



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

SUMMER– 2018 EXAMINATION

Model Answer

Subject Code:

22220

Important Instructions to examiners:

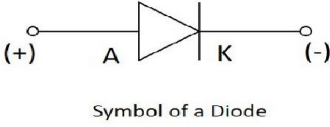

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by the candidate may vary, but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills)
- 4) While assessing figures, the examiner may give credit for principal components indicated in the figure. The figures drawn by the 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 the model answer.
- 6) In case of any questions credit may be given by judgement on the part of examiner of relevant answer based on candidate's understanding.
- 7) In 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 <u>FIVE</u> of the following:	10 M
	a)	Give the classification of components. Ans: i) Active components ii) Passive components	1 mark each
	b)	State the material used for resistors. Ans: i) Ceramic ii) Glass iii) Nichrome iv) Carbon composition v) Carbon film cermet vi) cobalt Vii) Nickel	1 mark each
	c)	List any two types of a capacitors. Ans: i) fixed capacitor ii) Variable capacitor iii) Electrostatic capacitor iv) Electrolytic capacitor v) Ceramic capacitor vi) Mica capacitor Vii) Paper capacitor viii) Plastic capacitor	1 mark each



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d)	<p>Write any two application of magnetic materials. Ans: i) Electrical motors ii) Power iii) Transformer iv) Generator v) Permanant magnet vi) Data storage equipment vii) Other electrical equipment</p>	1 mark each									
e)	<p>Give the classification of semi-conductor. Ans: i) Intrinsic Semiconductor. ii) Extrinsic semiconductor. - N-type - P-type</p>	2M									
f)	<p>Define rectifiers. Ans:- A rectifier is an electrical device that converts an Alternating Current (AC) into a Direct Current (DC) by using one or more P-N junction diodes.</p>	2M									
g)	<p>Draw symbols of : i) PN junction diode ii) Zener diode Ans: i) PN junction diode</p> <div style="text-align: center;">  <p>Symbol of a Diode</p> </div> <p>ii) Zener diode</p> <div style="text-align: center;">  </div>	1 M 1M									
2.	<p>Attempt any <u>THREE</u> of the following:</p>	12 M									
a)	<p>Compare linear potentiometer and logarithmic potentiometer. Ans:</p> <table border="1" data-bbox="282 1488 1398 1971"> <thead> <tr> <th data-bbox="282 1488 386 1593">Sr no.</th> <th data-bbox="386 1488 902 1593">Linear potentiometer</th> <th data-bbox="902 1488 1398 1593">Logarithmic potentiometer.</th> </tr> </thead> <tbody> <tr> <td data-bbox="282 1593 386 1850">1</td> <td data-bbox="386 1593 902 1850">A linear pot has a resistive element of constant cross-section, resulting in a device where the resistance between the wiper and one end terminal is proportional to the distance between them.</td> <td data-bbox="902 1593 1398 1850">A log pot has a resistive element that either 'tapers' in from one end to the other, or is made from a material whose resistivity varies from one end to the other.</td> </tr> <tr> <td data-bbox="282 1850 386 1971">2</td> <td data-bbox="386 1850 902 1971">Used to adjust the centering of the display on an analog cathode-ray oscilloscope.</td> <td data-bbox="902 1850 1398 1971">Used in connection with audio amplifiers, as human perception of audio volume is logarithmic.</td> </tr> </tbody> </table>	Sr no.	Linear potentiometer	Logarithmic potentiometer.	1	A linear pot has a resistive element of constant cross-section, resulting in a device where the resistance between the wiper and one end terminal is proportional to the distance between them.	A log pot has a resistive element that either 'tapers' in from one end to the other, or is made from a material whose resistivity varies from one end to the other.	2	Used to adjust the centering of the display on an analog cathode-ray oscilloscope.	Used in connection with audio amplifiers, as human perception of audio volume is logarithmic.	2M for each
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b) Explain air ganged capacitor with its constructional diagram.

