diode; it is a semiconductor diode with a very fast switching action, but a low forward voltage drop. When a current flows through the diode there is a small voltage drop across the diode terminals. In a normal diode, the voltage drop is between 0.6 to 1.7 volts, while in a Schottky diode the voltage drop normally ranges between 0.15 and 0.45volts. This lower voltage drop provides higher switching speed and better system efficiency. It is a unilateral junction. A metal semiconductor junction is formed at one end and another metal semiconductor contact is formed at the other end. It is an ideal Ohmic bidirectional contact with no potential existing between the metal and the semiconductor and it is non-rectifying. The built in potential across the open circuited Schottky barrier diode characterizes the Schottky diode. Schottky diode is a function of temperature dropping. It decreases and increasing temperature doping concentration in N type semiconductor. For manufacturing purpose, the metals of the Schottky barrier diode like molybdenum, platinum, chromium, tungsten Aluminium, gold, etc., are used and the semiconductor used is N type.  	**2M** **2M**

	(d)	**State the need of filter and explain working of low pass filter** **Ans: Need of filter:** The output that is obtained from a rectifier is pulsating in nature, which basically means that it has certain amount of AC component called as ripple. These ripple components are very much unwanted and undesirable in a rectifier circuit as they reduce the efficiency of AC to DC conversion. So, in order to remove these components, filters are used. **The Low Pass Filter:** A simple passive **RC Low Pass Filter** or LPF can be easily made by connecting together in series a single Resistor with a single Capacitor as shown below. In this type of filter arrangement the input signal (VIN) is applied to the series combination (both the Resistor and Capacitor together) but the output signal (VOUT) is taken across the capacitor only. This type of filter is known generally as a "first-order filter" or "one-pole filter", **RC Low Pass Filter Circuit:**  	**1M** **2M** **1M**
4.		**Attempt any THREE of the following:**	**12 M**
	(a)	**Explain polarized cell and depolarized of a cell with neat sketch.** Ans: **Polarized cell:** Surrounding the cells of the body are body fluids, which are ionic and which provide a conducting medium for electric potentials. The principle ions are involves sodium, potassium, and chloride. The concentration of the sodium ion more on the outside of the cell membrane than on the inside. Since sodium is a positive ion, in its resting state, a cell has a negative charge along the inner surface of its membrane and positive charge along the outer portion. The unequal charge distribution is a result of certain electrochemical reactions and process occurring within the living cell and potential measured is called the resting potential. The cell in such condition is said to be polarized.  **Fig: Polarized cell** **Depolarized cell:** A decrease in this resting membrane potential difference is called depolarization. When the cell is exited or stimulated, the outer side of the cell membrane becomes momentarily negative with respect to the interior. This process is called depolarization and the cell potential changes to approximately +20mv.	**2M** **2M**