Ans:

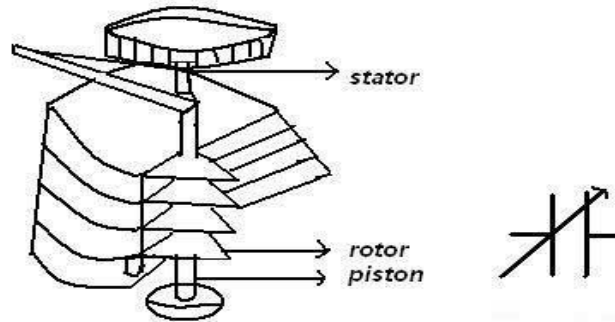


Fig : Air Ganged Capacitor

Air ganged capacitors are capacitors which use air as the dielectric medium located between conductive plates. Air ganged capacitors are capacitors which use air as their dielectric. The simplest Air ganged capacitors are made of two conductive plates separated by an air gap. Air ganged capacitors can be made in a variable or fixed capacitance form. Fixed capacitance Air ganged capacitors are rarely used since there are many other types with superior characteristics. One set is fixed and the other is attached to a shaft which allows the user to rotate the assembly, therefore changing the capacitance as needed. The larger the overlap between the two sets of plates, the higher the capacitance. The maximum capacitance state is achieved when the overlap between the two sets of plates is highest, while the lowest capacitance state is achieved when there is no overlap.

Diagram = 2M

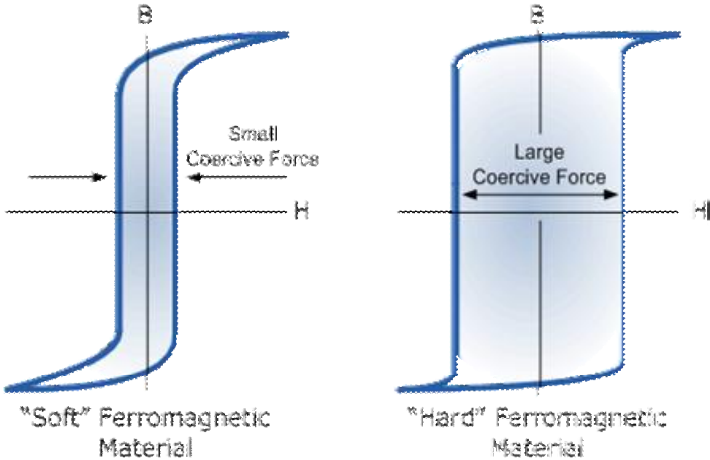
Explanation = 2M

c) Explain the colour coding scheme for capacitors.

Ans:

Band	Digit	Digit	Multiplier	Tolerance	Tolerance
Colour	A	B	D	(T) > 10pf	(T) < 10pf
Black	0	0	x1	± 20%	± 2.0pF
Brown	1	1	x10	± 1%	± 0.1pF
Red	2	2	x100	± 2%	± 0.25pF
Orange	3	3	x1,000	± 3%	
Yellow	4	4	x10,000	± 4%	
Green	5	5	x100,000	± 5%	± 0.5pF
Blue	6	6	x1,000,000		
Violet	7	7			
Grey	8	8	x0.01	+80%, -20%	
White	9	9	x0.1	± 10%	± 1.0pF
Gold			x0.1	± 5%	
Silver			x0.01	± 10%	

4M

	<p>d) Compare low pass filter and high pass filter. Ans:</p> <table border="1"> <thead> <tr> <th data-bbox="285 260 386 327">Sr no</th> <th data-bbox="386 260 902 327">Low pass filter</th> <th data-bbox="902 260 1398 327">High pass filter</th> </tr> </thead> <tbody> <tr> <td data-bbox="285 327 386 457">1</td> <td data-bbox="386 327 902 457">It is a circuit which allows the frequency below the cutoff frequency to pass through it.</td> <td data-bbox="902 327 1398 457">It is a circuit which allows the frequencies above the cutoff frequency to pass through it.</td> </tr> <tr> <td data-bbox="285 457 386 541">2</td> <td data-bbox="386 457 902 541">It consists of resistor followed by a capacitor.</td> <td data-bbox="902 457 1398 541">It consists of Capacitor followed by a resistor.</td> </tr> <tr> <td data-bbox="285 541 386 667">3</td> <td data-bbox="386 541 902 667">It is significant in removing aliasing effect.</td> <td data-bbox="902 541 1398 667">It is significant when the distortion due to low frequency signal such as noise is to be removed.</td> </tr> <tr> <td data-bbox="285 667 386 709">4</td> <td data-bbox="386 667 902 709">Lower than the cutoff frequency.</td> <td data-bbox="902 667 1398 709">Higher than the cutoff frequency.</td> </tr> <tr> <td data-bbox="285 709 386 800">5</td> <td data-bbox="386 709 902 800">Communications circuit as anti-aliasing filter.</td> <td data-bbox="902 709 1398 800">Audio amplifiers, low noise amplifiers etc.</td> </tr> </tbody> </table>	Sr no	Low pass filter	High pass filter	1	It is a circuit which allows the frequency below the cutoff frequency to pass through it.	It is a circuit which allows the frequencies above the cutoff frequency to pass through it.	2	It consists of resistor followed by a capacitor.	It consists of Capacitor followed by a resistor.	3	It is significant in removing aliasing effect.	It is significant when the distortion due to low frequency signal such as noise is to be removed.	4	Lower than the cutoff frequency.	Higher than the cutoff frequency.	5	Communications circuit as anti-aliasing filter.	Audio amplifiers, low noise amplifiers etc.	4M
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3.	Attempt any <u>THREE</u> of the following :	12 M																		
	<p>a) Show the hysteresis curve for soft and hard magnetic materials. Ans:</p> <div style="text-align: center;">  <p>Fig : Hysteresis Curve</p> </div>	4M																		
	<p>b) How inductors are classified on the basis of frequency ? Ans: There are different types of inductors. Depending on the basis of frequency they are basically categorized as follows:</p> <ol style="list-style-type: none"> i) Air core inductor ii) Iron Core Inductor iii) Ferrite Core Inductor <p>i) <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</p>	1M 1M																		

	<p>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 advantage 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.</p> <p>ii) Iron Core Inductor</p> <p>In the areas where low space inductors are in need then these iron core inductors are best option. These inductors have high power and high inductance value but limited in high frequency capacity. These are applicable in audio equipments. When compared with other core inductors these have very limited applications.</p> <p>iii) Ferrite Core Inductor</p> <p>Ferrite is also referred as ferromagnetic material. They exhibit magnetic properties. They consist of mixed metal oxide of iron and other elements to form crystalline structures. The general composition of ferrites is XFe_2O_4. Where X represents transition materials. Mostly easily magnetized material combinations are used such as manganese and zinc (MnZn), nickel and zinc (NiZn). Ferrites are mainly two types they are soft ferrites and hard ferrites. These are classified according to the magnetic coercivity. Coercivity is the magnetic field intensity needed to demagnetize the ferromagnetic material from complete saturation state to zero.</p>	<p>1M</p> <p>1M</p>
<p>c)</p>	<p>Explain the construction of photodiode with sketches.</p> <p>Ans:</p> <div data-bbox="557 1102 1136 1438" data-label="Diagram"> <p style="text-align: center;">Photodiode Symbol & Construction of Photodiode</p> <p style="text-align: right; font-size: small;">© Electronics Coach</p> </div> <p>The photodiode is made up of two layers of P-type and N-type semiconductor. In this, the P-type material is formed from diffusion of the lightly doped P-type substrate. Thus, the layer of P⁺ ions is formed due to the diffusion process. And N-type epitaxial layer is grown on N-type substrate. The P⁺ diffusion layer is developed on N-type heavily doped epitaxial layer. The contacts are made up of metals to form two terminal cathode and anode. The front area of the diode is divided into two types that are active surface and non-active surface. The non-active surface is made up of SiO₂ (Silicon di Oxide) and the active surface is coated with anti-reflection material. The active surface is called so because the light rays are incident on it. While on the non-active surface the light rays do not strike. The active layer is coated with anti-reflection material so that the light energy is not lost and the maximum of it can be converted into current. The entire unit has dimensions of the order of 2.5 mm.</p>	<p>Diagram = 2M</p> <p>Explanation = 2M</p>