		 **Fig: Depolarized cell**	
	(b)	**Write down classification of medical equipment on the basis of application and mention one example of each type.** Ans: Classify medical equipment's with examples as follows: 1. **Diagnostic equipment:** ultrasound machine, MRI machines, Positron emission tomography (PET), CT scan machine, and x-ray machines. 2. **Analytical equipment:** spectrophotometer, oxygen analysers, gas chromatographs, fluorometer, 3. **Imaging equipment:** X-ray radiography, Magnetic resonance imaging, Medical ultrasonography or ultrasound, Thermography, Positron emission tomography (PET) and Single-photon emission computed tomography (SPECT). 4. **Therapeutic Equipment:** Examples are CPM, Traction machine, short wave diathermy, micro wave diathermy, ultrasound therapy unit, Electrotherapy machine, Nerve muscle stimulator.	**1M** **1M** **1M** **1M**
	(c)	**Explain Light dependent Resistor (LDR) and Temperature dependent Resistor (TDR)** **Ans:** **Light dependent Resistor (LDR)** Photo resistors, also known as light dependent resistors (LDR), are light sensitive devices most often used to indicate the presence or absence of light, or to measure the light intensity. In the dark, their resistance is very high, sometimes up to 1MΩ, but when the LDR sensor is exposed to light, the resistance drops dramatically, even down to a few ohms, depending on the light intensity. LDRs have a sensitivity that varies with the wavelength of the light applied and are nonlinear devices. They are used in many applications but are sometimes made obsolete by other devices such as photodiodes and phototransistors. **Temperature dependent Resistor (TDR)** Thermistor is also known as temperature sensitive resistor or temperature dependent resistor (TDR). It is a type of resistor whose resistance is dependent on temperature. Thermistor is used for devices, which have high temperature coefficient and used to detect very small changes in temperature. It is widely used as inrush current limiter, self-resetting over current protectors, temperature sensor and self-regulating heating elements. thermistor can be classified depending on the temperature coefficient of resistance are, **1. Negative temperature coefficient (NTC) thermistor.** The negative temperature coefficient (NTC) means that the temperature increases with the decrease in resistance. It is two terminal devices. The NTC thermistors are made by sintering sintering semiconductor ceramic materials prepared from mixtures of metallic oxides of manganese, cobalt, nickel etc. **2. Positive temperature coefficient (PTC) thermistor.** The positive temperature coefficient (PTC) means that small change in temperature with very large change in resistance. The PTC thermistors are made by using silicon or germanium on semiconductor barium titrates.	**2M** **2M**

(d) **Compare variable capacitor with fixed capacitor(any two points of each)** — **2M(each point)**

Ans:

Sr no	Variable capacitor	Fixed capacitor
1	Fixed Capacitor is one where the conducting plates are not adjustable	Variable capacitor is the capacitance will change while changing the plate physically and electrically.
2	Value of capacitor is fixed	Value of capacitor is variable
3	e.g. paper capacitor, plastic capacitor, ceramic, mica, electrolytic	e.g. tuning, trimmer, mechanical electrolysis
4	Symbol 	Symbol 

(e) **List any four material used for construction of resistor along with its properties.** — **4M(any four)**

Ans:

Material used for construction of resistor along with its properties as follows

- Surface Mount Technology (SMT).
- Carbon Film Resistors.
- Carbon Composition Resistor.
- Wire-wound resistors.
- Metal film resistors.

SMT (Surface Mount Technology)

Many modern circuits use SMT resistors. Their manufacture involves depositing a film of resistive material such as tin oxide on a tiny ceramic chip. The edges of the resistor are then accurately ground, or cut with a laser to give a precise resistance (which depends on the width of the resistor film), across the ends of the device. Tolerances may be as low as ±0.02%. Contacts at each end are soldered directly onto the conductive print on the circuit board, usually by automatic assembly methods. SMT resistors normally have very low power dissipation. Their main advantage is that very high component density can be achieved.

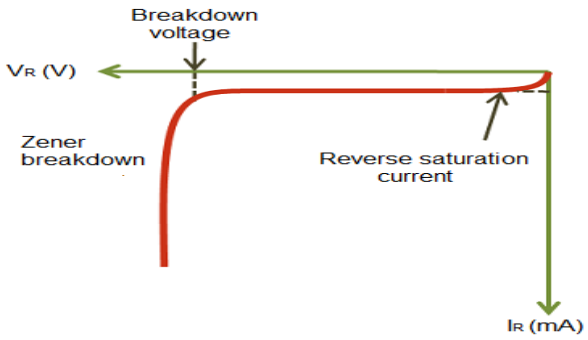
Carbon Film Resistors

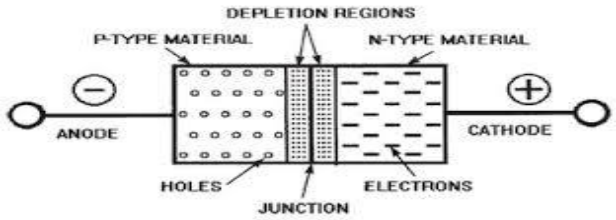
Similar construction to Metal film resistors but generally with wider tolerance (typically +/- 5%), shown in Fig. 2.0.2 mounted on paper strips for machine insertion into printed circuit boards. Small resistors are extremely inexpensive components and are also often sold in batches of 10s or 100s in this form for easier handling.