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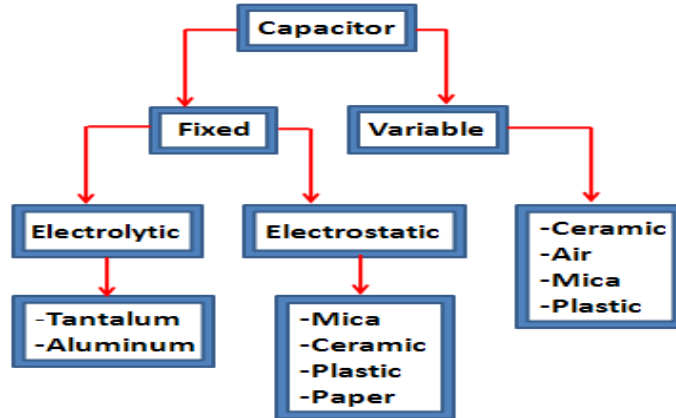
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	<p>d) An ac supply of 230 V is applied to half wave rectifier circuit through a transformer turns ratio 10:1. Find d.c. output voltage and PIV of a diode.</p> <p>Ans: Given Data: $V_1=230\text{volts}; N_2/N_1=1/10$</p> <p>i) DC output voltage:</p> <p>We know that the secondary voltage,</p> $V_2=V_1*(N_2/N_1)=230*(1/10)=23\text{V}$ <p>And maximum value of secondary voltage,</p> $V_m=\sqrt{2}*V_2=\sqrt{2}*23=32.5\text{V}$ <p>Therefore, DC output voltage,</p> $V_{dc} = 0.318V_m = 0.318*32.5 = \mathbf{10.3V.}$ <p>ii) PIV of a diode:</p> <p>We also know that peak-inverse voltages of a diode,</p> $\text{PIV} = V_m = \mathbf{32.5V} .$	<p>2M</p> <p>2M</p>
<p>4.</p>	<p>Attempt any <u>THREE</u> of the following :</p>	<p>12 M</p>
	<p>a) Define: i) ECG ii) EEG</p> <p>Ans:</p> <p>i) ECG (Electrocardiogram): A recording of the electrical activity of the heart. Electrodes are placed on the skin of the chest and connected to a machine that, when turned on, measures electrical activity the heart. Output usually appears on a long scroll of paper that displays a printed graph of activity on a computer screen.</p> <p>ii) EEG (Electroencephalogram): A recording of the electrical activity of the brain. Electrodes are attached on the scalp and connected to a machine that, when turned on, measures electrical activity of the brain. Output usually appears on a long scroll of paper that displays a printed graph of activity on a computer screen.</p>	<p>2M</p> <p>2M</p>
	<p>b) Describe basic medical instrumentation system with its sketch.</p> <p>Ans: System components are given below:-</p> <p>i) The subject – The subject is human being on whom the measurements are made.</p> <p>ii) Stimulus – The instrument used to generate and present this stimulus to the subject is a vital part of man – instrument system when responses are measured. Stimulus may be visual (e. g. flash of light), auditory (e.g. a tone), tactile (e.g. a blow to the Achilles tendon) or direct electrical stimulation of some part of nervous system.</p> <p>iii) The Transducer – A device capable of converting one form of energy or signal to</p>	<p>2M</p>

	<p>another. Here each transducer is used to produce an electrical signal that is analog of the phenomenon. Transducer may measure temperature, pressure, flow or any other variables found in body.</p> <p>iii) Signal condition equipment – The part of instrumentation system that amplifies modifies or in any other way changes the electric output of transducer is called signal conditioning Equipment. It also combines or relates the output of two or more transducers output signal is greatly modified with respect to the input.</p> <p>iv) Display Equipment – Electric output of signal conditioning equipment must be converted into a form that can be perceived by one of mans senses and can convey information. Obtained by measurement in meaningful way. Input to display device is modified electric signal and its output is some is form of visual, audible or possible tactile information here display equipment may include graphic pen recorder.</p> <p>v) Recording Data – Processing & Transmission equipment - It is often necessary to record the measured information for possible latter use or to transmit it from one location to another on-line digital computer mau be part of this system where automatic storage or processing data is required.</p> <p>vi)Control devices – A control system is incorporated where it is necessary or desirable to have automatic control of stimulus, transducers or any other part of man instrument system.</p> <div data-bbox="397 1018 1295 1591" data-label="Diagram"> </div> <p style="text-align: center;">Fig : Man Instrumentation system. OR Any other relevant diagram.</p>	<p>2M</p>
<p>c)</p>	<p>Write the colour codes for following resistors:</p> <p>i) 560 kΩ, ± 05% ii) 43 kΩ, ± 10%</p> <p>Ans:</p> <p>1) Green, Blue, Violt, Gold</p> <p>2) Yelloe, Orange, Green, Silver</p>	<p>2m</p> <p>2m</p>

d) **Classify capacitors. Also state different materials used for capacitors.**

Ans:



Different material used in capacitors as follows :

- i. Mica
- ii. Paper
- iii. Glass
- iv. Ceramic
- v. Plastic film
- vi. Oxide layer

2M

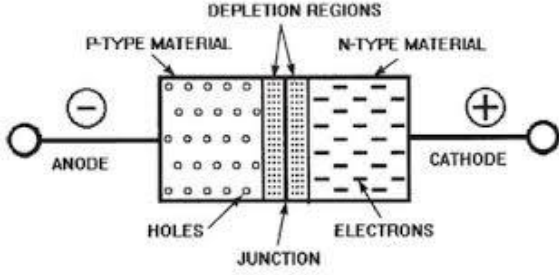
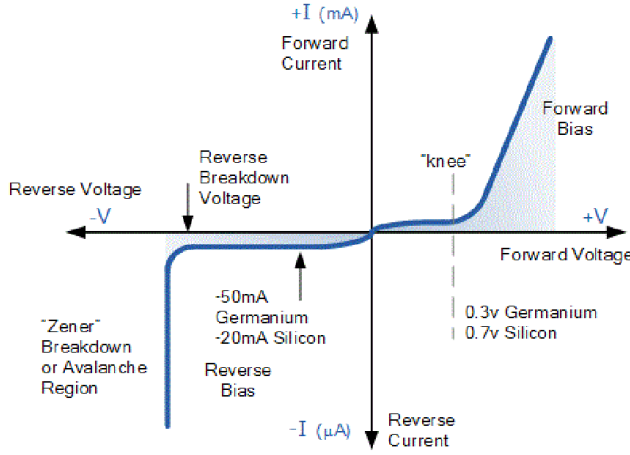
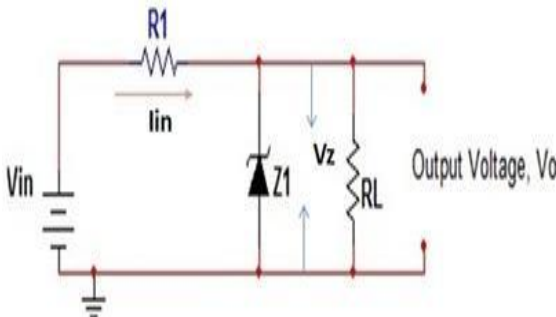
2M

e) **Distinguish between Light Dependent Resistor (LDR) and Temperature Dependent Resistor (TDR).**

Ans:

Sr no	Light Dependent Resistor (LDR)	Temperature Dependent Resistor (TDR)
1	LDR is a device that has a resistance change with light intensity	TDR is a device that has a resistance changes with temperature.
2	When light intensity increases, its resistance decreases.	When temperature increases, the resistance of thermistor decreases.
3	It could be used to activate a burglar alarm, switch on the street lamp, Camera shutter control	It could be used to activate a fire alarm, switch on a heater
4		

4M

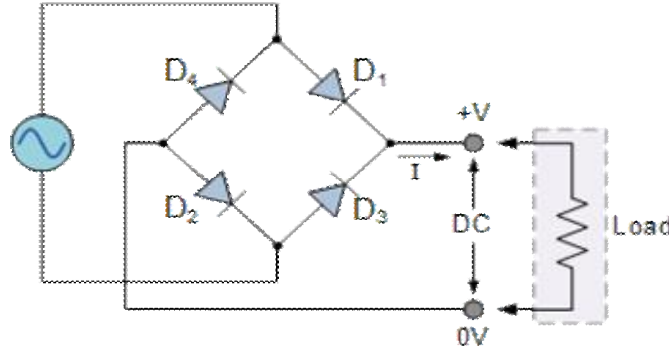
<p>5.</p>	<p>Attempt any <u>TWO</u> of the following:</p>	<p>12 M</p>
	<p>a) Explain construction of PN Junction diode. Also draw its V-I characteristics. Ans:</p> <div style="text-align: center;">  </div> <p>PN Junction diode is a device made of two semiconductor material joined together with the required amount of impurity. These materials are N-type, having electrons are majority carrier and P-type material, having holes are majority carrier.</p> <div style="text-align: center;">  </div> <p align="center">Fig : V-I characteristics of PN Junction diode.</p>	<p align="center">3M</p> <p align="center">3M</p>
	<p>b) List the applications of zener diode and explain any one in brief. Ans:</p> <ol style="list-style-type: none"> 1. Zener diodes are used in Voltage stabilizers (or) shunt regulators 2. used in Surge suppression circuitry for device protection 3. used in Over voltage protection circuits. 4. Zener diodes are used in clipping and clamping circuits especially peak clippers . 5. They are used as Reference elements. 6. Used in switching applications. <p>1.Zener diodes are used in Voltage stabilizers (or) shunt regulators</p> <div style="text-align: center;">  </div>	<p align="center">3M</p>