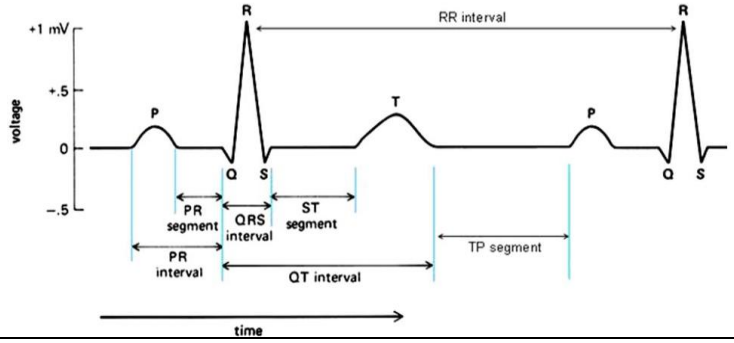
Carbon Composition Resistor

Carbon composition is the oldest design and usually the cheapest of the resistors. Carbon granules are mixed with a filler material and inserted into a tubular casing. In earlier types vulcanised rubber was used but in modern designs the carbon is mixed with ceramic filler. The value of resistance is determined by the amount of carbon added to the filler mixture. Carbon composition resistors do not have the close tolerances of either carbon or metal film types. Typical tolerances are +/-10% or 20%. One advantage however is that they are better suited to applications involving large voltage pulses than the more modern types.

Wire –wound resister

		Wire wound resistors are very variable in construction and physical appearance. Their resistive elements are commonly lengths of wire, usually an alloy such as Nichrome (Nickel/Chromium) or Manganic (Copper/Nickel/Manganese) wrapped around a ceramic or glass fiber rod or tube and coated in an insulating flameproof cement film. They are normally available in quite low values of resistance (single ohms to a few Kilohms) but can dissipate large amounts of power. In use they may get very hot. **Metal film resistors** These resistors are made from small rods of ceramic coated with metal such as a nickel alloy or a metal oxide such as tin oxide. The value of resistance is controlled firstly by the thickness of the coating layer; the thicker the layer, the lower the value of resistance. Also by a fine spiral groove cut along the rod using a laser or diamond cutter to cut the carbon or metal coating effectively into a long spiral strip, which forms the resistor. Metal film resistors can be obtained in a wide range of resistance values from a few Ohms to tens of millions of Ohms with a very small TOLERANCE. For example a typical value might be 100KΩ ±1% or less i.e. for a stated value of 100KΩ the actual value will be between 99KΩ and 101KΩ. Note that although the body color (the color of the lacquer coating) on metal film resistors is often grey, this is not a reliable guide. Small carbon, metal and oxide resistors may be made in various body colours such as dark red, brown, blue, green, grey, cream or white.	
5.		**Attempt any <u>TWO</u> of the following:**	**12 M**
	(a)	**Explain Zener diode with its characteristics.** **Ans:** The VI characteristics of a zener diode is shown in the below figure. When forward biased voltage is applied to the zener diode, it works like a normal diode. However, when reverse biased voltage is applied to the zener diode, it works in different manner. When reverse biased voltage is applied to a zener diode, it allows only a small amount of leakage current until the voltage is less than zener voltage. When reverse biased voltage applied to the zener diode reaches zener voltage, it starts allowing large amount of electric current. At this point, a small increase in reverse voltage will rapidly increase the electric current. Because of this sudden rise in electric current, breakdown occurs called zener breakdown. However, zener diode exhibits a controlled breakdown that does damage the device. The zener breakdown voltage of the zener diode is depends on the amount of doping applied. If the diode is heavily doped, zener breakdown occurs at low reverse voltages. On the other hand, if the diode is lightly doped, the zener breakdown occurs at high reverse voltages. Zener diodes are available with zener voltages in the range of 1.8V to 400V.  	**3 M** **3 M**
	(b)	**Explain construction of P-N junction diode with neat sketch.** Ans:	