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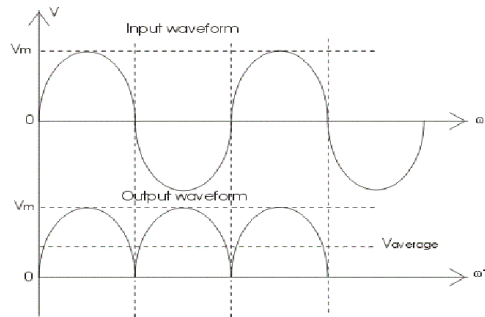
	<p>A simple circuit involving Zener diode as a regulator requires a resistor of low value connected in series with the input voltage source. The low value is required so as to allow the maximum flow of current through the diode, connected in parallel. However, the only constraint being, the current through zener diode should not be less than minimum zener diode current. Simply put, for a minimum input voltage and a maximum load current, the Zener diode current should always be I_{zmin}.</p> <p>While designing a voltage regulator using zener diode, the latter is chosen with respect to its maximum power rating. In other words, the maximum current through the device should be:-</p> <p>$I_{max} = \text{Power/Zener Voltage}$</p> <p>Since the input voltage and the required output voltage is known, it is easier to choose a zener diode with a voltage approximately equal to the load voltage, i.e. $V_z \sim V_o$.</p> <p>The value of the series resistor is chosen to be</p> <p>$R = (V_{in} - V_z)/(I_{zmin} + I_L)$, where $I_L = \text{Load Voltage/Load resistance}$.</p>	3M
c)	<p>Describe different sources of biomedical signals.</p> <p>Ans:</p> <p>1. Bio-electric signals:- These are unique to the biomedical system. They are generated by nerve cells and muscle cells. Their basic source is the cell membrane potential. The most common examples of bioelectric signal are the ECG and EEG.</p> <p>2. Bio-acoustic signals: These signals are obtained from sounds created by Biological system and provide information about underlying phenomenon .Eg. Flow of blood in heart through valves, flow of air in lungs.</p> <p>3. Bio-mechanical signals:-These signals are obtained from mechanical function of biological system it includes all types of motion and displacement signal.Eg.Motion of chest wall.</p> <p>4. Bio-chemical signals: - These types of signals are obtained from the measurements of chemical compositions. Eg- composition of various ions, partial pressure of oxygen or co2 in living tissues or from sample.</p> <p>5. Bio-magnetic signals:-In bioelectric signals, some organs produce very weak electromagnetic signals; measurement of these signals is called "Bio-magneticsignals."</p> <p>6. Bio-optical signal:- These signals are generated as result of optical function of the biological system, occurring either naturally or induced by the measurement process. Eg.blood oxygenation may be estimated by measuring the transmitted /back scattered light from a tissue at different wavelength.</p> <p>7. Bio-impedance signal:- The impedance of the tissue is a source of important information concerning its composition, blood distribution and blood volume etc.The measurement of galvanic skin response is typical example of this type of signal.</p>	Any 3 (2M each)
6.	Attempt any <u>TWO</u> of the following:	12 M
a)	<p>Draw bridge rectifier circuit and explain its working with neat waveforms.</p> <p>Ans:</p> <p>Bridge rectifier definition :</p> <p>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 AlternatingCurrent (AC) into Direct Current (DC).</p>	



2M

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 D_1 and D_2 conduct in series while diodes D_3 and D_4 are reverse biased and the current flows through the load as shown below. During the negative half cycle of the supply, diodes D_3 and D_4 conduct in series, but diodes D_1 and D_2 switch “OFF” as they are now reverse biased. The current flowing through the load is the same direction as before.

2M



2M

b) **Classify medical equipment. Give two examples of each.**

Ans:

Classification :

1. Diagnostic equipment
2. Analytical equipment
3. Imaging equipment
4. Therapeutic Equipment

Examples :

1. Diagnostic equipment:

Ex. ultrasound machine, MRI machines, Positron emission tomography (PET), CT scan machine, and x-ray machines.

2. Analytical equipment:

Ex. spectrophotometer, oxygen analysers, gas chromatographs, fluorometer,

3. Imaging equipment:

Ex. 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:

Ex. CPM, Traction machine, short wave diathermy, micro wave diathermy, ultrasound therapy unit, Electrotherapy machine, Nerve muscle stimulator.

2 M

4 M