		 PN Junction diode is a device made of two semiconductor material joined together with the required amount of impurity. These materials are N-type, having electrons are majority carrier and P-type material, having holes are majority carrier. When an electron reaches the conduction level it leaves a hole in the valence level. Electricity is conducted via the flow of electrons and holes. In a pure crystal the number of conduction electrons equals the number of holes and this number is rather small at room temperature. Recombination refers to the return of an electron to the valence .The conduction characteristics can be changed by a process of doping.	**3M** **3M**
	(c)	**Describe any four objectives of medical instrumentation system in detail.** **Ans: Four objectives of medical instrumentation system as follows:** **1)Information Gathering**: In an information gathering system, instrumentation is used to measure natural phenomena and other variables to aid man in his quest for knowledge about himself and the universe in which he lives. **2) Diagnosis:** Measurements are made to help in the detection and hopefully, the correction of some malfunction. 3) Evaluation: Measurements are used to determine the ability of a system to meet it's functional requirements. **4) Monitoring**: it is used to obtain continuous or periodic information about the state of the system. **5) Control**: Instrumentation is sometimes used to automatically control the operation of a system based on changes in one or more of the internal parameters or the output of the system.	**6M**
6.		**Attempt any <u>TWO</u> of the following:**	**12 M**
	(a)	**Define the following parameters of rectifier** **(i)ripple factor (ii) ripple frequency (iii) P/V of diode (iv)TUF** Ans: **(i) Ripple Factor** Ripple Factor is the ratio of rms value of ac component present in the rectified output to the average of rectified output. It is a dimensionless quantity and denoted by γ. Its value is always less than unity. **(ii) ripple frequency** The half-wave rectifier gets its name from the fact that it conducts during only half the input cycle. Its output is a series of pulses with a frequency that is the same as the input frequency. Thus when operated from a 60-hertz line, the frequency of the pulses is 60 hertz. This is called RIPPLEFREQUENCY. **(iii) P/V of diode** peak reverse voltage or peak inverse voltage is the maximum voltage that a diode can withstand in the reverse direction without breaking down or avalanching **(iv) TUF**	**06 M**

		The transformer utilization factor (TUF) of a rectifier circuit is defined as the ratio of the DC power available at the load resistor to the AC rating of the secondary coil of a transformer.	
	(b)	**State the full meaning of ECG, EEG, EMG signals and write any one specific use of these signals. Draw standard wave form of ECG.** **Ans**: **Meaning of ECG, EEG, EMG signals** • Electrocardiogram (ECG) • Electroencephalogram (EEG) • Electromyogram (EMG) **Use of signals:** • The electrocardiogram (ECG): It is the electrical activity of the heart /cardiac cells. • The electroencephalogram (EEG): It is the electrical activity of the brain. • The electromyogram (EMG): It is the electrical activity of the muscle cells.  	**2M** **2M** **2M**
	(c)	**Explain merits and demerits of i)ferrite core inductors ii) iron core inductors** **Ans: Merits of ferrite core inductors** • The ferrite core inductor can be operated at medium and high frequency. • Ferrite core inductor has low eddy current losses. • It can be control the parameters such as temperature coefficient and hysteresis loss by the air gap adjustment. • Ferrite core inductor provides complete screening. • It has higher value of inductance. • Ferrite core inductor provides suitable value inductance even of higher values. • It has high permeability with low loss. • Q factor can be arranged to fall in required frequency band. **Demerits of ferrite core inductors** • Poor heat transfer • Medium frequency range **Merits of ferrite core inductors** • The iron core inductor has a high Q factor. • The iron core inductor has a large inductance value as compared to air core inductor. • It has low losses as compared to air core inductor. • It is simple in construction and size. **Demerits of iron core inductors** • The iron core inductor has a more eddy current. • In iron core inductor loss increases at higher frequencies. • It has harmonic current rating. • It has sophisticated isolation.	**3M** **3M**